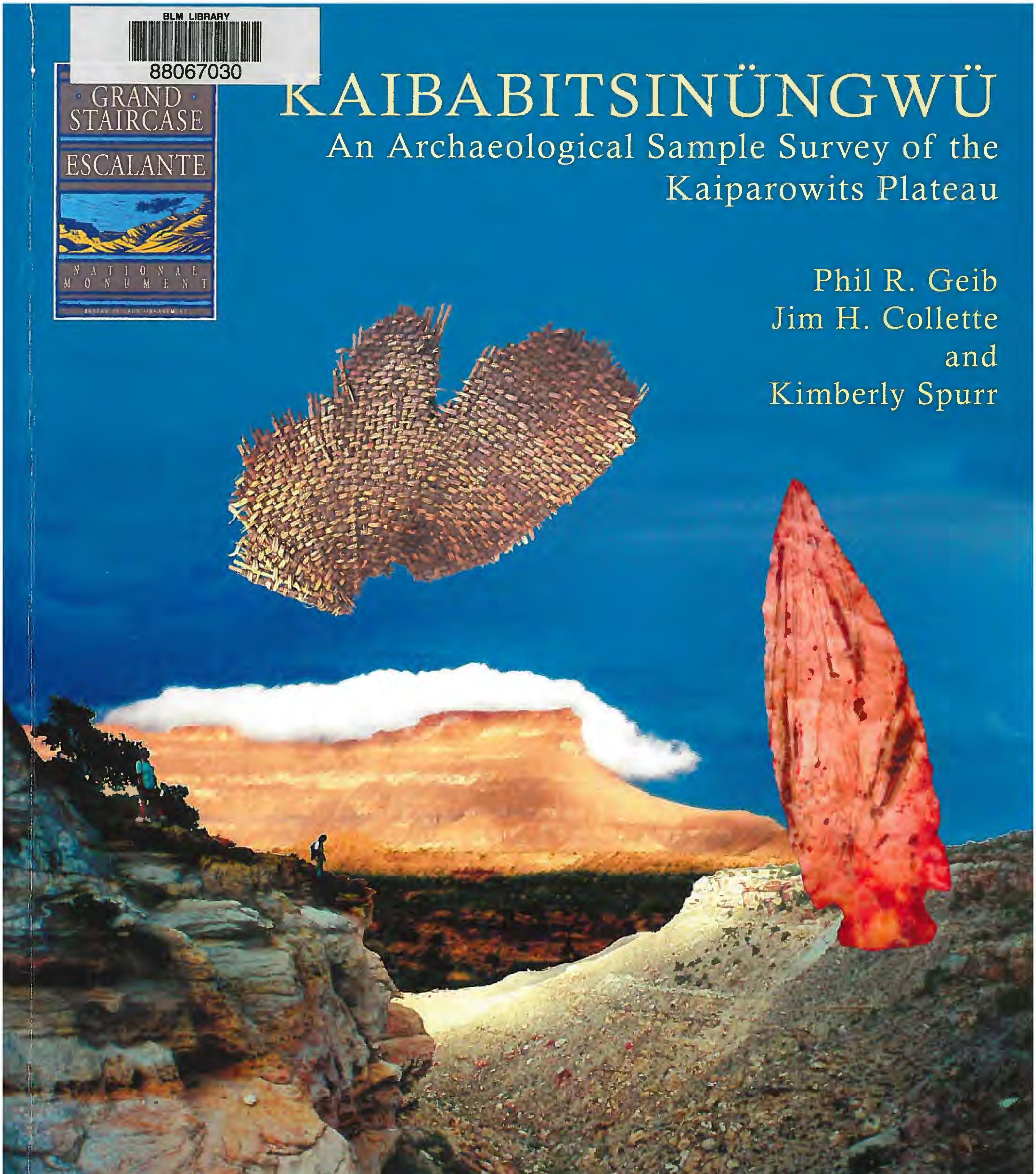
GRAND STAIRCASE ESCALANTE NATIONAL MONUMENT

KAIBABITSINÜNGWÜ

An Archaeological Sample Survey of the Kaiparowits Plateau

Phil R. Geib
Jim H. Collette
and
Kimberly Spurr



Cultural Resource Series No. 25

Grand Staircase-Escalante National Monument Special Publication No. 1

Kaibabitsinüngwü

AN ARCHAEOLOGICAL SAMPLE SURVEY OF THE KAIPAROWITS PLATEAU

Phil R. Geib
Jim H. Collette
and
Kimberly Spurr
Navajo Nation Archaeology Department

with contributions by
Lisa Huckell
and
Andrea Miller

Cultural Resource Series No. 25
Grand Staircase—Escalante National Monument Special Publication No. 1

United States Department of the Interior
Bureau of Land Management
Salt Lake City, Utah

Utah Projects U98 NK 0667b and U00 NK 0604b

October 2001

ABSTRACT

The Navajo Nation Archaeology Department (NNAD) conducted an archaeological survey of 17,280 acres on the central and western portions of the Kaiparowits Plateau in south-central Utah. The principal survey objective was to obtain data to characterize and estimate the density, distribution, and diversity of cultural resources in the 800,000 acre Kaiparowits Plateau study area. A secondary goal was to examine patterns in the distribution of cultural remains that are potentially reflective of settlement and land-use strategies for various environmental zones and temporal periods.

NNAD used a stratified probability sample, wherein sample frames coincided with a series of broad benches and tablelands that effectively furnished self-defined strata, being bounded and relatively homogeneous with respect to geology, soil, elevation, and vegetation. The sampling design explicitly omitted portions of the Kaiparowits Plateau, such as Fiftymile Mountain and steep rugged terrain poorly suited to human use. Nine sample strata were surveyed during the two separate phases of fieldwork, one in 1998 and another in 2000. The Phase 1 survey focused on five strata that comprise the western portion of the project area: Horse Mountain, Long Flat, Horse Flat, Brigham Plains, and East Clark Bench, whereas the Phase 2 survey concentrated on the remaining four sample strata, which comprise the central portion of the project area: Collet Top, Fourmile Bench, Smoky Mountain, and Nipple Bench. For the Phase 1 effort the 53 units were distributed among the five western sampling strata by simple proportional allocation, but for Phase 2, the 55 units were distributed among the four central strata by optimal allocation using variance estimates based on the Phase 1 results.

NNAD archaeologists documented 710 archaeological sites and 816 isolated occurrences. The 710 sites consist of 670 that are prehistoric, 19 with both prehistoric and historic components, and 21 that are historic. NNAD archaeologists considered 514 of the 710 sites (72.4%) as eligible to the National Register of Historic Places based on their potential to yield data important for interpreting prehistory; 196 sites were classified as not eligible. Site density varied from a low of 0.7 per quarter section on Nipple Bench to 12.1 per quarter section on Horse Mountain. The overall average site density was 6.6 sites per quarter section or 26.4 per section. The survey clearly demonstrates that higher elevation benches generally contain significantly more sites than the lower elevation benches. Sites are not randomly distributed but are clustered in specific areas to take advantage of desirable resources such as easy access, food, and water. Based on the survey data, we estimate that there are approximately 7730 sites within the nine sampling frames. Given the terrain excluded by our survey, the actual site count for the Kaiparowits Plateau likely exceeds 10,000.

Documented Native American remains date from the early Archaic (ca. 8000 cal. B.C.) into the historic period, potentially overlapping with the Euro-American use of the area in the early 1900s. Occupation may not have been continuous, but Native people appear to have used the area in some fashion during each major time period. Archaic sites are the most numerous among all temporal periods, and the 321 components assigned to this interval represent 43 percent of the Native American components documented. At the other end of the temporal spectrum, Post-Formative foragers account for 48 sites, and another 38 sites may date anywhere from Formative to Post-Formative. We assume that Post-Formative sites are evidence of Southern Paiute use of the Kaiparowits Plateau because this was the principal group using the area during the time of contact. Because Archaic sites cover a huge span of time, roughly 6000 years, Post-Formative sites actually have a greater density per unit of time: 0.05 Archaic sites per year compared to 0.1 Post-Formative sites per year.

The archaeological records left by foragers at different ends of the temporal spectrum (Archaic and Post-Formative) appear quite different, suggesting that perhaps Paiute ethnographies cannot be used in simple analogical fashion to reconstruct Archaic forager behavior. Contrasts in the morphology of Archaic and Paiute sites and assemblages imply differences in settlement and subsistence strategies and in the organization of flaked stone technology. Patterns of raw material usage imply that Archaic foragers were perhaps ranging further or that they periodically occupied places infrequently used by the Paiute occupants of the area. Small and briefly occupied camps used for processing and hunting are the most common types of Post-Formative sites, with few large residential camps. The distribution of Post-Formative sites coincides with the area that Isabel Kelly (1934, 1964) mapped as the core

territory of the Kwaguiuavi economic unit of the Kaiparowits Band of the Southern Paiute.

The Kaiparowits Plateau Survey also documented the remains of both Fremont and Anasazi occupation during the Formative period. There are no Fremont structural sites, just scatters of stone artifacts with sparse sherds of Emery Gray. Most of these sites appear to be temporary residential camps associated with foraging and hunting in the region. Based on pottery associations, Fremont use of the area probably predated A.D. 1100 and was prior to the main Anasazi occupation. Anasazi use of the survey area seems to have been much more intensive and varied than that of the Fremont, including semipermanent residential sites and granaries along with residential camps, processing camps, and hunting camps. The 62 recorded Anasazi sites represent a huge spike in the intensity of use of the Kaiparowits Plateau, as these correspond to a comparatively brief span of use, on the order of 100 years or less. The density of Anasazi sites per unit of time is about 0.6 or even more; thus the Anasazi remains on portions of the plateau represent an intensity of use of the area not seen before or after.

The survey documented portions of a small community of Anasazi residential sites on Collet Top that mimic the findings from Fiftymile Mountain surveyed by the University of Utah for the Glen Canyon Project. Half of the sites have masonry and jacal structures in the form of single rooms and roomblocks, with up to at least 8 rooms in one case. A local developmental trajectory is lacking for this community, thus the Anasazi people were likely immigrants to the plateau. We believe that the source for this population is more likely to have been from the west and that the notion of a Kayenta migration to the Kaiparowits Plateau does not square with the evidence on the ground.

The majority of the 40 Euro-American sites documented by the survey indicate that use of the area was greatest between 1900 and the middle 1930s, with another flurry of activity in the 1960s and 1970s. Nearly all of the historic sites from the earlier period appear related to ranching, whereas the later resources reflect mineral exploration.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

FOREWORD

In 1996, with a proclamation by President William J. Clinton, the Grand Staircase–Escalante National Monument was established in an effort to understand and protect this "unspoiled natural area ... that greatly enhances the monument's value for scientific study." In November of 1999 the articulated goals of the new monument were legally acknowledged with the publication of a management plan. The Grand Staircase–Escalante National Monument is the first to be managed by the Bureau of Land Management and is now part of the recently established National Landscape Conservation System (NLCS), a new department within the BLM. The publication of this volume heralds a significant step in achieving some of the goals of the proclamation, and this report validates the scientific merit of the archaeological values described in the proclamation. Archaeologically speaking, the Kaiparowits Plateau remained largely unknown until this publication. We now have a much better understanding of the diverse ways in which people in the distant past used this remote region. This publication fills a major gap in our ever-expanding understanding of people's use of this rugged, desolate, and forbidding place.

This volume is the first in a series of works that will comprise the scientific body of what is fast becoming a rich and revealing legacy of this remote section of the Colorado Plateau. Inspiration for this volume comes foremost from the vision of Douglas McFadden, long-time BLM archaeologist and scientist, whose interest generated the focus for an inventory on the Kaiparowits Plateau. Other supporters include Kate Cannon, Monument Manager, Navajo Nation Archaeology Department staff, in particular Phil Geib, Miranda Warburton, Jim Collette, and Kimberly Spurr, all the field crews who conducted work in this far corner of the world, and finally Garth Portillo, BLM State Archaeologist for Utah.

Marietta Eaton
Assistant Monument Manager
Division of Cultural and Earth Sciences
Bureau of Land Management

NNAD surveyors for Phase 2 of the project. Back row, left to right: Leo Tsinnijinnie, Ted Neff, Roger Stash, Phil Geib, Mick Robins, Jim Collette; Front row, left to right: Ettie Anderson, Kim Spurr, Kim Mangum.

ACKNOWLEDGMENTS

NNAD's Kaiparowits Plateau Survey was a true team effort, and the success of this project is the direct result of the outstanding team members. The core of surveyors during both phases of the project consisted of Jim Collette, Mick Robins, Kim Spurr, Roger Stash, Leo Tsinnijinnie, and Kim Mangum. Robert Begay, Peter Bungart, Ted Neff, and Ettie Anderson formed part of this core during one of the phases. Helping out on one or more of the sessions were Darsita Ryan (Oozie), Judith Breen, Janet Hagopian, Anthony Klesert, Ora Marek, Jenn Minor, Peter Noyes, Lanell Poseyesva, Kerry Thompson, Neomie Tsosie, and Natasha Yazzie. Everyone labored hard to ensure that the fieldwork was completed on time and with excellent documentation. Many of these same individuals worked in the office on various tasks essential to report and project completion. Ettie Anderson, Darsita Ryan, Kerry Thompson, Ora Marek, Carissa Tsosie, Neomie Tsosie, and Natasha Yazzie suffered the tedium of entering all information from the 710 field site forms into a computer database. Peter Bungart, the office database wizard, deserves credit for designing an easy-to-use site database that greatly facilitated the timeliness and quality of project deliverables. Peter also served as a crew chief during the first survey phase. Kim Mangum, a perfectionist in all details, performed countless essential duties in the office: checking and correcting site plots, taking charge of the photo archives, helping to edit the site forms, generating various data tables. Laboring diligently behind the scenes to make sure that things ran smoothly were Lanita Collette, Stewart Deats, Sandy Ketchum, David Ortiz, Sharon Sanders, and Olivia Yazzie. Wrangler Jeff "Tuffy" Allen of Kanab, Utah, provided logistical help for the testing phase of the project by horse packing us to and from sites.

Co-authors and crew chiefs Jim Collette and Kim Spurr can be credited with much of the success of this project and both deftly crafted portions of this report. Kim wrote Chapter 9 and much of the sampling portion of Chapter 4 (including the thankless task of the sampling statistics); she also generated data tables for much of Chapters 5–8 and was critical in assembling and reviewing drafts of this document and the contract reports for each phase. Jim is credited with Chapter 2, much of Chapter 3, the feature descriptions of Chapter 6, and much of the Formative and Post-Formative discussions of Chapter 8. Miranda Warburton (a.k.a. the Dragon Lady) kept the project on track, edited reports and site forms, and helped with the limited site testing prior to the second phase of survey. Tim Wilcox had the onerous task of transforming field site sketches into finished maps for the site forms and report. Most of the excellent graphics of this report are his doing, including the outstanding cover; Mick Robins created several of the maps of Chapters 1–4 with Tim adding essential details and making edits. The projectile point photos are the work of Dan Boone and Anthony M. Polvere of the Bilby Research Center, NAU—as usual, they did a masterful job. Anthony went to extra efforts to "stitch" together the several scans of the space image used for Figure 1.2. Louella Holter, also of the Bilby Research Center, did a technical edit of the draft report and transformed it into this final version with her usual skill.

Finally, I would also like to acknowledge the input and advice of Doug McFadden, BLM archaeologist for the new monument. It was a pleasure to work for such an experienced field archaeologist so keenly interested in local prehistory. Barbara Bellio, the BLM contracting officer, was also a pleasure to work with and extremely helpful in answering numerous questions and helping with contract matters.

Looking back, it is easy to claim that this project and report represents a true collaborative effort, one that will always be fondly remembered. Thanks everyone!

PRG

October 2001

CHAPTER 1

INTRODUCTION

This report documents the findings from a Class II cultural resource inventory and limited testing project on the Kaiparowits Plateau of the Grand Staircase–Escalante National Monument, south-central Utah. The Navajo Nation Archaeology Department, Northern Arizona University Branch Office (NNAD) completed the project under two separate contracts with the Bureau of Land Management (BLM): 1422-N66O-C98-3016 and NAC 990054. The primary goal of the survey was to provide BLM managers with an objective basis for characterizing and estimating the density, distribution, and diversity of cultural resources on the Kaiparowits Plateau. A secondary goal was to obtain data for examining patterns in the distribution of cultural remains that potentially reflect settlement and land-use strategies for various environmental zones or localities and within various temporal periods. The primary goal for the limited testing was to provide information that would help with the temporal placement of sites and with assessing the nature and preservation of features.

In response to the original solicitation for the inventory, NNAD proposed a stratified probability sample as the best means to approach the BLM's objectives while maximizing information return for expended effort (Geib, Huffman and Warburton 1998). The sampling approach took into account environmental variability, previous survey work on the Kaiparowits Plateau, and the logistical problems of accessing sample units scattered across dissected terrain with few roads. The Fiftymile Mountain portion of the plateau was explicitly excluded from consideration because of extensive prior surveys of this area and a lack of vehicle access. The sampling scheme allows comparison of cultural remains among various prominent physiographic features that make up the Kaiparowits Plateau study area. The implemented survey strategy was little different than that of the proposal, but the work effort had to be split into two phases for budgetary considerations. The first phase occurred during 1998 and focused on five sampling strata that comprise the western portion of the Kaiparowits Plateau (Geib, Huffman and Spurr 1999). The second phase took place 2 years later during 2000 and focused on four sampling strata that comprise the central portion of the plateau (Geib, Spurr and Collette 2001). In all, NNAD archaeologists systematically surveyed 17,280 acres within 108 quarter sections and recorded 710 archaeological sites. The testing project occurred between the two phases, at 13 sites recorded during Phase 1.

The descriptive and interpretive reports prepared for each phase of the survey are combined here to provide an overall summary of the inventory and testing results. Virtually all information contained in the Phase 1 and 2 reports is presented here in updated and more fully edited form. Thus, this document supplants the two prior documents with the exception that the phase-specific site descriptions and isolated occurrence descriptions appended to those reports are excluded. This report examines in detail how the survey and testing findings inform about differential use of the project area through time and by various cultural groups.

DEFINITION OF THE STUDY AREA

The roughly 800,000-acre Kaiparowits Plateau study area is located in Kane and Garfield Counties, Utah, in the south-central portion of the state (Figures 1.1 and 1.2). The Kaiparowits Plateau is part of a giant staircase of tablelands, benches, and escarpments along the southern margin of the High Plateaus section of Utah. The Kaiparowits Plateau occupies the southeast side of this margin. Here the various cliffs and tablelands are formed of the more somber-colored shale and sandstone of the Cretaceous Period rather than the brightly colored Jurassic and Triassic formations of the Grand Staircase further west. Marginal erosion by the Colorado River and its tributaries of alternating soft and hard rock layers has created the step-like topography. Harder units create cliffs and accompanying benches and tablelands, whereas the soft rock units are eroded back into slopes and badlands. The staircase is intricately dissected by the headwaters of steep drainages that flow mostly south and southeast into the Colorado River.

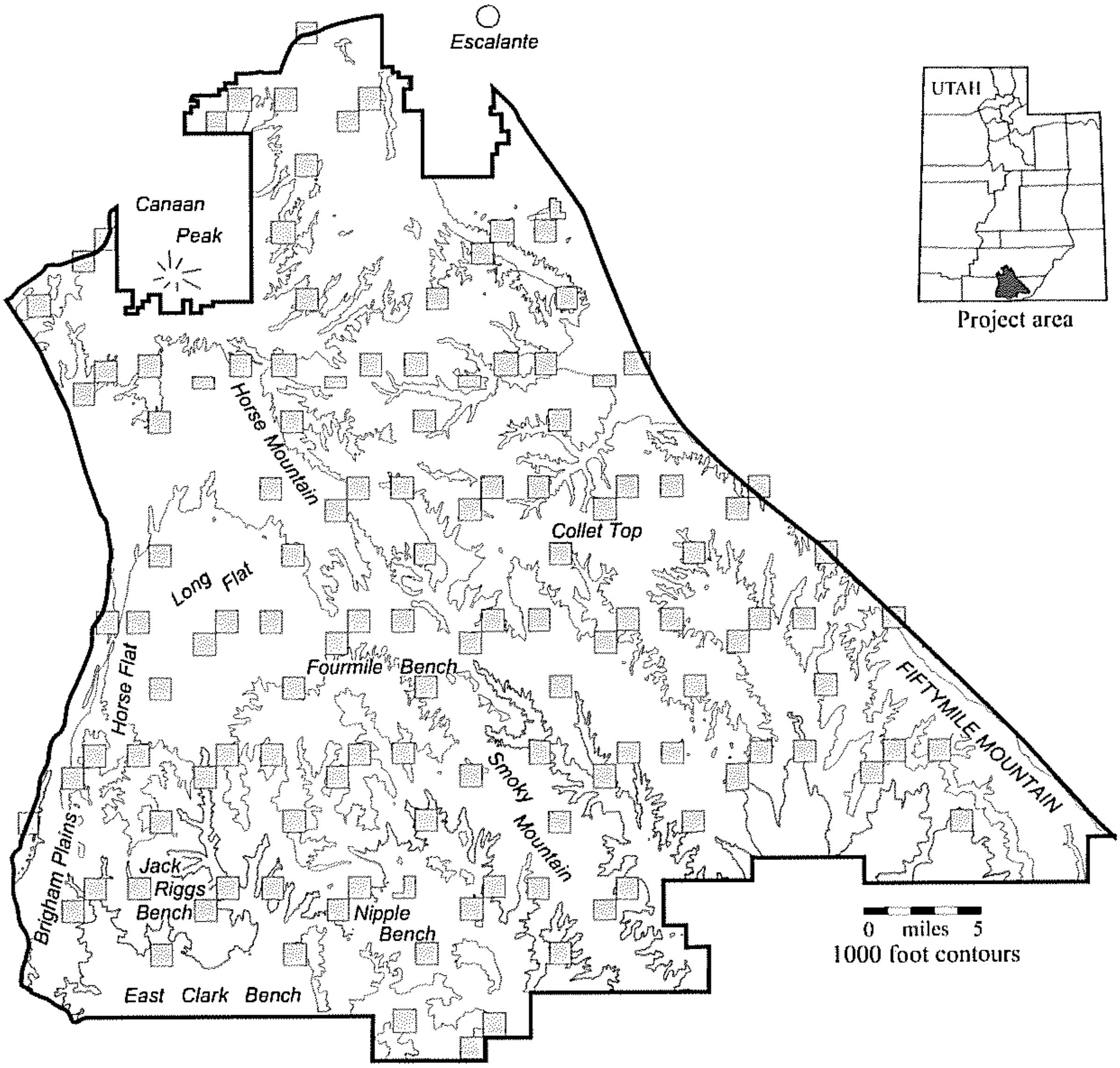


Figure 1.1. The Kaiparowits Plateau study area showing prominent topographic features and exchanged State Trust lands.

Although the Kaiparowits Plateau is a topographic high, it is a structural basin defined on the east and west by two large monoclines: the East Kaibab and Waterpocket Fold. The Straight Cliffs, a scarp rising 300–600 m above the adjacent Escalante Desert, sharply delimits the Kaiparowits Plateau on the north and east. This scarp has but a single drainage break known as Collet Canyon, which drains eastward into the Escalante River. The Cockscomb, a result of the East Kaibab monocline, creates an equally abrupt but lower relief demarcation for the west side of the study area. On the south, the Kaiparowits Plateau is defined by the Glen Canyon gorge of the Colorado River, but our study area ends at the Glen Canyon National Recreation Area boundary and a large parcel of Utah School and Institutional Trust Lands.

Elevations in the project area are highest in the north and decrease to the south with each giant step down through the geologic formations. The highest points, at 2130 to 2440 m (ca. 7000–8000 feet), are Fiftymile Mountain and the ridges and slopes extending off the 2833-m Canaan Peak. Vegetation at these elevations is characterized by dense pinyon-juniper forest with scrub oak thickets and flats covered with big sage. In places there are ponderosa pine parklands with manzanita

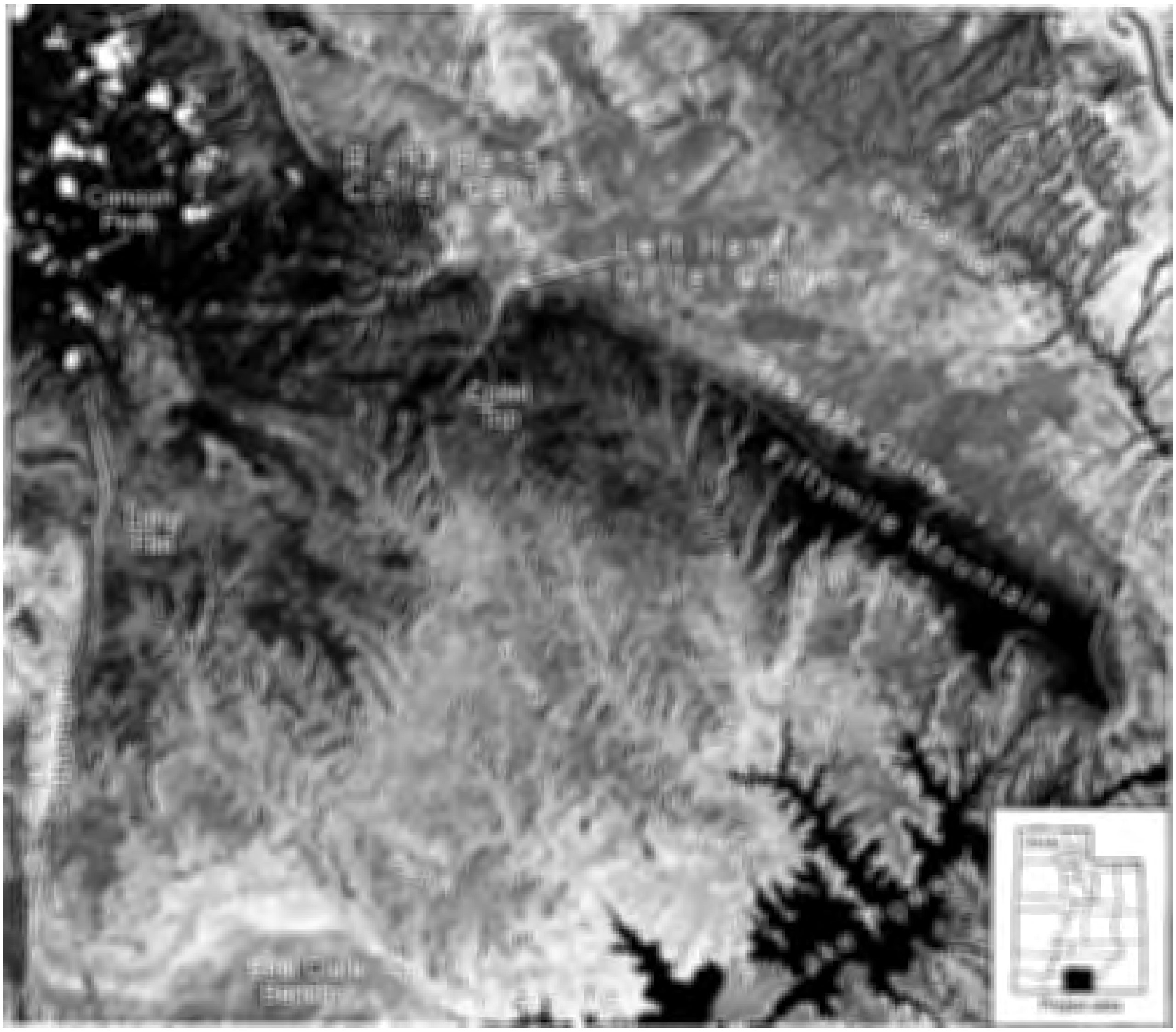


Figure 1.2. The Kaiparowits Plateau study area as seen in a Landsat 5 Satellite Thematic Mapper image with 30 m ground resolution.

understory. South of these topographic highs are a set of tablelands and benches that range in elevation between 1706 and 1890 m (ca. 5600 and 6200 feet). These include such prominent features as Fourmile Bench, Horse and Long Flats, Brigham Plains, and Smoky Mountain. Pinyon-juniper forest still predominates at these elevations, but there are differences in vegetation associations and plant density. The lowest landforms in the study area are Nipple Bench at an average elevation of 1525 m (ca. 5000 feet) and East Clark Bench at about 1280 m (ca. 4200 feet). Grasses and low shrubs cover these benches.

Deep and intricately cut canyons separate the various tablelands and benches, often impeding vehicle or foot passage from one topographic feature to another. The largest of these drainages from west to east are Wahweap Creek, Warm Creek, and Last Chance Creek. Even small tributaries of these drainages create canyons 100 m deep or more, and the largest drainages are in places confined in canyons 350 m deep.

PROJECT OBJECTIVES

The impetus for the Kaiparowits Plateau survey was compliance with Section 110 (a) (1) of the National Historic Preservation Act (Public Law 89-665; 80 Stat. 915; 16 U.S.C. 470, as amended), which directs federal agencies to "undertake a program to identify historic properties under its jurisdiction or control." The principal objective of this project was to use surface inventory data to

provide an objective basis for characterizing and estimating the potential distribution, diversity, and density of cultural resources in the 800,000-acre Kaiparowits Plateau study area. A secondary objective was to use the inventory data to examine patterns in the distribution of cultural remains that are potentially reflective of settlement and land-use strategies for various environmental zones or localities. Both of these objectives had to be met by examining just a fraction (ca. 2%) of the entire study area. The original solicitation requested survey of 16,000 acres using 100 units that were each a quarter section (160 acres) in size. The plan for where and how these units would be distributed was left up to the contractor.

Funding limitations required that the inventory be split into two phases. Ultimately this benefited the project because it allowed for limited and highly focused testing of select sites prior to the Phase 2 survey. This effort followed directly from the recommendations of the Phase 1 report, which called for testing prior to any further survey (Geib, Huffman and Spurr 1999:7–37). As the report stressed, testing should help to refine survey observations and recording procedures by (1) examining the alternative dating methods used during Phase 1; (2) obtaining a better understanding of the range of tool types and functions and thereby a better understanding of site activities; (3) acquiring a better understanding as to the nature and use of various features such as fire-cracked rock scatters and charcoal stains; and (4) determining if sites that appear deflated actually lack depth. Each of these aspects had the potential to benefit any future survey work by decreasing the number of sites placed in the temporally unknown category, helping to diagnose site functions and activities, and allowing more informed assessments of site and feature preservation. Of course, each of these aspects also would aid in making National Register recommendations.

PROJECT DESIGN AND RESEARCH ORIENTATION

The BLM's interest in having at least 16,000 acres on the Kaiparowits Plateau surveyed for archaeological remains presented a wonderful opportunity to begin the process of describing and ultimately understanding (explaining) settlement practices and land-use strategies for this portion of the Southwest. The first task was to obtain a detailed and unbiased record of how sites are distributed across the landscape. As described in Chapter 4 of this report, NNAD employed a stratified probability sample to furnish this record, an approach that maximized information return for the effort expended and provided a means for examining settlement practices. Describing how sites are distributed across the landscape is, of course, much easier than explaining why they are distributed in a certain pattern, but the latter goal is usually of greater interest to archaeologists. Supported by ethnographic observations and foraging theory, archaeologists commonly assume that specific properties of the environment directly influenced the location of settlements. "The geographies of subsistence and settlement are intertwined and, among foragers [and simple horticulturists], interdependent; *home*, whether transitory or permanent, tends to be located so as to enhance the efficiency of work spent acquiring resources" (Raven 1991:42). We assume that economic pursuits were the principal motivation for prehistoric visits to the Kaiparowits Plateau and that the properties and spatial patterning of the resulting archaeological record across the diversity of its physiographic features will inform about these pursuits and their organization.

Modeling settlement behavior can proceed at two quite different spatial scales and levels of past decision making. One is site-specific, focused on trying to determine if and why prehistoric people occupied a specific geographical point or parcel of some size. The other is concerned about if and why various broad geographic zones or environmental strata were occupied. In this latter approach, the regional landscape is viewed as a composite of opportunity zones that are thought to have conditioned the general placement of sites in both frequency and type. Much of the "predictive" modeling in the Southwest is of the former kind, examining such factors as slope, distance to water, availability of shelter, and the like (see review in Thoms 1988). Modeling at the more general level probably has greater anthropological utility in the long run, because locational decisions at this scale are more directly related to subsistence strategies, to the resource structure of the landscape, and to changes in this structure from environmental change. Our approach to the Kaiparowits Plateau survey had this more broad level in mind.

Modeling general site location requires partitioning a region into environmental zones based on variables that are thought to have conditioned prehistoric use or non-use. Zones can be defined by a single variable or by the intersection of two or more variables. It is important that such variables

have relevance within a body of theory about hunter-gatherer or horticulturist settlement-subsistence behavior. This provides a basis for understanding why models work, and for moving from the simple task of describing settlement location to the difficult task of explaining settlement choices. If decisions of general site placement are fundamentally economic (subsistence related), then it is important to use variables that measure the availability of various energy sources critical to prehistoric societies. Particularly useful would be isoplethic productivity maps of various plant and animal resources that are central to human subsistence (for a hypothetical example see Foley 1977:172–175, Figs. 3–6). Raven and Elston (1989) provided a detailed application of just such a model building exercise to the Stillwater Marsh of Nevada, and Raven (1990) subsequently tested it with a sample survey.

For the Kaiparowits Plateau there was no possibility of developing a detailed pre-fieldwork settlement model. Even with the availability of fine-grained ecological studies necessary for mapping productivity values of critical resources (and there were none for the Kaiparowits Plateau), there were no funds for the time needed to articulate such a model. The available money had to be spent mostly for fieldwork, for survey and site recording. Nonetheless, it seemed that NNAD could emphasize fieldwork and still generate useful settlement data by devising a simple means to explore general spatial patterning in the archaeological record of the Kaiparowits Plateau. The various physiographic features that make up the study area appeared to provide an effective means to design a sampling scheme that would allow us to observe general patterns in site placement, a means to generate data useful for both management and research purposes. The sampling strategy is described in Chapter 4 of this document; here we develop an interpretative framework.

Settlement Location

Site locations represent the result of complex choices made routinely by prehistoric populations under given parameters. These choices were likely made with "limited rationality" (see Wood 1978: 258–259), following Simon's (1957:198–199) characterization of human decision making as pursuing a course of action that was simply "good enough," but not necessarily optimal with respect to the real world. Choices tended to satisfy some predetermined need, but not necessarily to maximize returns. "To the extent that human decisions are rational, they are rational with respect to a bounded view of the alternatives and consequences that affect the outcome of decisions; in other words, a cognized model of the environment" (Wood 1978:259). The sum total of cultural knowledge and beliefs about the environment (Rappaport 1971:247–248) provides a cultural map of sorts employed to select, among other things, settlement locations. Because subsistence strategy exerts a strong influence over cultural perceptions of the environment and the value placed on portions of the landscape, groups with different subsistence strategies will have different criteria for settlement selection. The societies that occupied the Kaiparowits Plateau were hunter- gatherers and simple horticulturists, for whom we assume that social factors played a secondary role in settlement behavior. Such an assumption may not apply to areas of the Southwest occupied by more socially complex farmers where the social context can be crucial to understanding settlement behavior (for example, see Rogge and Lincoln 1987:146). Prehistoric settlement of the Kaiparowits Plateau study area was probably conditioned by three principal factors: subsistence base, the organization of subsistence tasks, and the structure of the natural environment. Social networks that might partially relate to historical factors and language differences must have also played a role but it is difficult to analyze their importance archaeologically.

Decisions about where on the landscape to settle can be dichotomized as those that are spatially general in character and those that are spatially specific. Decisions about where to locate sites generally within a region are made prior to specific choices, and different factors of the natural environment are relevant to the choices made at each level. We assume that decisions about the location of most hunter-gatherer and horticulturist residential sites were first made relative to the proximity of subsistence resources (Jochim 1976: 47–49). The distribution of subsistence resources across a region can be seen to structure decisions of site location at a general level; that is, people locate most sites generally with respect to environmental zones that they need to exploit for subsistence. In this view, the environment is composed of a series of zones relevant to the procurement of various subsistence resources. These zones can overlap spatially, and they will vary depending on the subsistence base and organizational properties of cultures. Although fundamentally spatial in character, the zones also have a temporal character directly tied to the seasonal availability and abun-

dance of resources. Such zones can be seen as part of the cognitive maps used by cultures to make choices about general site placement.

For example, during the harvest season a group dependent upon ricegrass (*Stipa hymenoides*) might have a coarse-grained mental map that generally partitions a landscape into productive and non-productive ricegrass terrain. Accordingly the group will locate seasonal sites for exploiting this resource somewhere in a zone of abundant ricegrass cover. This says nothing about the choice of specific site locations within this zone—just that certain types of sites, perhaps in certain frequencies, will be located in the zone. Choice of location at this general level is fundamentally an economic decision.

Specific site location within various economic zones, however, will additionally depend on localized micro-environmental factors such as the occurrence of natural shelters, proximity to water, or availability of firewood. Decisions at this specific level require a fine-grained mental map of the terrain, for example knowing where a good rockshelter and a permanent seep occur next to each other. Specific site locations are usually related directly to subsistence resource exploitation only to the extent that the sites occur within a general resource exploitation zone. (An exception might be a kill site located at a natural jump.)

The hierarchical nature of making decisions about site location has several ramifications. General ecological principals could allow decisions of general site location to be made with partial or indirect knowledge of a region. In contrast, decisions of specific site placement are best made based on detailed, intimate knowledge of a given terrain. Only with such knowledge will an ideal rather than merely adequate location be selected. Another contrast is that decisions about general settlement placement within some vast region are more consequential than deciding where to locate a site specifically within a general exploitation zone. A wrong choice in general location could have serious ramifications, for example where spring drought has resulted in a poor ricegrass harvest. Decisions of specific location are of less consequence. One location in an area of dense ricegrass could be less desirable or convenient than another, but not life threatening.

To reiterate the main point, the natural environment structures decisions of site location into those that are spatially general and those that are spatially specific. Sites are generally located based on one or more resource requirements, mainly those pertaining to subsistence. Decisions about specific site placement follow those of general site location and may be predicated on a variety of factors that usually relate to convenience, efficiency, and comfort in daily activities. Deciding what general zone of a broad region to settle within is systemically more important and takes precedence over deciding about a specific site location. Because choices of general site location are principally made based on staple food resources, subsistence adaptation exerts a strong influence over settlement behavior.

Differential Use of the Kaiparowits Plateau

The Kaiparowits Plateau study area consists of a series of broad benches and tablelands that descend in elevation from north to south. These features are separated from each other east to west by canyons and north to south by escarpments. The benches and tablelands are relatively homogeneous with respect to geology, soil, elevation, and vegetation. This is so because the tablelands and benches are the result of differential weathering along the horizontal bedding of sedimentary formations. Cliff escarpments and canyons mark natural boundaries to these topographic features. Besides providing for a good degree of internal environmental homogeneity, these topographic features have some degree of environmental contrast with one another (Table 1.1). Compare, for example, Nipple Bench with the adjacent Fourmile Bench. Erosion of the Straight Cliffs Formation, a series of cliff-, bench- and slope-forming sandstones, mudstones, carbonaceous shale, and coal (Hackman and Wyant 1973), created Nipple Bench, whereas erosion of the Wahweap Sandstone created Fourmile Bench. With an average elevation of about 1525 m (ca. 5000 feet), Nipple Bench is covered by low shrubs and grasses. Averaging about 300 m higher in elevation, Fourmile Bench is covered by open to dense stands of pinyon-juniper and sagebrush-filled small drainage basins. Not only does Fourmile Bench receive more precipitation than Nipple Bench, it has lower rates of evapotranspiration.

Comparing environmental characteristics between physiographic features seemed a simple but fruitful way to examine patterning in cultural remains that was at least partly reflective of settlement and land-use strategies. The topographic features also provide a means to monitor changes in cultural remains on both north to south and east to west gradients that could relate to cultural or adaptive boundaries. For example, Horse Flat and

Table 1.1. Environmental characteristics of the nine sampling strata for the Kaiparowits Plateau Survey.

Sampling Stratum	Elev. Range; Avg. (ft)	Geologic Formation	Geomorphology & Topography	Vegetation	Major Drainages	Avg. Precip. (inches)	Major Springs	Other Resources
Collet Top	5750-7200; 6475	Wahweap	Thin soils mantling s.s. bedrock cut by drainages & Left Hand Collet Canyon; rises considerably to north	Dense pinyon-juniper Sagebrush Shrubs, sparse grasses Some riparian	Collet Canyons Upper Reese Canyon	12-14	Circle Spring Hardhead Water Springs in Collet Can.	Dry farming zone? Domestic water Mule deer
Horse Mountain	6075-6900; 6500	Kaiparowits Formation	High north-south landform with numerous ridges dissected by drainages & mantled w/alluvial cobbles; thin soils	Pinyon-juniper Sagebrush Sparse grasses Relic pine-fir Some riparian	Paradise Canyon Escalante Canyon	12-14	None in vicinity	Allnvial cobbles & chert; Mule deer Groundwater discharge
Long Flat	5750-6400; 6075	Kaiparowits Formation	Rises gradually to north; cut by major drainages such as Wahweap; alluvial & eolian deposits thread bench; alluvial cobbles drape ridges	Pinyon-juniper Riparian species Various shrubs Some grasses	Wahweap Creek Blue Wash Tommy Smith Creek	10-12	Tommy Water Fourmile Water Headquarters Spring	Alluvial cobbles in abundance Local chert Major drainage Wahweap
Horse Flat	5750-6250; 6000	Kaiparowits & Wahweap Sandstone	Relatively level finger between Cockscomb & Wahweap cut by Coyote Can.; pockets of shallow alluvium/eolian sand	Pinyon-juniper Shrubs where chained Sagebrush Sparse grasses Some riparian	Upper Coyote Creek Wahweap Creek	10-12	Springs in upper Wahweap Cr.	
Fourmile Bench	5900-6250; 6075	Wahweap Sandstone	Fairly homogenous landscape of low ridges & drainages; generally thin soils, but some dunes; s.s. rims drainages	Pinyon-juniper Diverse shrubs Sagebrush Galleta-blue grama	Wahweap-Tommy Smith Wesses Canyon John Henry Canyon Drip Tank Canyon	10-12	Fourmile Water Springs in Paradise Can.	
Smoky Mountain	5250-5575; 5400	Straight Cliffs Formation	Relatively level rising to high pts. to north; some s.s. outcrops & semi-badlands; burning coal seams	Juniper-some pinyon Blackbrush-hopsage Sagebrush Some grasses	Warm Creek Last Chance Creek	8-10	Needle Eye Water	Grasslands to south? Hardened s.s. from coal fires
Brigham Plains	5200-5575; 5390	Straight Cliffs Formation	Numerous sandstone ridges & outcrops w/shallow soils; bench divided by Coyote Creek	Rimrock pinyon-juniper Sagebrush Sparse grasses	Coyote Creek Wahweap Creek	10-12	Lower Coyote Spring	Bighorn sheep?
Nipple Bench	4900-5250; 5075	Straight Cliffs Formation	Relatively flat projection rising to ridge/mesas to north; s.s. outcrops w/eolian mantles & semi-badlands	Shadscale Blackbrush Galleta grass Sagebrush	Nipple Creek Tibbet Canyon	8-10	Nipple Spr. Tibbett Spr.	Grasslands Antelope?
East Clark Bench	4250-4500; 4375	Entrada & Dakota sandstone	Sand/silt mantling ridges & mesas w/badlands & sandstone exposures along major drainages such as Wahweap	*Atriplex* Ricegrass Dropseed	Wahweap Creek Coyote Creek Paria River	6-8	Springs in Wahweap Cr.	Grasslands; Antelope Cobbles in drainages Floodplain farming? Groundwater discharge

Brigham Plains at the far western edge of the study area might exhibit more evidence of Virgin Anasazi presence. In contrast, greater evidence for Fremont activity might occur on benches east of Wahweap Creek. Expectations from existing settlement models, such as McFadden's (1996) proposal of a Virgin adaptive strategy and his subsequent contrast of Anasazi and Fremont adaptations (McFadden 1998), could also be tested against the survey data collected by specific physiographic features.

METHODS

Sampling

Chapter 4 describes the sampling design in detail, so discussion here is limited. In brief, we employed a stratified sampling design, wherein sample frames coincided with the ascending series of broad benches and tablelands described in Table 1.1. These named geographic features effectively furnish self-defined strata for the Kaiparowits Plateau. The sample design explicitly omitted inhospitable terrain and focused instead on the areas most conducive to human occupancy. It also factored in the findings of prior inventory work and the logistical problems of accessing sample units scattered across dissected terrain with few roads. Because of these two considerations, the Fiftymile Mountain portion of the Kaiparowits Plateau was excluded from our survey (this area lacks roads and has received rather intensive survey coverage in the past; see review in Chapter 3). We also excluded for two reasons most of the far northwest part of the plateau: one, because it was the subject of a prior sample inventory (ESCA-Tech's Escalante Project) and second, because most of the area consists of the rugged terrain of narrow ridges, deep canyons, cliff scarps, and steep slopes. The sampling fractions differed for each of the nine strata, ranging from 8.4 to 10.8 percent of each sample frame.

Survey Fieldwork

Crews and Schedule

Three 3-person crews formed the foundation for the work effort, but during the first few sessions for both phases of the survey, one or two students from the NNAD-NAU training program supplemented each crew. Also, two professional archaeologists volunteered their help during the final session of the Phase 2 effort. Each crew consisted of at least one seasoned field archaeologist who acted as the chief, accompanied by other archaeologists with a range of experience. Consistency in recording effort and observation was maintained between the two survey phases because personnel on both phases were nearly identical. The Phase1 crew chiefs consisted of Peter Bungart, Jim H. Collette (formerly Huffman) and Phil Geib; Robert Begay, Kimberly Mangum (formerly Tsosie), Michael Robins, Kimberly Spurr, Roger Stash, and Leo Tsinnijinnie served as crew members. Helping out on two separate sessions were L. Theodore Neff and Jennifer Minor. Students who participated during Phase 1 were Natasha Yazzie, Darsita Ryan, Ettie Anderson, and Kerry Thompson. The Phase 2 crew chiefs were Jim Collette, Phil Geib, and Kimberly Spurr; crew members consisted of Ettie Anderson, Kimberly Mangum, L. Theodore Neff, Michael Robins, Roger Stash, and Leo Tsinnijinnie. Helping out on one or more of the sessions were Judith Breen, Peter Bungart, Janet Hagopian, Anthony Klesert, Ora Marek, Peter Noyes, Lanell Poseyesva, Kerry Thompson, and Neomie Tsosie.

Crews were assigned individual sample units and mostly worked on their own; in a few cases two crews worked on a single unit but still as separate entities. The crews usually camped together, but occasionally camped separately, close to their survey units.

Phase 1 of the Kaiparowits Plateau Survey was conducted in five field sessions during the summer and early fall of 1998 (July 22 through September 23). The Phase 2 survey was conducted in six field sessions during the summer and early fall of 2000 (July 19 through October 1). Field sessions were 8 days long, 10 hours a day, with a 6-day break between each one. For the Phase 1 effort NNAD archaeologists spent 421 person-days in the field, but 53 of these person-days were spent in travel to and from the project area. For Phase 2, NNAD archaeologists spent 455 person-days conducting the survey, with 85 of these person-days spent in travel to and from the project area.

The amount of time required to finish a 160-acre observation unit varied from a low of less than 2 person-days in the few instances of easy walking and no sites, to a high of about 21 person-days in a few instances of exceptionally high site densities and complex sites. Units with rugged terrain were always more difficult to survey than those with unbroken land, but this was usually offset by few or no sites in the rugged terrain. Site density and complexity were the most critical factors in determining how much time was required to finish a sample unit. Site recording took anywhere from 1 to 3 hours (3 to 9 person

hours) in most cases, and when there were 22 sites in a single unit as happened on Smoky Mountain, almost a whole session was consumed.

The Phase 1 survey had an overall average of 5.8 sites per survey unit, which was close to our predicted site density based on results from previous surveys.[1] For Phase 2, however, this average seemed too low because it included the East Clark Bench, which had few sites. We estimated that all four of the Phase 2 survey strata would have far more sites per survey unit on average than was the case for East Clark Bench. By excluding this stratum, the average site density for the Phase 1 effort was considerably higher—6.8 sites per quarter section. Because this average was based on inclusion of the Horse Mountain stratum, which had several units with extremely high site densities, we anticipated that it might be too high for Phase 2 sampling strata. Thus we used an estimate of 6 sites per survey unit as our average for calculating the Phase 2 survey budget. As it turned out, the Phase 2 strata had an average density of 7.2 sites per unit.

In general, because of sample frame design, little time was lost accessing or finding the sample units. We encountered the greatest difficulty on Paradise Bench, where a lack of usable roads resulted in walks of 3 miles or more just to reach a unit. Logistics for the entire Phase 2 effort were greatly complicated by approval of the management plan for the Monument, which occurred in the interim between Phases 1 and 2. Extensive road closures are one aspect of the plan, and this prevented easy access to some units because roads running through or close to certain units were no longer open. The most significant impact in this regard was with three closely clustered units on Window Sash Bench, where road closure meant a 5-mile hike one way to the units. In this instance, the BLM provided helicopter support which allowed two crews to locate a field camp among the three units and reduced the walk to a maximum of 1 mile.

Survey Procedures

Field crews thoroughly inspected each of the 160-acre observation units for cultural remains by walking a series of systematic transects spaced 15 m apart. Wider spacing was used when dictated by the terrain, such as with highly dissected steep slopes and ledgy canyons, or when the vegetation was low and sparse, as on East Clark and Nipple Benches. We used 15-m intervals on the vast majority of the survey units. Any deviations from standard transect width were documented on survey unit forms (see below).

Most units were on moderately level terrain; in these cases, transects were compass-directed during Phase 1 and GPS-directed during Phase 2. No matter the method of controlling the transects, they always began at a sample unit corner, in nearly all cases marked by a section or quarter-section brass cap marker or monument. At the end of each compass-directed transect, as crew members spread out for the next pass, the outside was flagged to ensure that transects did not deviate and to mark the end of the unit. This flagging was removed on the return pass. If significant transect deviations occurred, these were rectified by covering any ground that might have been missed.

During Phase 2 survey crews abandoned the use of compasses to control survey transects, opting to use GPS units. This was possible because of President Clinton's lifting of "selective availability" for GPS; with this change even inexpensive units have approximate 5-m accuracy. By using the Easting or Northing UTM coordinates on GPS units as a reference it is possible to walk north-south or east-west transects respectively with great precision over any distance. Such transects not only have greater precision than traditional compass-oriented transects, but the method is far easier and more efficient of field time. There is no back sighting, no trying to remember which bush of the many you were sighting on, no need for flagging tape, and so forth. In specific terms, if one is walking a north-south transect, for example, the crew chief with the GPS unit makes a note of the Easting coordinate (only the last 3 or 4 numbers need to be tracked). Say this number is 4820. As she/he walks northward from the south edge of

[1]Site densities were estimated from existing surveys on and near the Kaiparowits Plateau. The ESCA-Tech Tract II sample for the "Escalante Project" is a useful source, but only after separating the 46 sample units into two groups: (1) mostly level (good terrain) and (2) steep, rugged, and dissected (inhospitable terrain). The 16 sample units that consisted mostly of level terrain had an average site density of 5.8 sites per 160 acres and a range from 1 to 14. In contrast, the 30 sample units of "inhospitable" terrain had an average site density of 0.9 site per 160 acres and a range from 0 to 5 sites. More significantly, well over half of the units (60%) of inhospitable terrain contained no sites, whereas sites occurred in every unit of level terrain. Other site density estimates are from lower elevation benches immediately south of the Kaiparowits Plateau study area. The Lower Glen Canyon Benches sample survey resulted in a site density of 3.6 sites per 160 acres (Geib 1989); a block survey for the Lone Rock and Wahweap development area resulted in a site density of 4.8 sites per 160 acres (Tipps 1987).

the unit, they keep track of the Easting coordinate making sure that they are still on 4820, give or take a few meters in either direction (ca. 4818 to 4822). No matter how dense the pinyon-juniper cover, one can progress at a rapid pace and still be on track with straight transects and no gaps between passes. This was also an effective method to track survey progress, because our unit forms had 100-m UTM intervals marked on them (see below).

Systematic transects were abandoned for sample units or portions thereof where the terrain consisted of canyons, steep talus slopes, or the like. In these cases, crew chiefs devised the best strategy for walking the area to ensure complete coverage. Contouring and following topographic features was the usual means to achieve the best results. Spacing between crew members in these instances necessarily varied, but thorough coverage and continuity between transects was maintained. The general survey route in such instances was sketched on the survey unit forms.

Prior to the start of fieldwork, UTM coordinates were calculated for the four corners of each 160-acre survey block. These coordinates were included on the survey unit forms and proved invaluable for locating each quarter section on the ground using GPS units. The UTM coordinates for the starting point of a survey block (one of its corners) were entered into a GPS unit so the locating function could be used to direct field crews to that point. In most cases, the starting points were marked section corners or quarters that field crews readily located because the GPS units brought them within 20 m or less of the monuments.

For each of the 108 quarter sections that we examined, a standardized survey unit form was prepared ahead of time to record environmental notes or other observations, and to track cultural remains documented as sites and isolated occurrences. An example of one of these forms is shown in Figure 1.3. On the back of each form were three maps of each unit to help document information visually. These showed contour lines and other geographic features that occur on the USGS topographic maps, as well as the general vegetation (tree cover or none). Crew chiefs noted on the maps the distribution of geologic formations, disturbances (such as roads and chaining), and other pertinent information about the units. The principal map on the Phase 2 forms also included a 100-m UTM grid; this proved to be a useful improvement over the Phase 1 forms. Crew chiefs used these forms in the field to help locate the quarter sections on the ground using the UTM coordinates of corner points, and they filled out the information as the survey of each unit progressed.

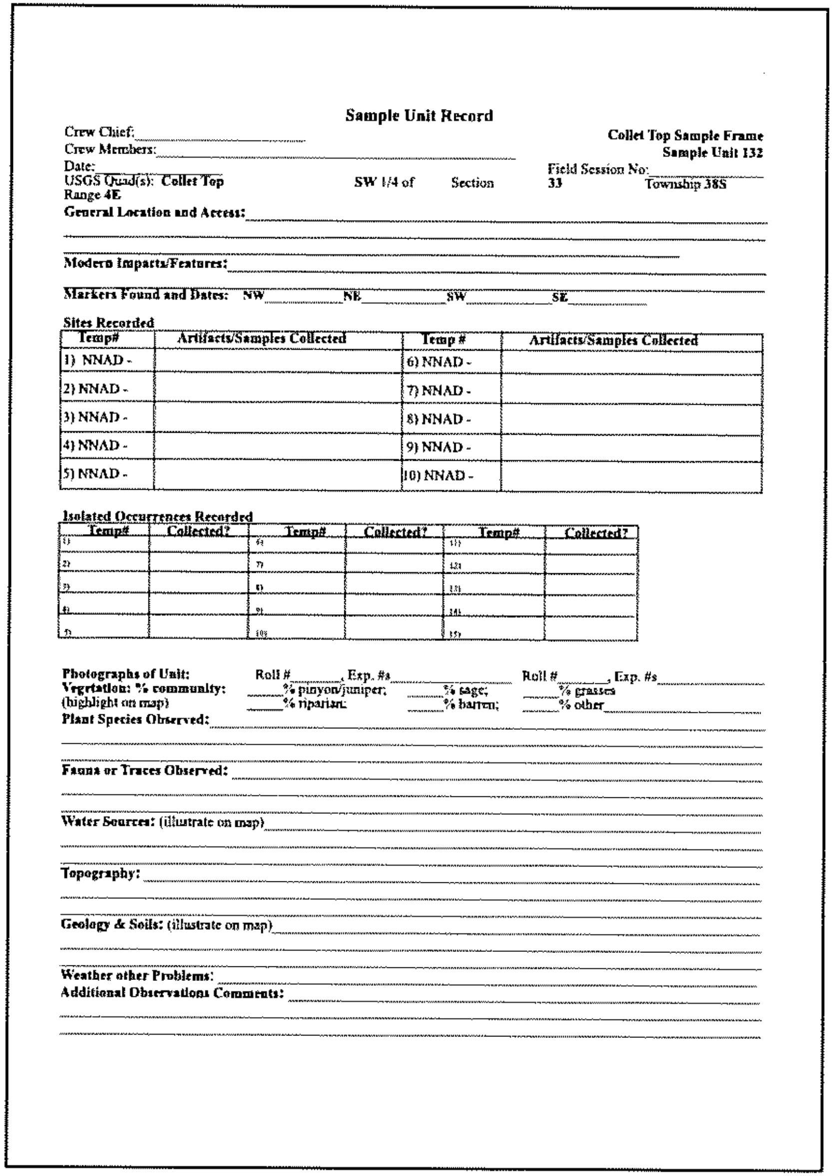
Discovered cultural remains that met the site criteria (see below) were recorded on Intermountain Antiquities Computer System (IMACS) forms. The forms for each field session were turned over to laboratory personnel at the end of each session so that data entry could begin immediately. At the end of fieldwork, crew chiefs edited the site forms.

For Phase 1 of the survey NNAD devised its own automated site database using Microsoft Access as the underlying software. This system efficiently generated forms and reports and enabled the electronic transfer of site data to the Division of State History. By the time the Phase 2 fieldwork began, archaeologists with the Grand Staircase–Escalante National Monument had begun to use a similar database for Microsoft Access, one devised for the Dugway Proving Grounds. Because this system seemed to be what the BLM and the Division of State History will be using in the future, we opted to use it instead of the one NNAD developed.

Scale sketch maps were drawn of each site using compass bearings and paced measurements. The maps included the site datum, general topographic contour lines, all cultural features, site boundaries, artifact concentrations, collected artifacts, and specific field-analyzed artifacts. In the laboratory, these maps were scanned and then traced on the computer to generate high-quality maps for inclusion with the finalized forms; some of these maps are included in Chapters 5 through 9 to illustrate specific discussion topics.

The datum for each site was marked by a PVC pipe cut into 12-inch lengths and marked with a sequential series of numbers starting with 1, prefixed by NN (Navajo Nation). These numbers were both engraved into the plastic and written with indelible ink. These field numbers were used on the site forms and maps. In the laboratory, IMACS site numbers were obtained and used for reporting purposes. Concordance between the IMACS and NNAD site numbers is presented in Appendix A. Field numbers are also included on the IMACS site forms and accompanying maps.

Site locations were plotted in the field on the survey unit forms and 7.5 minute USGS topographic quadrangles using UTM coordinates obtained from GPS units. Except for a few rockshelters, the coordinates were measured at the site datum. To ensure the best possible accuracy, all GPS readings on site datums were made using the



Sample Unit Record

Crew Chief:________________ **Collet Top Sample Frame**
Crew Members:________________ **Sample Unit 132**
Date:________ Field Session No:________
USGS Quad(s): **Collet Top** SW 1/4 of Section 33 Township 38S
Range 4E

General Location and Access:________________

Modern Impacts/Features:________________

Markers Found and Dates: NW______ NE______ SW______ SE______

Sites Recorded

Temp#	Artifacts/Samples Collected	Temp #	Artifacts/Samples Collected
1) NNAD -		6) NNAD -	
2) NNAD -		7) NNAD -	
3) NNAD -		8) NNAD -	
4) NNAD -		9) NNAD -	
5) NNAD -		10) NNAD -	

Isolated Occurrences Recorded

Temp#	Collected?	Temp#	Collected?	Temp#	Collected?
1)		6)		11)	
2)		7)		12)	
3)		8)		13)	
4)		9)		14)	
5)		10)		15)	

Photographs of Unit: Roll #____, Exp. #s______ Roll #____, Exp. #s______
Vegetation: % community: ____% pinyon/juniper; ____% sage; ____% grasses
(highlight on map) ____% riparian; ____% barren; ____% other____
Plant Species Observed:________________

Fauna or Traces Observed:________________

Water Sources: (illustrate on map)________________

Topography:________________

Geology & Soils: (illustrate on map)________________

Weather other Problems:________________
Additional Observations Comments:________________

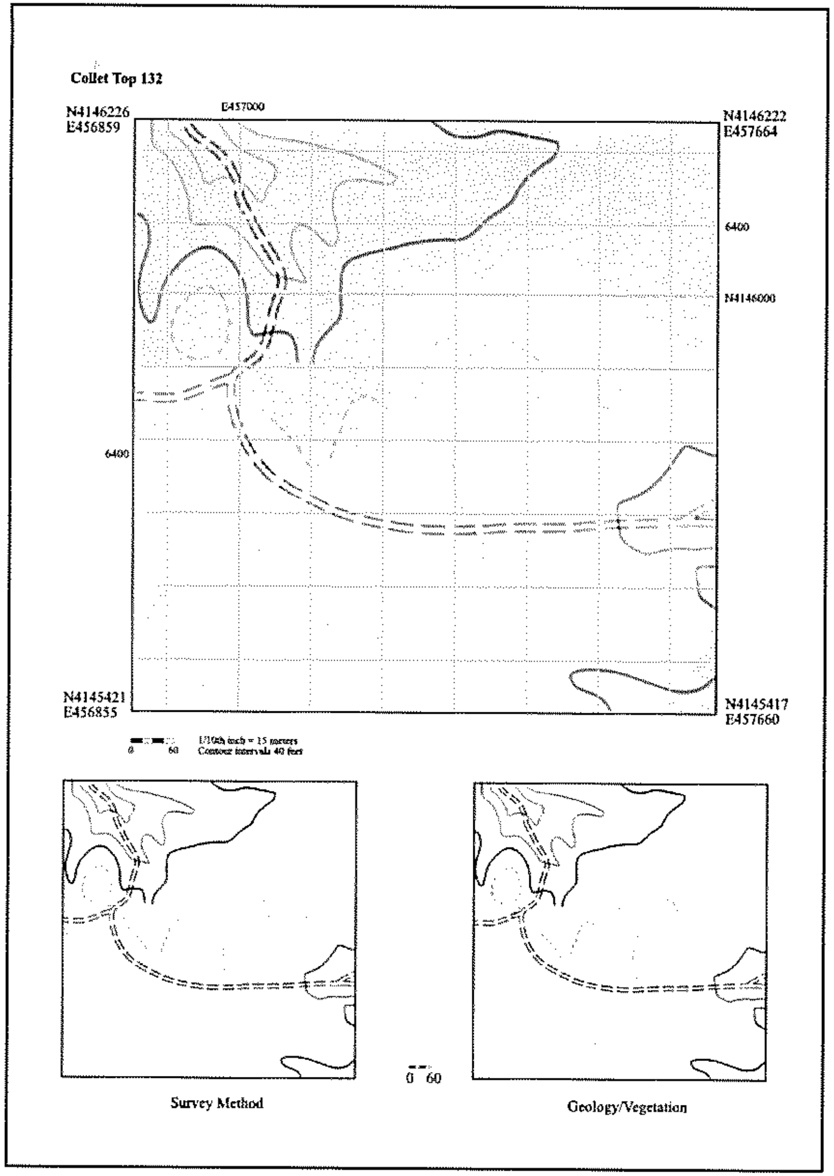


Figure 1.3. Example of the Survey Unit form designed for use during the Kaiparowits Plateau Survey. Each of the 108 units had one of these forms for recording environmental and other observations, as well as keeping track of cultural remains documented as sites and isolated occurrences.

averaging function. At shelters the datum was usually placed under the overhang, thus we had to make the reading in the open but as close as possible to the datum. The current lack of distortion to satellite signals means that GPS readings for the Phase 2 sites are quite accurate. The Phase 1 readings are slightly less accurate, but doubtless much better than had we not used GPS units. We had no trouble returning to Phase 1 sites during testing by using the UTM coordinates programmed into GPS units. In the laboratory the site plots were transferred to clean copies of USGS topographic quadrangle maps, illustrating site boundaries as exactly as possible.

The BLM permitted artifact collection for this project. Collection was mainly limited to temporally diagnostic projectile points and ceramics, but also included a small sample of stone tools for laboratory analysis and illustration, flakes of obsidian for potential sourcing analysis, and several organic samples for potential radiocarbon dating. A list of all collected remains is given in Appendix A. Curation of the collections will be at Southern Utah University in Cedar City, with long-term expenses the responsibility of the BLM.

Sites were documented with color print film using advanced photo system (APS) cameras. Field crews took at least two overview photographs of each site from different angles, as well as close-up photos of features or other interesting finds. The landscape and environment of the sample units was also documented photographically.

Site Definition and Problems

To qualify for site status, remains had to meet a 50-year age guideline, though some younger remains were recorded as isolated occurrences. For example, we did not document as sites any of the numerous traces from the 1960s and 1970s coal exploration era. The definition of a site follows criteria established by the BLM: (a) any single cultural feature such as a hearth or rock enclosure, (b) five or more artifacts within 50 m of each other (excluding items in washes or otherwise out of context), and (c) artifacts located more than 50 m apart but in obvious association. These criteria were applied consistently to our survey, except for several survey units, especially those of the Horse Mountain stratum and portions of Collet Top. Some of these areas had a nearly constant low background scatter of prehistoric artifacts (principally flakes) that complicated the drawing of site boundaries. Cultural resources that did not meet the criteria for a site were designated as isolated finds. These were documented on an isolated occurrence inventory log that included a brief description of the find along with its context, and UTM coordinates as calculated in the field by GPS units. Isolated projectile points and some other tools were collected.

The usual procedure in the field upon finding remains was for field crews to make an initial inspection, frequently using pin flags to mark artifacts. If the find did not meet the site criteria, it was recorded as an isolated occurrence. If an artifact scatter seemed to meet the site criteria, then a more intensive search of the area was conducted, marking flakes and tools with pin flags. The search spread outward from the original find location, marking remains in an attempt to define site boundaries. Boundaries were placed at marked declines in artifact frequencies, factoring in erosional dispersion down slopes and washes (obvious erosional remains were excluded from site boundaries). Recording commenced after delimiting the artifact scatter.

Boundary definition by this procedure was usually accomplished without difficulty because most areas of the Kaiparowits Plateau that NNAD examined have a low background scatter of remains, and sites stood out in marked contrast to the surrounding terrain. A few areas, however, proved frustrating because of a high background scatter of artifacts. This was particularly true of the Horse Mountain sampling stratum and portions of Collet Top. NNAD had a hint that this might be the case based on ESCA-Tech's survey of a single quarter section on Horse Mountain (Kearns 1982). They ended up with many sites, including one that extended outside the unit for a considerable distance and was roughly 160 acres in size. During the Phase 1 prefieldwork conference with BLM archaeologist Douglas McFadden, we discussed the potential problem of site boundary definition and the utility of creating one large site or many small sites. His preference was for small sites to the extent practicable. Finding boundaries in artifact scatters to create small sites proved difficult in practice but we made the effort and learned more as a result.

The central portion of Paradise Bench (part of the Horse Mountain stratum) presented the worst problems with site boundaries, especially for Unit 75. It is no exaggeration to state that virtually the entire central portion of this bench is one large artifact scatter. It is impossible in some areas to take more than 2 paces without seeing a flake and 10 paces without seeing a flaked tool. This is not a

case of a continuous scatter resulting from exploitation of a raw material source, because no raw materials occur on this portion of Paradise Bench. Endless flake scatters from raw material procurement are another sort of problem, one that is perhaps best handled by creating one large site, or designating the area as a nonsite resource extraction zone. Obviously, Paradise Bench was used intensively for various foraging activities, resulting in multiple overlapping artifact scatters. Greatly complicating matters though is the deflation and sheet wash erosion seen across vast areas. Even if discrete artifact concentrations were once present, postdepositional erosion has created an almost unpartitionable scatter.

If we had continued with our usual procedure for delimiting sites, much of Paradise Bench would have become one large site that contained hundreds of artifact loci or concentrations. This would have made our recording effort far simpler and faster, but such an approach has little interpretive value. Instead we decided to concentrate on high-density scatters of remains, especially those that appeared to retain some depositional integrity, and we ignored the low-density artifact scatter. In practice this usually meant ignoring the constant high background of flakes and using pin flags to mark remains concentrated at the level of two flakes per square meter. We also factored in postdepositional processes by generally ignoring artifacts in the numerous small washes and drainages. By this approach we ended up recording 36 comparatively small sites in Unit 75 of Paradise Bench instead of just a single site or two of large proportion. By this method we were also able to identify some interesting sites that probably would have gone unrecognized, such as the Formative hunting camp 42KA4813 (see Chapter 7). We readily acknowledge that another group of archaeologists surveying on Paradise Bench might arrive at a different number of sites and different site boundaries than the ones we drew. We wish them luck.

Testing

Crew and Schedule

The testing portion of the Kaiparowits Plateau study was conducted in one 8-day field session, May 15–22, 2000. A single 3-person crew was used, amounting to 24 person-days in the field. Phil Geib directed the testing program, aided by Miranda Warburton and Roger Stash. The crew tested 13 sites scattered on Paradise Bench, Long Flat, Horse Flat, and Jack Riggs Bench. Camps were located on Jack Riggs Bench, Long Flat, and Paradise Bench in a manner that minimized travel time to and from the sites. Horses were used for much of this work to transport crews and gear to and from the sites; the crew was especially thankful to have the horses for transporting flotation samples. Wrangler Jeff "Tuffy" Allen of Kanab, Utah, provided horses, steaks, and local color.

Procedures

The testing crew easily relocated targeted sites using the GPS coordinates obtained during Phase 1. To save time, metric grids were not established; instead 1 x 1 m test units were laid out where needed to test features or deposits. These were oriented to magnetic north and their position relative to the site datum was recorded according to the angle and distance from the datum to the SW corner of the unit. This allowed the units to be accurately plotted on site maps. In addition, GPS readings were taken from the center of each unit. In all cases, we used 1 x 1 m test units for arbitrary horizontal control during excavation, even when testing what appeared to be small and relatively well defined hearths; this helped provide strict limits to our excavations. After obtaining clear plan view outlines of features, further excavation was controlled horizontally by the natural limits of features. At many sites, removing just a few centimeters of loose sediment from the 1 x 1 m units provided clear feature definition; at these sites the cultural layer was exposed at ground surface and consisted of little more than a near-surface phenomenon. Vertical control of all excavation was by natural layers, which, with the exception of the one tested rockshelter, were quite simple. Excavations were recorded using standard unit and feature forms, including plan and profile drawings when useful, and were documented with black-and-white and color print film. In addition, Phil Geib kept general notes about the progress and findings of testing.

All excavated sediment not saved for flotation or other analysis was screened through 1/8-inch mesh. All artifacts, bone, and samples were bagged by specific horizontal and vertical provenience and assigned provenience and bag numbers, which were recorded in site-specific PN logs that kept track of relevant find information. Carbon samples for radiocarbon dating were collected either directly while excavating features or from the screen. Most nonartifactual samples consisted of radiocarbon specimens and bulk sediment for flotation recovery of macrobotanical

remains. At the rockshelter we also collected several pollen samples. All bulk sediment samples were returned to the NNAD laboratory in Flagstaff for flotation and separation into light and heavy fractions; NNAD staff also performed an initial scan and sort of the fractions to separate artifacts and bone. Funding allowed for only eight of the samples to be analyzed; the samples that appeared most informative while also covering a range of probable feature ages were sent to Lisa Huckell for sorting and plant identification (see Chapter 5). In several cases we also carefully examined the light and heavy fractions in search of plant portions that would yield better dates than wood charcoal. Further detail about the extent of work done at each site is presented in Chapter 5, where we also present the results of various analyses.

OFFICE WORK

For each survey phase there was a prework conference with Douglas McFadden at the Kanab BLM Field Office. Phil Geib and Miranda Warburton attended both of these meetings. A key aspect of the meeting for the first phase was finalizing the sampling strategy. The basic approach was unchanged from that presented in the proposal (Geib, Huffman and Warburton 1998), but because funding would only allow for survey of 8480 acres, negotiation was required on where to allocate the survey acreage. An important aspect of the Phase 2 meeting was finalizing the testing strategy. As with the survey sampling design, the basic approach was unchanged from that presented in the proposal (Geib, Huffman and Warburton 1999).

Coinciding with both the Phase 1 and 2 meetings, Geib and Warburton conducted a site file and literature search and made copies of all survey reports for the Kaiparowits Plateau study area that NNAD did not already have on file. Site locations and survey areas were transferred to topographic maps for future reference. The forms and sketch maps for any sites likely to fall within a NNAD sampling frame were also copied so that these would be available in the field to prevent duplicate site numbers.

As fieldwork progressed for each survey phase, all site forms recorded during a given field session were turned over to laboratory staff for entry into a computer database. In this way we prevented an office work bottleneck at the end of the field season, and we could identify problems, such as missing information, while the work was still in progress. After all of the site forms were entered, the information on isolated occurrences was entered into a separate database.

The summary data presented in this report on prehistoric sites and tools come principally from a database that we created from the site forms. The coding sheet for this database as well as the raw data are given in Appendix B. Some of the information came directly from the IMACS database, whereas some of the fields had to be hand coded from the information on the forms. Having this separate database greatly facilitated data manipulation in SYSTAT. Some information in this report was obtained by directly querying the site form database.

A photo log database was created from the field photographic records. After photo processing, stick-on labels listing the IMACS site number, NNAD field number, description, and orientation were attached to the back of each print.

All collected artifacts from sites or isolated occurrences were processed and labeled and then analyzed. These artifacts were documented by photographs or drawings for inclusion in the final report. Projectile points were analyzed using a coding form and all information was entered into a computer database (Appendix C). Other stone artifacts and ceramics were described individually.

All site sketches were scanned for computer drafting. Macromedia Freehand was used to transform the sketches into high-quality maps that are easy to update and incorporate into publications or databases. Map scanning was done at the end of each field session, but the actual drafting took place after the end of all fieldwork.

The crew chiefs and Miranda Warburton, the co-principal investigator, edited the site forms to ensure thoroughness and consistency. The authors, along with Miranda Warburton, edited the Phase 1 and 2 reports as well as this final report on technical and substantive matters prior to submitting drafts for BLM review.

SYNOPSIS OF RESULTS

Phase 1

Phase 1 of the Kaiparowits Plateau survey documented 307 archaeological sites and 330 isolated occurrences within 53 quarter sections (8480 acres). These 53 survey units were distributed according to a stratified random sample within five sampling strata that comprise the western portion of the Kaiparowits Plateau. These sampling strata in north to south sequence are

Horse Mountain, Long Flat, Horse Flat, Brigham Plains, and East Clark Bench; this order also generally corresponds with decreasing elevation. The density of sites within the strata varies from a low of 0.7 per quarter section (2.8 sites per section) for East Clark Bench to a high of 12.1 per quarter section (48.4 sites per section) for Horse Mountain. The 307 sites consist of 284 that are prehistoric, 13 with both prehistoric and historic components, and 10 that are historic.

Testing

Because a main goal of the testing effort was to provide information that would help with the second phase of survey, the excavation fieldwork was conducted prior to the Phase 2 survey. During an 8-day session we were able to test 13 sites. Five of the sites had a probable Archaic age: four on Long Flat (42KA4547, 4548, 4549, and 4552) and one on Horse Flat (4655). Three of the sites had a probable Formative age: two on Paradise Bench (part of the Horse Mountain Stratum, 42KA4749 and 4750) and one on Jack Riggs Bench (part of the Brigham Plains Stratum, 42KA4794). Five of the sites had a probable Post-Formative age: two on Long Flat (42KA4575 and 4612), one on Horse Flat (41KA4662), and two on Jack Riggs Bench (42KA 4732 and 4797). Radiocarbon dating confirmed the general suspected age of the sites. Not all sites, however, could be dated because of limited funds. Faunal bones were the most abundant subsistence remains recovered from the testing effort; macrobotanical plant remains were next to nonexistent except in the one tested shelter. Overall, the testing effort successfully met its stated objectives; Chapter 5 gives a detailed account of the testing project.

Phase 2

Phase 2 fieldwork involved surveying 55 quarter sections (8800 acres) distributed within four sampling strata. The Phase 2 strata in north-south sequence are Collet Top, Fourmile Bench, Smoky Mountain, and Nipple Bench; together these strata comprise the central portion of the Kaiparowits Plateau. By the end of fieldwork NNAD archaeologists had documented 403 sites and 486 isolated occurrences. In addition to 399 newly recorded sites, NNAD archaeologists entirely redocumented three previously recorded sites that lay within the sample units (42KA1373, 1384, and 1440) and one previously recorded rockshelter (42KA2253) within an adjacent quarter section examined by ESCA-Tech (Kearns 1982). Archaeologists from the Museum of Northern Arizona (MNA) had recorded the three open sites within our sample units in the 1970s, but because the site records were substandard, redocumentation was essential. Three additional previously recorded sites also lay within the sample units (42KA1430, 2225, and 2301) but these were not redocumented—two because the site records were adequate and one because no remains could be found in or remotely near the recorded location of the site. The redocumented rockshelter lay immediately adjacent to one of our survey units but the records check at the monument headquarters failed to disclose that this site existed. As it turned out, re-recording this site proved fortunate, because it provides a striking example of how recent looting is taking a toll of the significant sheltered sites on the Kaiparowits Plateau (see discussion in Chapter 10).

For the Phase 2 survey, site density ranged from a low of 2.9 sites per quarter section (11.6 sites per section) for Nipple Bench, to a high of 9.0 sites per quarter section (36.0 sites per section) for Fourmile Bench. Nipple Bench was actually the only stratum with a low density; the other three sampling strata were essentially identical: Collet Top and Smoky Mountain had 8.4 and 8.3 sites per quarter section, respectively, just under the number for Fourmile Bench. Of the 403 site total, 386 sites are prehistoric, 6 have both prehistoric and historic components, and 11 sites are historic only.

REPORT STRUCTURE

This report is a consolidation and elaboration of two separate reports that individually documented the results of the Phase 1 and Phase 2 efforts (Geib, Huffman and Spurr 1999; Geib, Spurr and Collette 2001). All information of any relevance contained within the bodies of those reports is retained herein, although often organized in a different fashion and sometimes presented in greater detail. The appendices of those documents that presented individual site and isolated occurrence descriptions are not repeated here.

Chapters 2 and 3 provide background information about the Kaiparowits Plateau. Chapter 2 presents a summary of environmental information for the plateau overall and the nine sampling strata in particular. Previous archaeological research in and around the Kaiparowits Plateau is summarized in Chapter 3. Chapter 4 describes NNAD's sampling design in detail, as well as making statistical estimates of site count for each of the sampling strata and the project area overall. That chapter also discusses patterns in site distribution and offers some interpretation. The results of the

limited testing project are provided in Chapter 5, along with the analyses of all recovered remains. The interpretations of that chapter are directed primarily toward the principal objectives of the testing project, which concerned alternative dating methods, feature identification, and site preservation. Detailed findings for both phases of survey are presented in Chapters 6–9. Chapters 6–8 concern the Native American remains documented as sites and isolated finds, whereas Chapter 9 treats the Euro-American remains documented as sites and isolated finds. The final chapter (10) summarizes our findings, presents some management information, and makes recommendations for future work.

CHAPTER 2

ENVIRONMENTAL SETTING

The roughly 800,000-acre Kaiparowits Plateau study area is located in Kane and Garfield Counties, Utah, in the south-central portion of the state (see Figure 1.2). The Kaiparowits Plateau is part of a giant staircase of tablelands, benches, and escarpments along the southern margin of the High Plateaus section of south-central Utah, occupying the southeast side of this margin. The plateau and adjoining terrain to the west and northeast became part of the Grand Staircase–Escalante National Monument by Presidential proclamation on September 18, 1996.

The Grand Staircase–Escalante National Monument is bounded to the north by the Dixie National Forest and to the east by Capitol Reef National Park and Glen Canyon National Recreation Area. The southeast boundary skirts Glen Canyon, a portion of U.S. Highway 89a, and the Utah-Arizona border, before turning north just east of Kanab, Utah. The west side of the monument is generally defined by the Johnson Canyon road, the Skutumpah road, and Bryce Canyon National Park.

The two primary, paved access routes to the monument are Utah State Highway 12 to the north and U.S. Highway 89a to the south. The Grand Staircase portion can be accessed by the Johnson Canyon and Skutumpah roads, the Kaiparowits Plateau by the Cottonwood Wash and Smoky Mountain roads, and the Escalante canyons by the Hole-in-the-Rock and Burr Trail roads. With the exception of Burr Trail, these are unpaved dirt roads subject to occasional closure due to stream erosion, gullying, and rock slides. Secondary and tertiary graded roads and two-tracks related to mining and ranching provide limited access to more remote parts of the monument. Nearby communities include Page, Arizona and Big Water, Utah to the south, Kanab to the southwest, Tropic, Cannonville, and Henrieville to the northwest, and Escalante and Boulder to the north.

The monument encompasses almost 1.9 million acres, administered by the Bureau of Land Management. It was the first national monument to be managed by the BLM, which had previously administered nearly all of the same lands that now make up the GSENM (as part of the BLM's Cedar City District). At the time of its designation as a national monument, it contained 180,000 acres of state school trust lands (see Figure 1.1). In the fall of 1998, the U.S. government and the state of Utah negotiated a land exchange, whereby state school sections were traded for federal lands located outside of the monument along U.S. Highway 89a near Big Water. There are still existing private inholdings (about 15,000 acres), as well as valid mining and right-of-way claims and mineral and livestock leases within the monument (Bachtell and Johnson 1998).

The Grand Staircase–Escalante National Monument (GSENM) is contained within the much larger physiographic province known as the Colorado Plateau, centered on the Four Corners region of Arizona, Utah, Colorado, and New Mexico. The Colorado Plateau is large, about 800 km to a side, and high, up to 3200 m (10,500 feet) with flat-lying sedimentary strata that have been offset and folded along north-south crustal blocks. Within the monument, these have created the prominent monoclines of Waterpocket Fold and the Cockscomb, and synclines and anticlines such as the Circle Cliffs. Waterpocket Fold is the east geologic boundary of the monument, and the Paunsaugunt fault is the west boundary. North-south folds also segregate the monument into three broad physiographic regions: the Grand Staircase to the west, the Canyons of the Escalante to the east, and the Kaiparowits Plateau in the middle (Allison 1998).

Pioneering geologist Clarence Dutton named the Grand Staircase for a series of topographic cliffs and benches that rise 1680 m from the North Rim of the Grand Canyon to Bryce Canyon (Dutton 1880). The cliffs, or "risers," are composed of resistant and nonresistant rock, interspersed with plateaus, or "treads," and valleys. The monument encompasses the eastern portion of the Staircase, between the Gray Cliffs and the Cockscomb.

In ascending order (in elevation and most recent age), the Grand Staircase consists of the Chocolate Cliffs, Vermilion Cliffs, White Cliffs, Gray Cliffs, Straight Cliffs, and Pink Cliffs. The oldest geologic formations (forming the Chocolate,

Vermilion, and White cliffs) were laid down during the Triassic and Jurassic periods (225 to 145 million years ago), a relatively terrestrial era characterized by sand dunes, floodplains, beaches, and coastal plains. The Gray and Straight Cliffs were formed during the following Cretaceous period (145 to 65 million years ago), when shallow seas invaded and retreated from what is now Utah. The uppermost Pink Cliffs—the unit that forms the colorful landscape of Bryce Canyon—were created during the more recent Tertiary period (65 to 1.8 million years ago), a time that marks the final withdrawal of the seas. In general, the subsequent Quaternary (1.8 million years ago to present) periods were a time of deformation, uplift, and erosion, rather than deposition, resulting in much of the faulting and folding that now defines and demarcates the Grand Staircase–Escalante National Monument.

The Escalante canyons region is situated between Capitol Reef National Park on the north and east, the Straight Cliffs of the Kaiparowits Plateau on the south, and Boulder Mountain (Aquarius Plateau) on the west. Running roughly north-south through the area is the Escalante River, which empties into what is now Lake Powell but was formerly the Colorado River before construction of Glen Canyon Dam. Numerous twisting, incised tributaries to the river have cut through the Triassic and Jurassic Sandstone. The monument includes the west flank of the Escalante River basin and the Circle Cliffs uplift, which fronts the Waterpocket Fold of Capitol Reef.

GEOMORPHOLOGY AND PHYSIOGRAPHY

The Kaiparowits Plateau (Figure 2.1) is a triangular-shaped topographic highland that is a geologic structural basin, preserving the primarily Cretaceous-age formations eroded from other portions of the Grand Staircase–Escalante National Monument (Doelling and Davis 1989; Hettinger et al. 1996). The plateau covers an area of about 1650 square miles, wedged between two large monoclines (East Kaibab to the west and Waterpocket Fold to the east). The Straight Cliffs, a scarp that rises up to 335 m above the adjacent Escalante Desert, creates an abrupt demarcation of the Kaiparowits Plateau on the north and east. This scarp has but a single break, at Collet Canyon, which drains eastward into the Escalante River. The Cockscomb, formed by the East Kaibab monocline, creates an equally abrupt but lower-relief demarcation on the west side of the Kaiparowits Plateau. Within the plateau are numerous smaller folds, such as the Smoky Mountain, Upper Valley, Reese Canyon, and Escalante anticlines. The southern extent of the plateau is defined by the Glen Canyon gorge of the Colorado River, but the study area itself is bounded primarily by Glen Canyon National Recreation Area.

The plateau includes several sets of benches and escarpments, which rise south to north from just above Lake Powell to the Aquarius and Paunsaugunt Plateaus. Erosion by the Colorado River and its tributaries has created the step-like topography. Harder rock layers create cliffs and accompanying benches and tablelands, whereas the soft rock units have eroded into slopes and badlands. Examples of these benches within the study area include (from generally lowest to highest elevation) East Clark Bench, Nipple Bench, Brigham Plains, Jack Riggs Bench, Smoky Mountain, Horse Flat, Long Flat, Paradise Bench, Fourmile Bench, Collet Top, and Horse Mountain. The plateau is dissected by numerous steep drainages that flow south and southeast into the Colorado River. The resulting deep canyons that separate the various tablelands and benches often make passage from one topographic feature to another quite difficult by vehicle or foot.

Elevations on the plateau (Figure 2.2) are highest in the north and decrease to the south with each step through the geologic formations. The highest points, at 2130–2440 m (7000–8000 feet), are on Fiftymile Mountain and the ridges extending off the 2832 m Canaan Peak. Vegetation at these elevations is characterized by dense pinyon-juniper forest and flats covered with big sagebrush; there are also micro-environments of ponderosa pine. Below these topographic highs are a set of tablelands and benches that range in elevation from 1706 to 1890 m (5600 to 6200 feet). These include such prominent features as Collet Top (Figure 2.3), Fourmile Bench, Horse and Long Flats (Figure 2.4), Brigham Plains (Figure 2.5), and Smoky Mountain. Pinyon-juniper forest still predominates at these elevations, but there are distinct differences in vegetation associations and plant density. The lowest landforms are Nipple Bench, at an average elevation of 1524 m (5000 feet), and East Clark Bench (Figure 2.6), at about 1280 m (4200 feet). Grasses and low shrubs cover these benches.

GEOLOGY

The geology of the Grand Staircase–Escalante National Monument is essentially a record of sedimentary rock deposited over the past 256 million

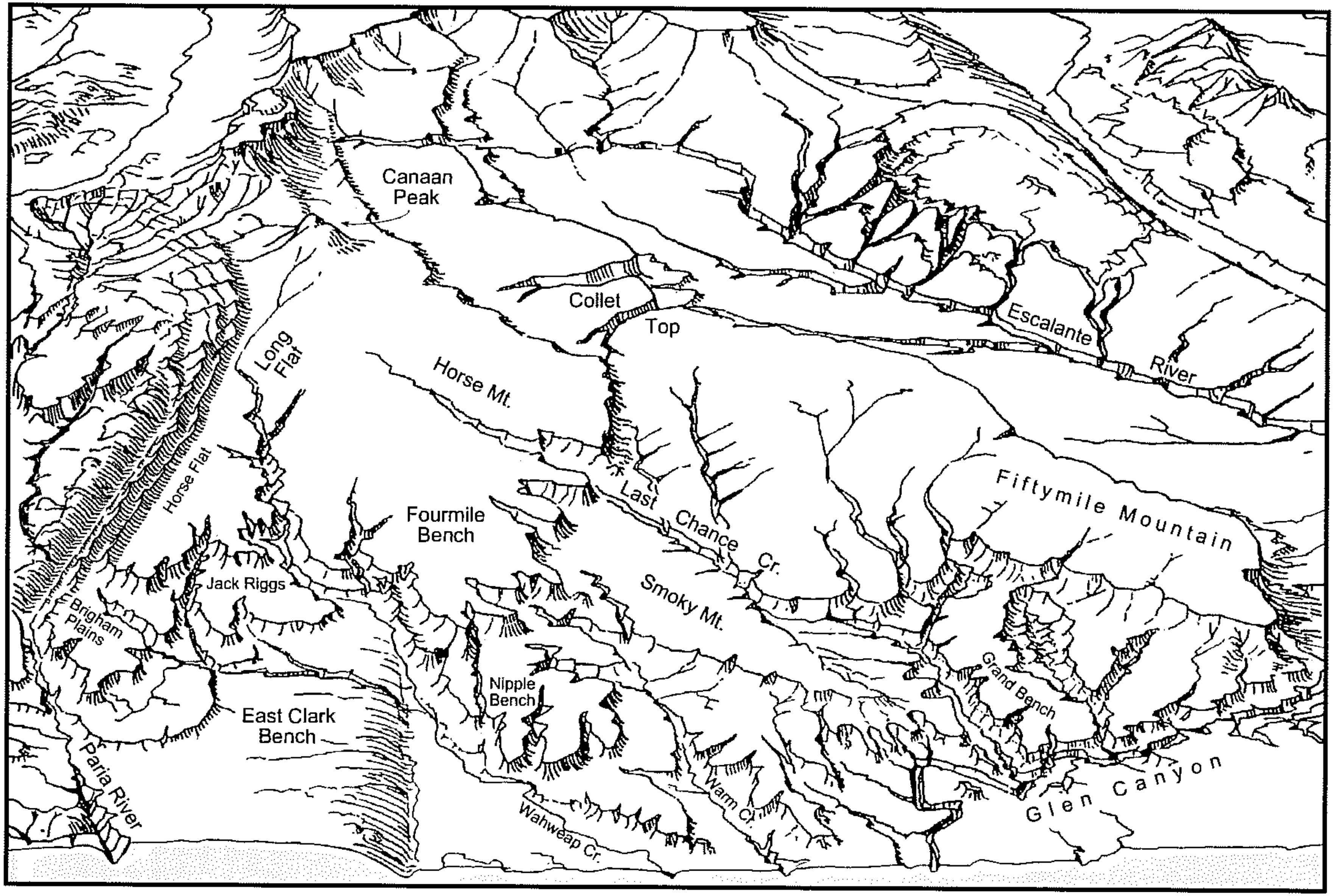


Figure 2.1. View of the Kaiparowits Plateau showing major topographic features and drainages (adapted from Gregory and Moore 1931).

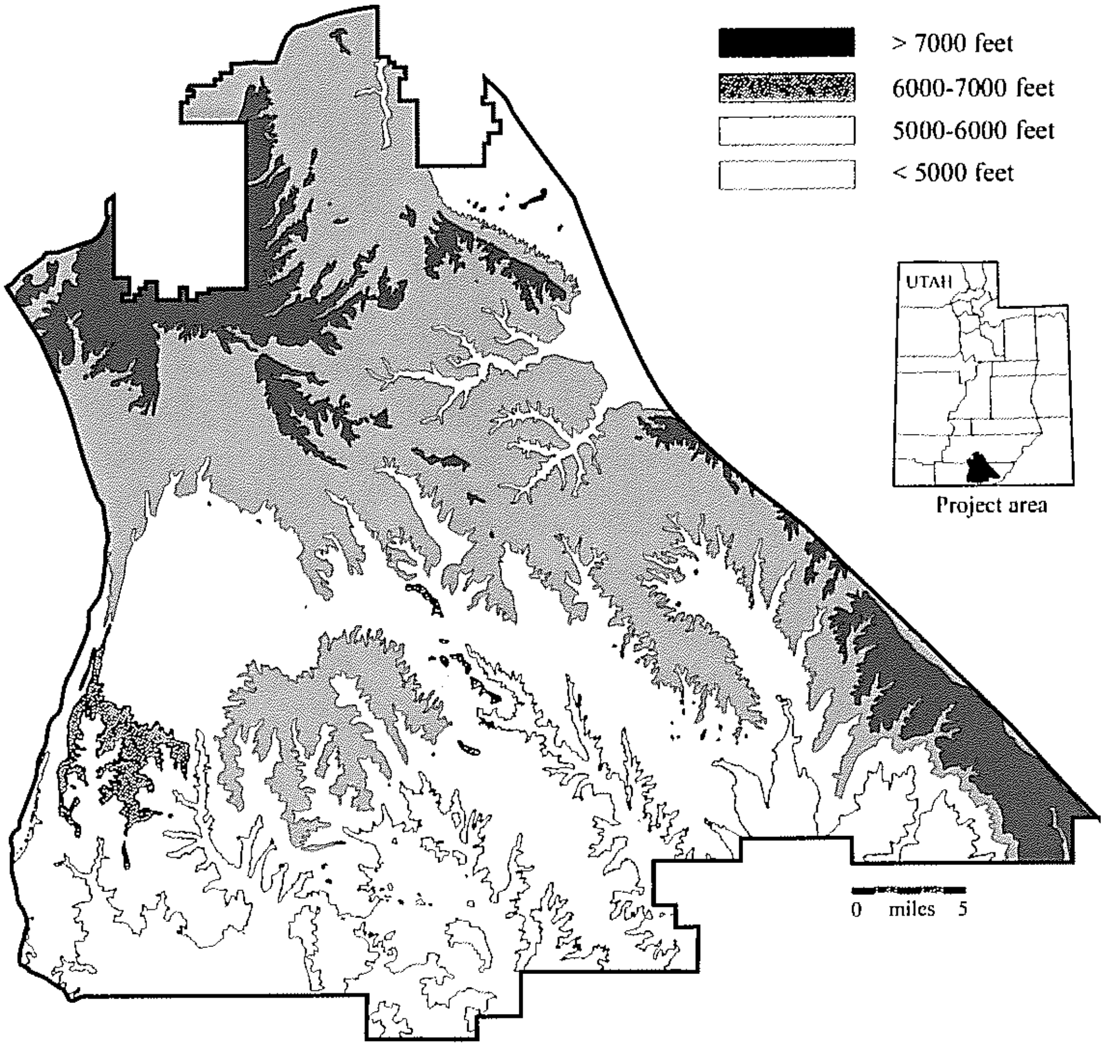


Figure 2.2. The Kaiparowits Plateau study area showing elevational zones in 1000 foot increments.

era) and 914 m of Tertiary strata (Cenozoic era). The Cretaceous strata consist of (from oldest to youngest) Dakota Sandstone, Tropic Shale, Straight Cliffs Formation, Wahweap Sandstone, Kaiparowits Formation, and the lower portion of the Canaan Peak Formation (Figure 2.7). The Cretaceous formations of the Kaiparowits Plateau "contain some of the most outstanding records of Mesozoic fossil mammals in the world" (Gillette 1998:15). The Tertiary period is represented on the plateau by the upper part of Canaan Peak.

Of ancillary interest to this study are the vast coal resources within the Straight Cliffs Formation of the Kaiparowits Plateau (Allison 1998; Doelling and Graham 1972; Hettinger et al. 1996; Sargent (Hettinger et al. 1996). The Kaiparowits Plateau coal field also has the potential for development of coal-bed methane gas, natural gas, and petroleum. Since the 1960s various energy companies have developed plans to mine coal from the plateau and have obtained leaseholds for that purpose. As part of the environmental impact process for the proposed mines, archaeological survey was undertaken throughout parts of the monument and the Kaiparowits Plateau (see Chapter 3). Andalex Resources, Inc. still holds 17 coal leases in the Smoky Hollow area of the monument, but the company withdrew its permit application after establishment of the GSENM. Various factors "make development of the Andalex coal leases

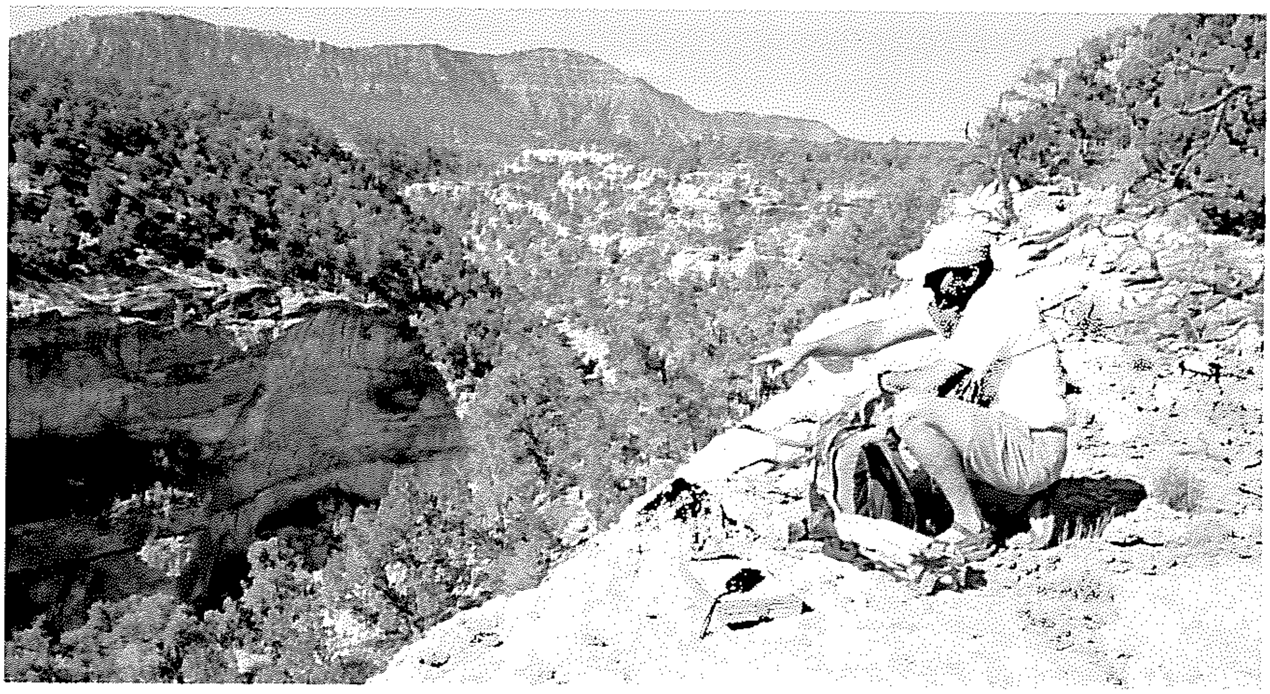


Figure 2.3. The Collet Top sample frame within Unit 70 looking into Willard Canyon; vegetation is dense pinyon-juniper forest with abundant large shrubs.

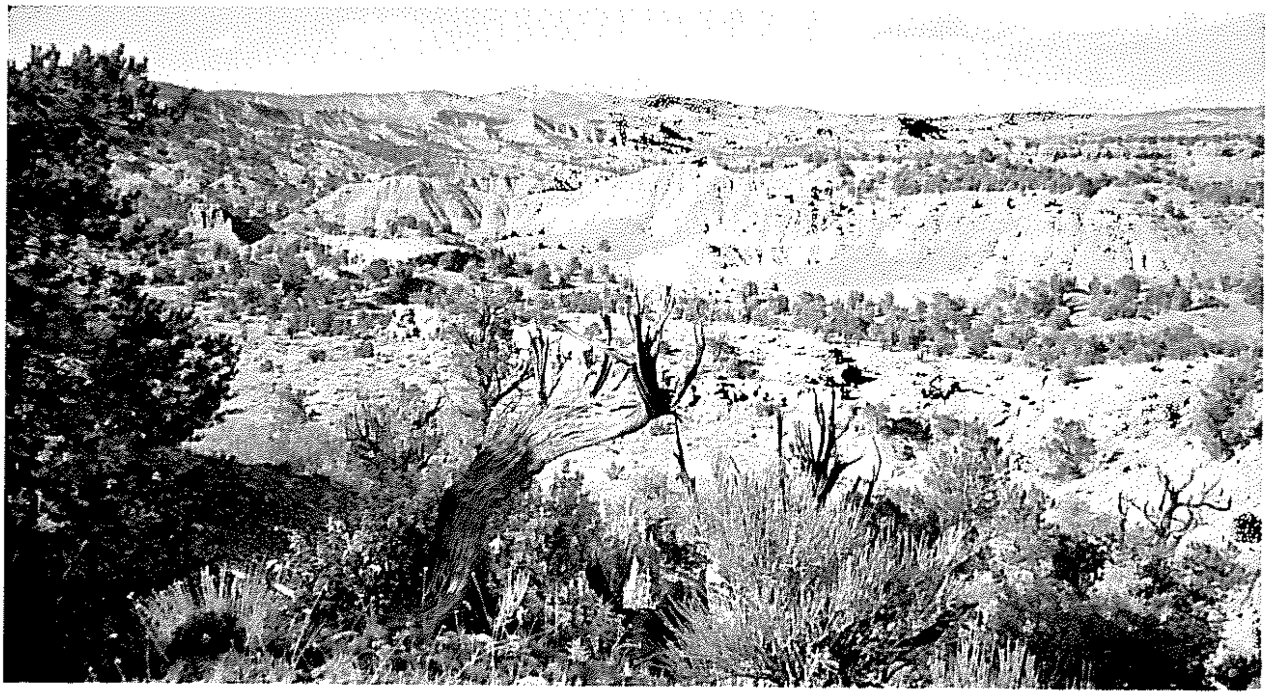


Figure 2.4. The Long Flat sample frame within Unit 111 along Blue Wash with Canaan Peak left of center on the horizon; badlands of Kaiparowits Formation support sparse vegetation but elsewhere there is dense pinyon-juniper forest and sage flats.

Figure 2.5. The Brigham Plains sample frame within Unit 41 looking toward Coyote Point draped in cloud; vegetation consists of extensive sage flats with open pinyon-juniper forest.

Figure 2.6. The East Clark Bench sample frame within Unit 31 looking at Chimney Rock; vegetation is grasses and small shrubs.

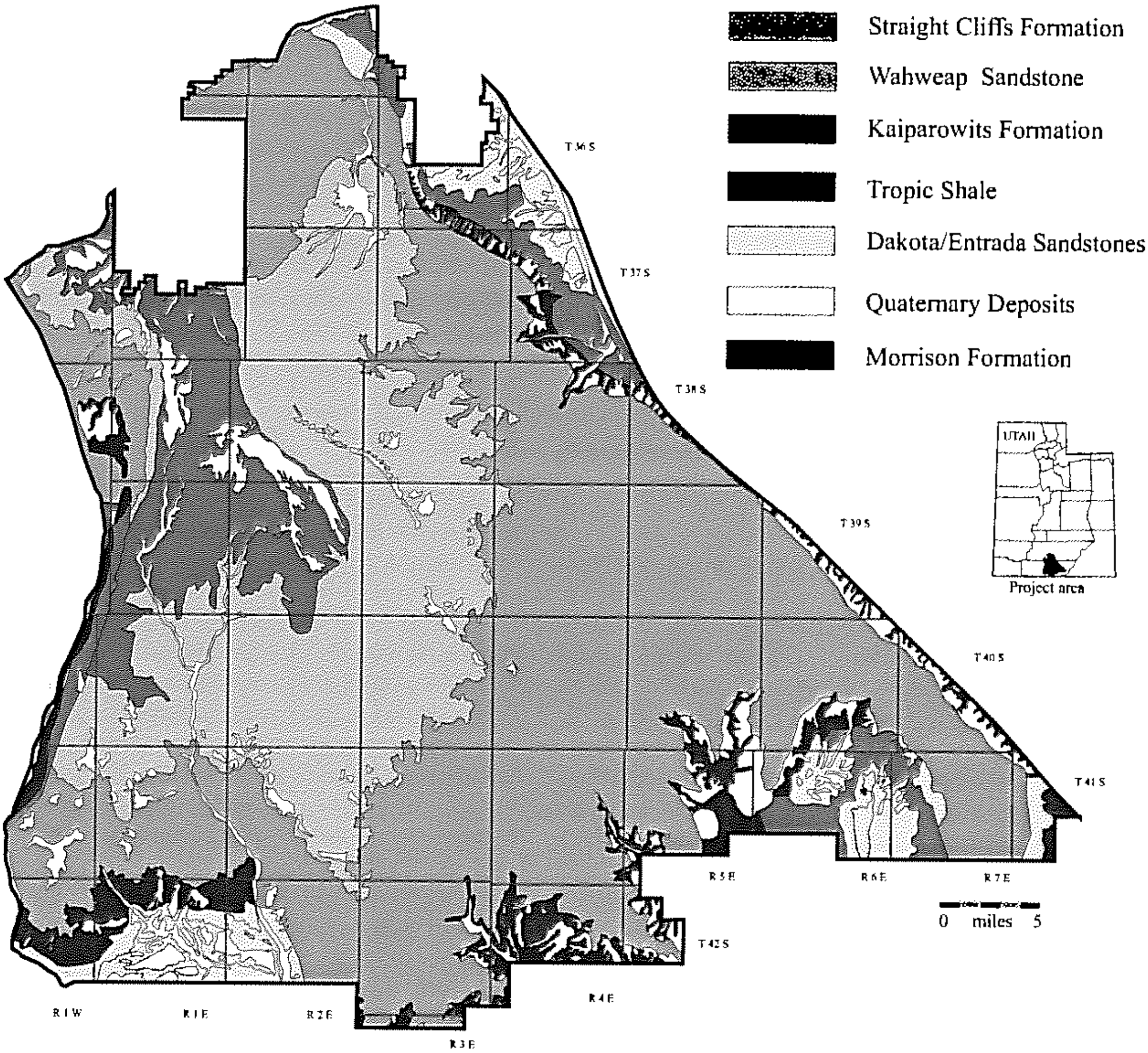


Figure 2.7. The Kaiparowits Plateau study area showing geologic formations (from Hackman and Wyant 1973).

unlikely" (USDI 1999:2.100); this also means that little or no cultural resource inventory tied to coal development is likely in the foreseeable future.

Following are the primary geologic formations and Quaternary deposits associated with each survey stratum.

Sampling Strata

Collet Top

The Collet Top survey frame encompasses the flat terrain along the large dendritic trench of Collet Canyon on the northern edge of the Kaiparowits Plateau. The far northern portion of the stratum, near Bull Run Canyon, is about 250 m higher than the far southern portion on Window Sash Bench. Regardless, the entire survey frame was within the Straight Cliffs Formation. Thin, rocky eolian and residual soils of the Straight Cliffs Formation were common in most units, mantling mostly sandstone bedrock. Sandstone interbedded with siltstone and some clay was noted in some units, such as Units 28 and 59. Window Sash Bench, on the south end of the frame, consists of a series of narrow fingers separated by deep, northward-eroding canyons.

Horse Mountain

This sampling stratum includes Horse Mountain proper and the adjacent Paradise Bench, which lies east of Paradise Creek. The narrow and

southward-sloping ridge that makes up Horse Mountain is Kaiparowits Formation, overlain with a cap of Quaternary gravel and cobbles eroded from the basal conglomerate of the Canaan Peak Formation. The gravel cap provides an effective erosional barrier for the friable Kaiparowits Formation. The portion of this stratum located on Paradise Bench is composed of Wahweap Sandstone according to Hackman and Wyant (1973); however, based on our observations, the Wahweap Sandstone that forms this bench is largely mantled by Kaiparowits Formation siltstone and friable sandstone. Most of this bench lacks the cap of Quaternary gravel and cobbles present on Horse Mountain, but on the northern portion of the bench these deposits are present in scattered patches (e.g., Unit 30).

Long Flat

This survey stratum consists mostly of Kaiparowits Formation, with fingers of Wahweap Sandstone exposed along drainages such as Wahweap Creek, Tommy Smith Creek, and Fourmile Wash. Alluvial and reworked eolian deposits thread the area, and pediment Quaternary cobbles top ridges and slopes in the north and northeastern part of the stratum (e.g., Unit 164, but noted in many other units as well). These gravels are an important source of raw material for the production of flaked stone tools (see Chapter 6) and derive from the basal conglomerate of the Canaan Peak Formation.

Horse Flat

Wahweap Sandstone is exposed throughout the upper end of Coyote Canyon and along the canyon and tributaries encompassing Wahweap Creek. Alluvial and colluvial deposits line the slopes and bottom of Coyote Creek. The northern, more level portion of the survey stratum consists of the Kaiparowits Formation, a friable, silty sandstone interspersed with mudstone, limestone, and more resistant sandstone; this is the southernmost extension of the formation on the plateau (see Unit 41, which is neatly divided between Kaiparowits Formation in its north half and Wahweap Sandstone in its south half). Scattered pockets of shallow alluvium and eolian sand mantle both formations.

Fourmile Bench

This bench is primarily composed of the Kaiparowits Formation, a friable, silty sandstone interspersed with mudstone, limestone, and more resistant sandstone. In units that encompassed canyon edges (such as 51, 52, and 111), the underlying Wahweap Sandstone could be seen along the rims. Wahweap Sandstone was also present outcropping in more minor drainages in Units 118, 141, and 145. In other units—generally those near the edge of the bench—such as 3, 115, and 160, Wahweap comprised much of the unit, usually thinly mantled with eolian sand and some minor remnants of the Kaiparowits Formation. Some units had ridges with fairly substantial dune accumulations, but otherwise soils were often thin (less than 20 cm deep). Units in the far northwest corner of the frame (e.g., Unit 8) had limited exposures of gravels and cobbles capping ridgetops.

Smoky Mountain

Smoky Mountain is composed of the Straight Cliffs Formation, but at a slightly higher elevation (about 100 m) than Nipple Bench overall. This landform, too, is relatively level until it begins to rise in a series of ridges and mesas, such as Pilot Rock and Ship Mountain Point, north toward Fourmile Bench. Both sandstone members of Straight Cliffs (as in Unit 75) and sandstone interbedded with more friable siltstone and mudstone (e.g., Unit 63) were observed. In Unit 1, at the head of Wesses Canyon, Wahweap Sandstone was seen along cliff edges and talus slopes; badland-type hills were noted as well, which are part of the Straight Cliffs Formation. In general, shallow soils were the norm, except in occasional areas of dune-covered ridges (e.g., west end of Unit 97). Smoke from burning coal seams was observed in Unit 114 and vents from these fires occurred just southeast of the unit near the edge of the tableland.

Brigham Plains

The Straight Cliffs Formation of sandstone and shale-mudstone make up this bench and the adjoining Jack Riggs, which together comprise the sampling stratum. Coyote Creek is a deep cleft between the two benches, and Coyote Point is a very prominent north-south ridge across Jack Riggs Bench. There are scattered deposits of overlying alluvium and eolian sand in more level areas. Wahweap Creek, to the east, contains recent deposits of silt, sand, and gravel. The benches are generally level with low ridges and friable shaley-sandstone outcrops; some of the ridges are flanked by clay badlands.

Nipple Bench

The Straight Cliffs Formation that makes up Nipple Bench is composed of white to gray, cross-bedded sandstone interbedded with shale-mud-

stone and coal seams, with scattered deposits of overlying alluvium and eolian sand in more level areas. Nipple Creek, to the west, and Tibbet Canyon, to the east, contain recent deposits of silt, sand, and gravel. In the survey area, the sandstone units of the formation are most prominent. On a smaller scale, survey crews observed semi-badlands and sandstone/conglomerate layers in Unit 3, mesas capped with Wahweap Sandstone in Unit 46, and low ridges composed of reddish eolian sand topped by white clay in Units 118 and 126. Topographically, the bench begins as a relatively flat projection on the south (overlooking Glen Canyon and Lake Powell) and rises to a series of ascending ridges and mesas on the north below Fourmile Bench. Below Nipple Bench are slopes of Tropic Shale.

East Clark Bench

In the survey area the surface is composed primarily of recent eolian sand and silt banked against cliffs and mantling ridges and mesas. The Carmel Formation and Entrada Sandstone are exposed along Coyote and Wahweap Creeks (in some places as steep canyon walls, such as Unit 76), where there are also alluvial sediments and gravels; hoodoos and balanced rocks can also be found along Wahweap. Above East Clark Bench, slopes of Tropic Shale rise toward Brigham Plains and Jack Riggs Bench. The basal conglomerate of the Dakota Sandstone is an important marker bed on East Clark Bench, serving as a cap rock of Entrada Sandstone to form prominent low white cliffs (see Unit 33). Above these cliffs the area is largely barren badlands; below the cliffs the area is a dunal grassland. Badlands, semi-badland benches, and shaley-clayey sediments are also present below the Rimrocks (such as in the southeast third of Unit 10) and in portions of others units, such as 2, 6, 10, and 31 (generally the western third of the frame). Grasslands and shrublands with eolian sand were noted in Units 69 and 83.

Archaeological Implications

The geology and geomorphology of the Kaiparowits Plateau had a direct bearing on cultural use of the region from Archaic through modern times. Individuals and groups first had to determine how to access the plateau, with cliff- and slope-forming layers of resistant and non-resistant sandstone, mudstone, limestone and the like channeling approach routes and travel between benchlands. The Straight Cliffs Formation, which defines primarily the east and southern margins of the plateau, was a formidable barrier (as its name implies) for people coming up from low-elevation benches such as East Clark, the lower Glen Canyon benches, and the Escalante desert. Fiftymile Mountain, for example, is particularly difficult to access to this day, with the best-known route being Collet Canyon through the east side of Fiftymile. Several other trails, such as the "Middle Trail" illustrated in Fowler and Aikens (1963:Figure 4), are shown on USGS topographic maps; all traverse the slope of the eastern escarpment.

Access from the south was probably primarily up north-south drainages such as Coyote Creek, Wahweap Creek, Nipple Creek, Tibbet Canyon, Warm Creek, and Last Chance Creek. Cliffs of Kaiparowits Formation sandstone shield Horse Flat, Long Flat, and Fourmile Bench from the south and east, although routes to these uplands were likely available via the headwaters of Wahweap and Paradise Canyon. The Burning Hills and adjacent canyons may have forced travelers to take a more northerly route, as today, through Collet Top. For parties en route to the highest reaches of the plateau, steep clay badlands and cobble-strewn ridges would have made approaches to Horse Mountain difficult but not impossible. To the west the Cockscomb was another barrier, with intermittent access through erosional breaks and faults. Finally, Alvey Wash and its many tributaries comprised the main access route from the north out of the upper Escalante River basin.

The geolgy of the plateau also conditioned the availability of lithic raw material resources. The basal conglomerate of the Canaan Peak Formation was one of the most important sources of lithic material, containing alluvial cobbles of chert, quartzite, metasediment, and igneous rock. As described above, the cobbles drape accross numerous ridges on Long Flat and Horse Mountain, and are actively eroding major drainages such as Waheap Creek; eroded cobbles travel as far as the East Clark Bench stratum near Big Water. The cobbles of coarse materials were modified for use as chopping, pounding, and scraping tools that required size and mass, and large core flakes from these cobbles-often decortication flakes-were also removed for use as choppers or scrapers, or were used directly for such purposes without modifaction. Cobbles were also found in many thermal features, particularly in areas where they were most ubiquitous, such as Long Flat. The cobbles may have served some architectual purpose (such as stone lining) or were used for heat retention (as in stone boiling).

Additional information on cobble tools and features is presented in Chapter 6.

Raw material for groundstone production was available on all strata, although the quality of the rock—generally sandstone—varied from one formation to another. Possibly the most erodable and least desirable material was Kaiparowits Formation sandstone, found primarily on Horse Flat, Long Flat, and Horse Mountain. Sandstone from the Straight Cliffs Formation and Wahweap Sandstone are somewhat superior. Better yet is the hard Dakota Sandstone that forms a cap rock along East Clark Bench and other lower Glen Canyon benches, although it would have taken some effort to haul this material onto the plateau. Entrada Sandstone was also available on East Clark Bench, and appeared to be the preferred "variety" on Archaic sites observed during NNAD's survey of the Big Water Trust Land Block (Collette and Spurr 2001). A unique form of sandstone was occasionally observed that appeared to derive from sources adjacent burning coal seams, such as those on Smoky Mountain. The coal "firing" altered the character and color of the rock, resulting in a highly cemented, purplish material similar to that seen on Black Mesa, Arizona. In general, however, ground stone raw material was selected on the basis of whatever was at hand. This was particularly the case for expedient grinding slabs; manos, which are more portable and have potentially greater production input, were sometimes fashioned from more exotic materials. Sandstone was also often found in thermal features, but as fragments that may have been the eroded remains of slab lining (see Chapter 6).

HYDROLOGY

The Kaiparowits Plateau is a semiarid environment with comparatively little surface water. A series of south and southeast trending drainages direct most seasonal runoff to the Colorado River; a few north and east trending drainages (Figure 2.8) flow into the Escalante River. The largest of the drainages are (from west to east) Wahweap Creek, which drains Jack Riggs Bench, Horse and Long Flats, and the west side of Fourmile Bench; Warm Creek, which empties the east side of Fourmile Bench and the west side of Smoky Mountain; and Last Chance Creek, which drains the east side of Smoky Mountain and Horse Mountain and several interior canyons. In addition, the benches and tablelands are dissected by numerous tributaries, ranging from minor (but sometimes deeply incised) arroyos to wide, cobble-strewn washes. Combined, these drainages make up the Kaiparowits Composite Drainage Area, one of four broad watersheds that cross the GSENM.

Little information on water flows is available for the Kaiparowits Plateau, as the USGS has maintained only a handful of scattered meters to record peak-flow events. Three high-flow partial record stations were active in the late 1980s, but all were located in the lower reaches of the Paria River, Coyote Creek, and Wahweap Creek (Price 1987). Stream flow fluctuates in response to snowmelt and runoff from thunderstorms, with the latter producing much of the water for drainages below 2438 m (8000 feet; Price 1987). There can also be large day-to-day fluctuations, and major flows in low elevations during the summer monsoons. As a rule for this region, most drainages in areas receiving less than 40 cm (16 inches) of annual precipitation are ephemeral, with long periods of no flow each year. In fact, the only perennial stream in the study area is an 8-mile stretch of upper Last Chance Creek (including Paradise Canyon and the lowest mile of Drip Tank Canyon, one of its tributaries) within the Horse Mountain stratum. There are also areas of groundwater discharge on East Clark Bench along lower Wahweap Creek and portions of the Paria River. In these reaches some amount of water is often available even when there is no active surface runoff from higher elevations.

There are also several aquifer systems underlying the Kaiparowits Plateau (Freethey 1997). The deepest and largest of these is the Glen Canyon aquifer within the Navajo and Wingate Sandstones, which contributes to part of the flows in Johnson Creek, the Paria River, and the Escalante River and tributaries. Above the Glen Canyon aquifer are a series of regional aquifers named after affiliated geologic formations. These consist of (in ascending order) the Entrada, Morrison, Dakota, and Mesaverde aquifers; the latter within the Straight Cliffs Formation and Wahweap Sandstone. Ground water within the aquifers recharges and moves toward the deeper canyons in and around Lake Powell. Although ground water would not have been available to people atop the Kaiparowits Plateau, the aquifers helped to sustain important ecosystems adjacent to the plateau.

Archaeological Implications

Although perennial streams are lacking, domestic water was probably available, in quantities sufficient for small groups of prehistoric mobile peoples, within a half day's journey in any direc-

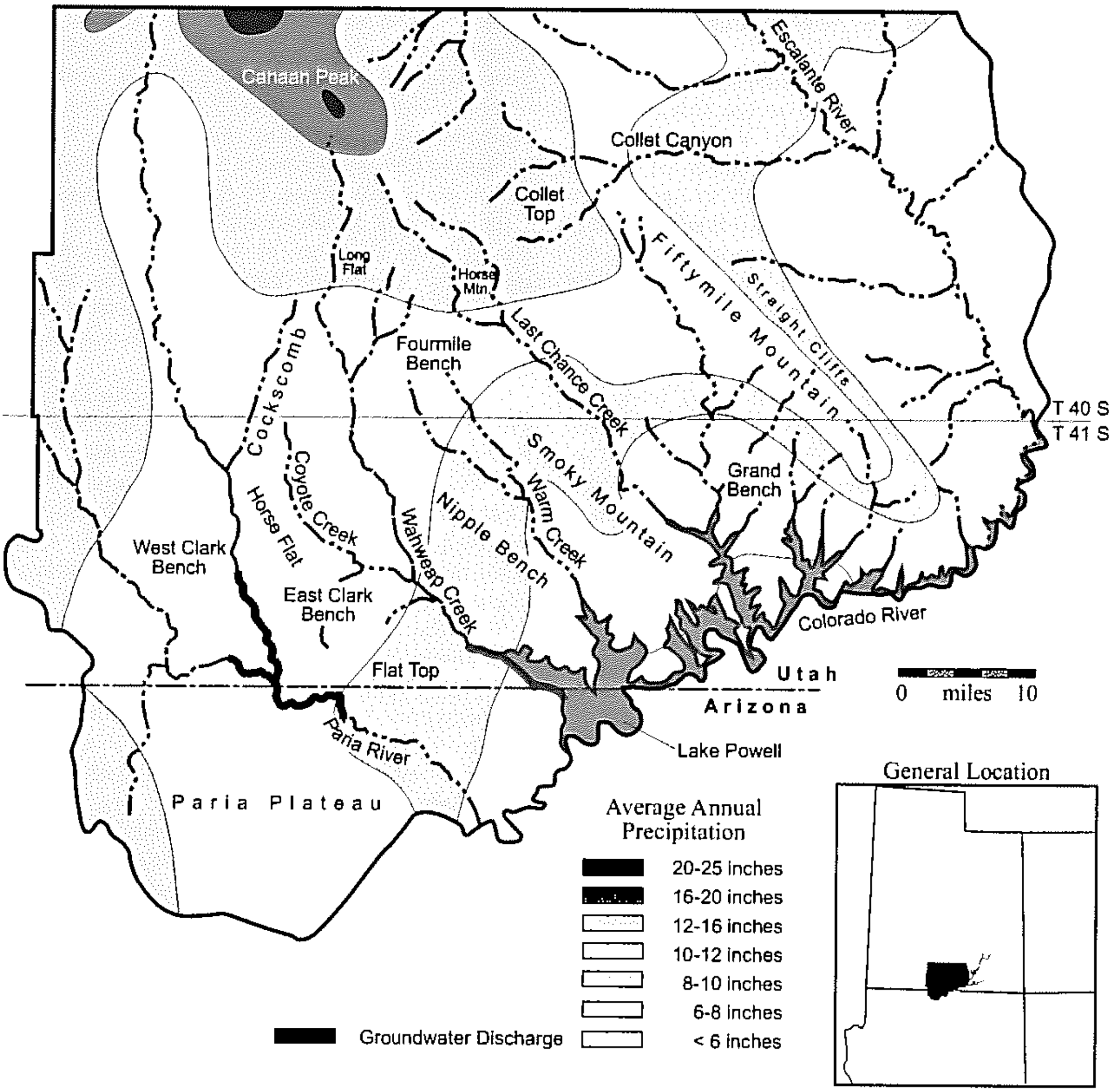


Figure 2.8. Map showing major hydrologic features, groundwater discharge and average annual precipitation in the study area (adapted from Price [1987: Figures 2.3-1, 6.1-1, and 7.2-2]).

tion (depending on the time of year and precipitation rates). The most dependable sources are named springs that are plotted on USGS maps. Water was seen at Tibbet Spring (and a spring just south of Tibbet), Nipple Spring, and John Henry Spring on Nipple Bench, Tommy Water Spring in Tommy Smith Creek, Lower Coyote Spring in Coyote Creek, Headquarters Spring in Headquarters Valley, and Fourmile Spring on Fourmile Bench. Water was also available at unnamed springs in upper Wahweap Creek and the left fork of Paradise Canyon, and several springs were known but not visited in the Collet Top area (e.g., Circle Spring, Hardhead Water Spring, Rock Spring). NNAD crews did not observe any springs or seeps on Smoky Mountain, but given the site density there must be several available (one spring—Needle Eye Water—is marked on the USGS map). In addition to springs and seeps, intermittent water is available following spring runoff and after summer thunderstorms; for example, water was observed in Wahweap Creek,

Tommy Smith Creek, Coyote Creek, and upper Last Chance Creek for several days following monsoon rains.[1]

Many of the observed water sources within units were seeps, unmarked on the USGS maps, which support riparian plants and wildlife; in some cases these fed standing pools of water (Table 2.1). Springs and seeps tend to issue from formations above and beneath coal-bearing units, although they can be found in most formations (Price 1987). Even when water was not available on the surface, stands of cottonwoods (*Populus* spp.), tamarisks (*Tamarix* spp.), and willows (*Salix* spp.) often mark the location of subsurface water within drainages. Plunge pools and slickrock catchments are another source of water, and perhaps ones that humans used quite regularly. The sandstones of the Wahweap and Straight Cliffs Formations are conducive to the creation of bedrock pools and catchments, but the softer Kaiparowits Formation sandstone, in the interior of the plateau, is not. In terms of water quality, surface water on the plateau is generally fresh, with less than 1000 mg per liter total dissolved solids (Freethey 1997).

CLIMATE

The BLM has partitioned the GSENM into three general climatic zones: desert, semi-desert, and upland (USDI 1999:3.16). Examples of the desert climatic zone include the Sooner Bench area of Hole-in-the-Rock Road and East Clark Bench. The semi-desert zone includes the west flank of Hole-in-the-Rock Road, the Phipps–Death Hollow area, the Circle Cliffs, and Highway 89a between Johnson Canyon and the Cockscomb. The upland zone is typified by three general areas of the monument: Fiftymile Mountain, the Kodachrome Basin and Skutumpah Road, and the Paria–Hackberry area. Table 2.2 summarizes the variations in precipitation, temperature, and elevation that produce the three zones.

The sampling strata of the Kaiparowits Plateau Survey span all three climatic zones. East Clark Bench, at about 1372 m (4500 feet), falls within the desert zone. Nipple Bench, Smoky Mountain, and Brigham Plains—ranging from about 1555 to 1676 m (5100–5500 feet)—are more typical of the semi-desert zone. Fourmile Bench, Horse Flat, Long Flat, Collet Top, and Horse Mountain—between 1830 and 2164 m (6000–7100 feet)—belong to the upland climatic zone. Precipitation for the zones ranges from 15 cm (6 inches) in the desert zone to 50+ cm (20+ inches) in the highest elevations of the upland area (e.g., Canaan Peak). Much of the precipitation falls as snow, particularly in the higher elevations, produced by west-to-east frontal systems between October and April. Thunderstorms from the south create intermittently heavy rains between July and September.

There are no weather stations with long-term climatic records within the Grand Staircase–Escalante National Monument (although the BLM monitors about 20 rain gauges there). Data from nearby stations (all located in Utah) can be used to provide proxy values for the desert, semi-desert, and upland regions of the area (see Figure 2.8). The Big Water station (1250 m) is within the desert zone, although a few hundred feet lower than the East Clark Bench survey stratum. Stations at Kanab (1506 m) and Kodachrome Basin State Park (1771 m) bracket much of the semi-desert climatic zone and function as proxies for Brigham Plains, Smoky Mountain, Horse Flat, Long Flat, and Fourmile Bench. The Kanab station is about 152 m lower than Brigham Plains, so the Kodachrome Basin State Park data may serve as a better indicator of the general climatic regime of the semi-desert zone. Note, however, that although the Kodachrome station is 265 m lower than the Boulder station (2036 m), the proxy for the upland zones on Collet Top, Horse Mountain, and Paradise Bench, it is slightly wetter and cooler than Boulder, with fewer frost-free and cooling degree days. This may be due, in part, to cold air drainage within the basin.

Tables 2.3 and 2.4 present 10-year averages for total annual precipitation and temperatures for the years 1986 to 1995. The Kanab station data also include the average departures from normal during this period. In general, this period was wetter than normal (at least in the Kanab area), but annual amounts ranged widely. For example, Kanab received 15.7 cm (6.2 inches) of precipitation in 1989 and 58 cm (22.8 inches) in 1995. The Kanab data also suggest that this interval was slightly warmer than normal. Tables 2.5 and 2.6 show the average number of frost-free days for this period and average seasonal cooling degree days. Frost-free days, in this case, are the number of days

[1]The effects of monsoon flood events were dramatically demonstrated in Paradise Canyon following a storm that occurred between survey sessions. A follow-up visit to the canyon showed a scoured stream bed and several newly deposited sand and gravel bars up to 1m thick. Large expanses of established vegetation (including trees up to 2m high) were also completely removed.

Table 2.1. Natural surface and subsurface water sources observed in or near observation units during the Kaiparowits Plateau Survey.

Unit No.	Comments
Collet Top	
30	Two seeps in N-S tributary to Sarah Ann Canyon in east 1/2 of unit; south seep has small pool
35	Seep in east edge of unit supporting roses & willows; "improved" as stock tank
47	Seep on west side of unit in canyon
138	Tamarisks
154	Good spring in canyon outside NW unit corner with willows & sumac; also seep in canyon along south edge of unit
189	Tamarisks
190	Tamarisks in drainage
Horse Mountain	
45	Tamarisk and cottonwoods in drainage to NW
62	Riparian vegetation, seeps, in major north-south drainage
Long Flat[1]	
81	Tamarisk in drainage in SW unit corner
160	Spring, modified into tank, and grassy swales & other riparian veg. in Tommy Smith Cr.
Horse Flat	
15	Tamarisks, cottonwoods in drainage in NW corner of unit
28	Cottonwoods in NE corner of unit; oak in various drainages
54	Seep in north-south drainage that bisects unit
Fourmile Bench	
31	Tamarisks in major drainage in unit
145	Good seep & small pool w/cottonwoods at head of major N-S tributary in NE corner of unit
160	Good seep with willows in drainage in SE corner of unit
Smoky Mountain	
35	Seep w/catch pool at head of primary drainage in unit—tributary to Coyote Canyon
46	Seep in small canyon in SE corner of unit
62	Seep in Coyote Canyon 500 m west of unit
98	Wahweap Creek in NE corner of unit; spring in canyon 450 m to the west
Brigham Plains	
98	Spring ca. 450 m west of unit in small canyon
103	Seep below pourover of small canyon below Rose Shelter (42KA4794)
Nipple Bench	
108	None in unit, but cottonwoods observed in John Henry Canyon to west
122	Sparse tamarisks in main drainage in unit
126	Seep/cottonwoods in canyon north of unit
East Clark Bench[2]	
76	East edge of unit comprised of Wahweap Creek alluvial terrace

Notes: Stock ponds were observed in Unit 122 on Nipple Bench, Units 18 and 41 on Brigham Plains and Unit 58 on Collet Top; trick tanks were located in Unit 126 on Nipple Bench and Unit 10 on Brigham Plains.

[1]In addition, Wahweap Creek, Blue Wash, or Tommy Smith Creek pass within or near Units 7, 15, 40, 51, 70, 111, 149, and 162.

[2]Wahweap Creek also passes immediately east of Units 69 and 83.

Table 2.2. Summary data on climate zones (after USDI 1999:3.15).

	Desert	Semi-Desert	Upland
Precipitation (inches)	6–8	8–12	12–16
Temperature (°F)	50–57	47–55	43–50
Frost-free Days	170–200	125–170	100–125
Elevation (feet)	4000–4800	4800–6200	6200–7500

Table 2.3. Total annual precipitation and departures from normal (inches) for weather stations near the project area.

				Kanab	
Year	Big Water	Boulder	Kodachrome Basin State Park	Normal	Departure*
1995	no data	8.91	11.11	22.77	9.47
1994	5.00	8.70	9.57	10.36	–2.94
1993	9.00	no data	16.06	19.57	6.27
1992	no data	14.18	16.52	17.97	5.40
1991	4.57	9.25	12.37	12.42	–0.15
1990	5.75	10.26	10.31	8.63	–3.94
1989	3.22	6.34	8.74	6.17	–6.40
1988	no data	9.50	8.80	11.61	–0.96
1987	8.09	12.45	12.71	16.71	4.14
1986	no data	11.34	11.88	15.23	2.66
Avg.	5.94	10.10	11.81	12.62	1.36

*Departure from normal for Kanab weather station only.

Table 2.4. Average annual temperature and departures from normal (°F) for weather stations near the project area.

				Kanab	
Year	Big Water	Boulder	Kodachrome Basin State Park	Normal	Departure*
1995	no data	51.2	51.0	54.7	0.3
1994	59.1	51.0	50.9	56.0	1.6
1993	57.5	no data	49.3	54.5	0.1
1992	no data	49.3	49.8	55.1	0.5
1991	57.3	48.5	49.2	54.5	–0.1
1990	58.5	49.7	49.6	55.2	0.6
1989	58.9	50.1	49.5	55.7	1.1
1988	no data	49.7	49.8	55.7	1.1
1987	57.9	48.8	no data	54.7	0.1
1986	no data	49.8	50.5	55.9	1.3
Avg.	58.2	49.8	50.0	55.2	0.8

*Departure from normal for Kanab weather station only.

Table 2.5. Annual total of frost-free days (days between dates 32°F or below) for weather stations near the project area.

Year	Big Water	Boulder	Kodachrome Basin State Park	Kanab
1995	no data	145	96	169
1994	175	168	140	170
1993	194	no data	127	176
1992	238	151	171	227
1991	197	167	154	169
1990	233	152	129	206
1989	213	140	122	181
1988	194	105	105	161
1987	214	164	no data	206
1986	no data	149	124	157
Avg.	207	149	130	182

Table 2.6. Seasonal cooling-degree days (base = 65°F*) for weather stations near the project area.

Year	Big Water	Boulder	Kodachrome Basin State Park	Kanab	Kanab Norm**
1995	no data	550	471	765	883
1994	2049	803	729	1310	883
1993	1558	no data	288	828	883
1992	no data	393	374	849	883
1991	1736	459	478	938	938
1990	1902	611	523	1059	938
1989	1912	498	445	991	938
1988	no data	599	507	1123	938
1987	1671	354	no data	867	938
1986	no data	458	416	952	938
Avg.	1805	525	470	968	N/A

*One cooling degree day is accumulated for each whole degree that the daily mean temperature is above 65° F.
**Norm for Kanab weather station only.

between dates of 32°F or below. Cooling degree days is another measure of seasonal temperature, where one cooling degree day is accumulated for each whole degree that the daily mean temperature is above 65°F (for an example of a similar measure tied to a 50°F base, see Peterson 1987:219). As measured against running norms, the Kanab station averaged somewhat higher cooling degree days over the 10-year period. Both measurements are good relative indicators of crop viability; the higher the values, the better the growing season.

Archaeological Implications

These data suggest that dry farming on the Kaiparowits Plateau would have been a challenge or, at the least, unpredictable from year to year (given current climatic conditions). About 100–120 frost-free days are required to mature modern hybrid corn, and more time is needed under dry conditions (Hack 1942; Crosswhite 1981). East Clark Bench, Nipple Bench, Brigham Plains, and Jack Riggs Bench have adequate year-to-year growing seasons, and this may also be true (but to a lesser extent) for Smoky Mountain, Horse Flat, and Long Flat. Availability of precipitation is another matter. Dry farming was out of the question on East Clark Bench, with about 15 cm (6 inches) of average annual precipitation (see Figure 2.8), and probably on Nipple Bench as well. Floodwater farming along the Paria River and Wahweap Creek would have been a better option. The survey strata within the semi-desert and upland zones probably received only 25–33 cm (10–13 inches) of precipitation on average, below or at the threshold of the amount needed to sustain corn agriculture (Hack 1942). But certain years would

have had more than enough precipitation; the Kanab station recorded annual totals of 31.5–57.8 cm (12.42–22.77 inches) 6 out of 10 years. Given this, a form of untended, "ad hoc" corn agriculture (as practiced by certain Southern Paiute bands; Kelly 1964) might have been successful on the Kaiparowits, particularly in spring-fed canyon bottoms (McFadden 2000). Also, the lower elevation benches historically supported good stands of grass, reportedly "stirrup-high" along lower Wahweap Creek in the early days of cattle ranching (Crampton 1994:20); possible evidence for prehistoric grass seed processing was observed during recent surveys in the Big Water area (Collette and Spurr 2001; Springer 2001).

FAUNA

Few wildlife studies have been conducted and published within the boundries of the GSENM. In the 1970s, researchers from Brigham Young University studied vertebrates in the area as part of the environmental assessment for the proposed Kaiparowits Power Project. Lists of vertebrate fauna for the Kaiparowits Plateau can be found in Atwood et al. (1980) and the BLM draft management plan for the monument (USDI 1999:A15.1-19). Since 1990, baseline mammal surveys have been conducted in many of the national parks and monuments surrounding the Grand Staircase–Escalante (Bogan and Ramotnik 1998), and these data are pertinent to questions of faunal diversity and status within the new monument. Table 2.7 lists wildlife observed by NNAD crews in the study area; it includes both sightings and signs, such as scat and tracks.

In terms of economically significant mammals that would have been present prehistorically, Rocky Mountain elk (*Cervus elaphus nelsoni*) winter in the monument, and the area provides year-round habitat for mule deer (*Odocoileus hemionus*) and desert bighorn sheep (*Ovis canadensis nelsoni*). The latter favor cliff scarps and rocky slopes, and were reintroduced into their historic ranges in the monument in the 1980s. Bighorn sheep were observed by NNAD crews in Unit 98 on Jack Riggs Bench, and deer tracks, scat, and antlers were seen throughout the monument. Based on the frequent recovery of deer and sheep bones from site excavations in Glen Canyon (Jennings 1966:22–23), and Cedar Ridge to the south of East Clark Bench (Moffitt, Rayl and Metcalf 1978), both species were probably important components of the prehistoric diet.

On the lower benches pronghorn antelope (*Antilocapra americana*) were probably the most sought-after big game animal. Antelope are well

Table 2.7. Common and scientific names for wildlife observed, live sightings and signs, excluding invertebrates.

Common	Scientific	Common	Scientific
Bat	Vespertilionidae or Molossidae	Horned lizard	*Phrynosoma* spp.
Bull snake	*Pituophis melanoleucus*	Hummingbird	*Archilochus alexandri* or *Selasphorus rufus*
Burrowing owl	*Speotyto cunicularia*		
Canyon wren	*Catherpes mexicanus*	Jackrabbit	*Lepus* spp.
Chipmunks	*Tamias* spp.	Kingsnake	*Lampropeltis* spp.
Clark's nutcracker	*Nucifraga columbiana*	Lizard	Iguanidae
Common nighthawk	*Chordeiles minor*	Mountain lion	*Felis concolor*
Common raven	*Corvus corax*	Mourning dove	*Zenaida macroura*
Cottontail	*Sylvilagus* spp.	Mouse	Heteromyidae, Cricetidae or Muridae
Coyote	*Canis latrans*	Mule deer	*Odocoileus hemionus*
Desert bighorn sheep	*Ovis canadensis nelsoni*	Ord's kangaroo rat	*Dipodomys ordii*
Eagle	*Haliaeetus leucocephalus* or *Aquila chrysaetos*	Owl	Strigidae
		Pinyon jay	*Gymnorhinus cyanocephalus*
Flicker	*Colaptes auratus?*	Rattlesnake	*Crotalus* spp.
Fox	Canidae	Red-tailed hawk	*Buteo jamaicensis*
Gambel's quail	*Callipepla gambelii*	Rock wren	*Salpinctes obsoletes*
Great horned owl	*Bubo virginianus*	Skunk	*Spilogale gracilis* or *Ephitis mephitis*
Ground squirrels	Sciuridae		
Hawk	Accipitridae		

suited to the moderately level grass and shrub lands of East Clark Bench (Ockenfels et al. 1996), and were reintroduced to the area in the 1970s and 1980s. NNAD crew members observed individuals from this herd, south of U.S. Highway 89a, during their sample survey near Big Water (Collette and Spurr 2001). Antelope may have also historically ranged onto the upper benches; members of the reintroduced herd have been sighted as far north as Butler Valley and Nipple Bench (Murdock et al. 1974:176). Antelope bones were recovered from Captains Alcove (Tipps 1984:128–129, Table 26), the arroyo site in Kitchen Canyon (Douglas McFadden, personal communication 2001), and the Kanab site (Nickens and Kvamme 1981), indicating that these animals were hunted prehistorically in nearby Glen Canyon.

Cottontails (*Sylvilagus* spp.) and jackrabbits (*Lepus* spp.) were the most frequently observed mammals during the NNAD survey, seen in nearly all survey units. These animals were common prehistoric table fare, providing not only meat, but fur for blankets, bones for tools, and other items as well.

Other game and non-game mammals native to the plateau are black bear (*Ursus americanus*), bobcat (*Lynx rufus*), mountain lion (*Felis concolor*), coyote (*Canis latrans*), common porcupine (*Erethizon dorsatum*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), wild turkey (*Meleagris gallopavo*, reintroduced in the Boulder area), chipmunks (*Tamias* spp.), gophers (*Thomomys* spp.), mice (*Perognathus* spp.), kangaroo rat (*Dipodomys ordii*), and various shrews, voles, skunks, and squirrels. Animals such as rodents were consumed prehistorically, but probably were not of great dietary significance.

Archaeological Implications

It is possible that the prime economic importance of the Kaiparowits Plateau across all time periods and cultures was as a hunting ground, excepting a 100-year window during Pueblo II–III when dry farming was successfully practiced on Fiftymile Mountain and perhaps Collet Top. Results from NNAD's recent testing of selected Kaiparowits sites (Chapter 5, this volume) and other excavations (Gunnerson 1959b; Fowler and Aikens 1963; Moffitt, Rayl and Metcalf 1978; McFadden 2000) indicate that prehistoric hunters targeted primarily artiodactyls such as mule deer and bighorn sheep, and small mammals such as rabbits and hares. During the Formative and Post-Formative periods on the plateau, for example, there was a reliance on large game (see Chapter 5), a finding that may have relevance to McFadden's (2000:169–170) speculation that the Coombs Site "shifted from full-time agriculture to being primarily a winter residential site that focused on hunting." At Coombs "mule deer were the most common faunal remains recovered, followed by bighorn sheep"; significant numbers of artiodactyl bones were recovered from Fiftymile sites as well.

On the lower, southern benches the big game of choice was probably antelope. During the Big Water Trust Land Block survey (Collette and Spurr 2001) most Archaic sites had numerous modified and unmodified cobble tools that appear to have been used to scrape and break down animal hide and bone. Whether they were used to process antelope parts, specifically, is unknown. We do know that, compared to all other sampling strata for the Kaiparowits Plateau Survey, such tools were found much more frequently on the Big Water survey portion of East Clark Bench. This suggests that Archaic hunters were concentrating on a type of fauna that may have been endemic to the Big Water area, and the most likely candidate is antelope (another possibility is the hunting of lagomorphs, perhaps via drives, but these animals are widespread across the plateau; antelope have a much narrower range, restricted to East Clark Bench and the lowest benches of the Kaiparowits).

VEGETATION AND BIOTIC COMMUNITIES

The biology of the Grand Staircase-Escalante National Monument and, more specifically, the project area, can be viewed by way of several organizational schemes: life zones, floristic regions, and vegetation and biotic communities, among others. The Grand Staircase-Escalante National Monument falls within the Colorado Plateau floristic region, one of five floristic divisions in Utah. The monument is a floristically rich area that encompasses the eastern part of the Canyonlands section, the southern portion of the Utah Plateaus section, and a small northeastern part of the Dixie Corridor section (Cronquist et al. 1972; USDI 1999); the Kaiparowits Plateau is associated with the Utah Plateaus section. The Canyonlands section contains 50 percent of Utah's rare flora, and the monument at large contains 87 percent of Utah's known plant species. The area has one of the highest rates of plant endemism ("percentage of the flora considered for listing as threatened or endangered, and percentage of flora considered as rare species"; Belnap 1989:21) in the United States,

with 125 plants that are native to Utah or the Colorado Plateau and 11 that are unique to the monument.

The majority of the study area is found within the Upper Sonoran Life Zone (1372–1980 m, 4500–6500 feet; Elmore 1976), typified by pinyon pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), and big sagebrush (*Artemisia tridentata*). Units with the highest elevations were located in the Transition Life Zone (1980–2438 m, 6500–8000 feet). Unit 13, in the upper part of the Horse Mountain survey stratum, contained ponderosa pine (*Pinus ponderosa*), with an understory of greenleaf manzanita (*Arctostaphylos patula*), mountain mahogany (*Cercocarpus* spp.) and Gambel or scrub oak (*Quercus gambelii*). Most of the units in Collet Top were also located in this zone; within this survey stratum there was a small stand of old-growth ponderosa pine with an understory of manzanita.

For land managers one of the most useful ways to summarize and analyze plant information is to map units by vegetation or biotic communities. Published vegetation maps are available for most of the project area (the exception being the Collet Top stratum), although not at the level of vegetation series or associations. An older but more detailed and comprehensive vegetation map was produced by Brigham Young University (BYU) in the 1970s for a Kaiparowits Plateau environmental baseline study (Murdock et al. 1974: 253–266). Their plant communities and habitat types are reproduced in Table 2.8. Figure 2.9 shows the distribution of the map units in the survey area and surrounding locales.

A digitized, hierarchical classification system for biotic communities in the Southwest was developed by Brown and Lowe (1980), although their geographic "Southwest" includes only the southern portion of the study area. This makes the map of limited use for our purposes, but their classificatory system of natural biological hierarchies is widely adopted and forms the basis for ongoing vegetation surveys within the monument. The project area is within the Forest, Grassland, and Desertland upland formations of the Nearctic biogeographic realm (most of continental North America). The Brown and Lowe (1983) map classifies the project area at the fourth level of the hierarchy, within the third-level warm temperate and cold temperate climatic zones. The fourth level consists of major biotic communities, also known as biomes.

Table 2.8. Legend of mapping units for Navajo-Kaiparowits vegetation map (after Murdock et al. 1974:257).

Map Units	Symbol	Percent of Area on Map
Steppe Lands		10.6
Blackbrush	5	0.2
Blackbrush-spiny hopsage	2	1.1
Spiny hopsage-blackbrush	4	1.3
Grasslands	13	6.1
Sagebrush	8	1.9
Pygmy Forest		50.5
Pinyon-juniper	10	33.1
Scattered juniper	3	1.6
Rimrock pinyon-juniper	1	15.8
Saltbush Communities		38.9
Mat atriplex	14	4.7
Shadscale-Mormon tea	11	31.6
Shadscale-galleta grass	7	0.1
Mixed shrubs with grasses	9	0.2
Mixed shrubs-galleta grass	6	1.5
Badlands	12	0.4
Slickrock	15	0.4

Brown and Lowe (1983) classified all of the upland benches of the Kaiparowits Plateau (including all survey strata except East Clark Bench) as Great Basin Conifer Woodland (122.4). This is a widespread, cold-adapted evergreen woodland dominated in the project area by pinyon pine and Utah juniper. Here, however, the woodland co-occurs with Great Basin Desertscrub (152.1), with sagebrush being the principal understory plant. Other important associates can include rabbitbrush (*Chrysothamnus* spp.), winterfat (*Ceratoides lanata*), shadscale (*Atriplex confertifolia*), and various grasses (depending on soil and rangeland conditions). In actuality, this type of woodland does not exist on Nipple Bench; it begins to appear on the northern portions of Smoky Mountain, and is well developed on Fourmile Bench and Collet Top.

More recently, maps depicting soil and vegetation mapping units have been completed for selected USGS quadrangles within the monument (Paul Chapman, personal communication 1998). Using Brown and Lowe's map of Southwest biotic communities (1983), the vegetation map of BYU's Kaiparowits baseline study (e.g., Murdock et al. 1974), the limited but more up-to-date data by BLM personnel, and field observations by NNAD crew members, it is possible to roughly delineate the vegetation and biotic communities of the project area. A list of plants observed during the project, by survey stratum, is presented in Table 2.9.

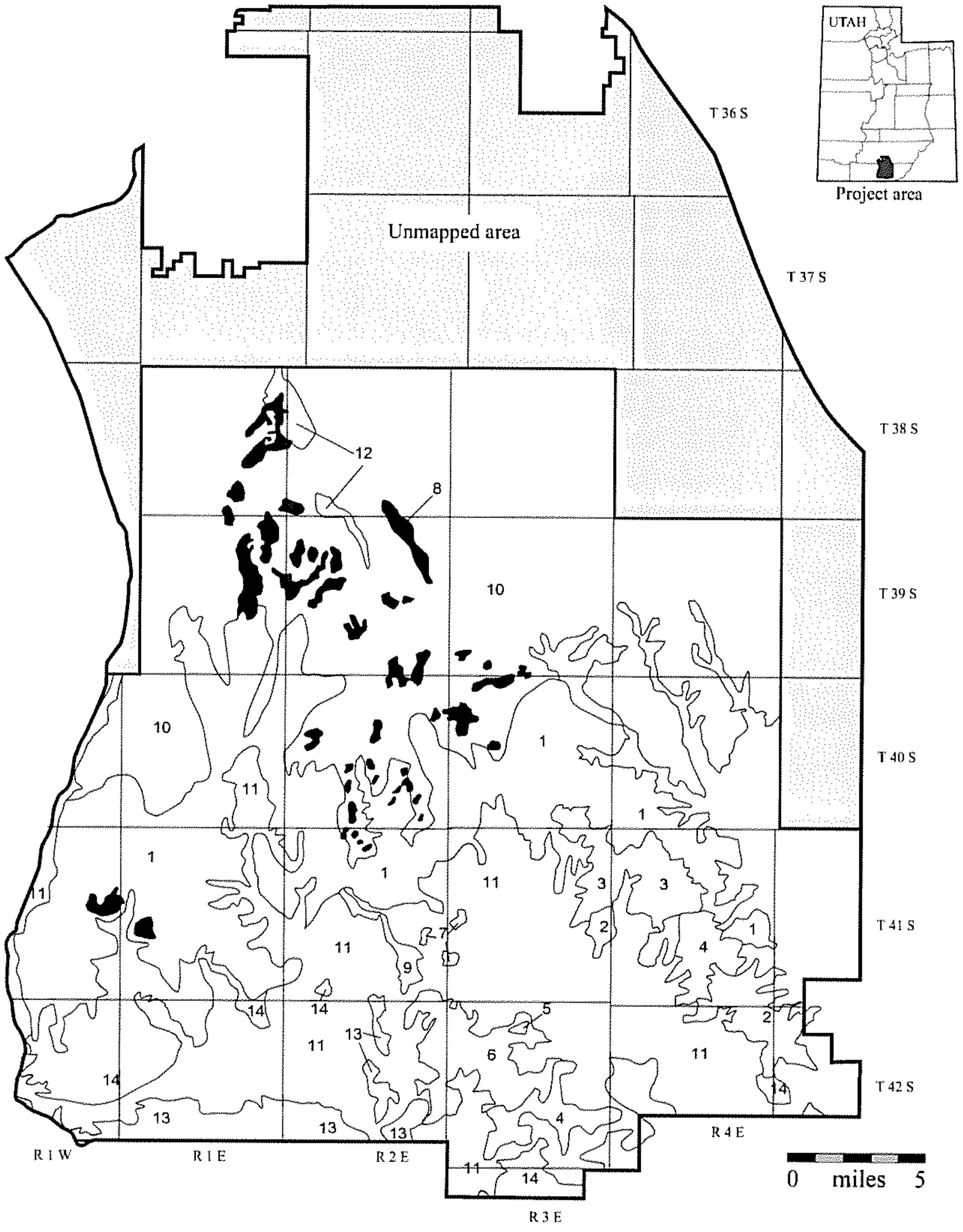


Figure 2.9. Vegetation mapping units for the Kaiparowits Plateau project area. Redrawn from Murdock et al. (1974: Figure 1-4.4).

Table 2.9. Common and scientific names for plants observed within sampling strata (names follow Welsh et al. 1987).

Common Name	Scientific Name	Collet Top	Horse Mtn	Horse & Long Flat	Four-mile Bench	Smoky Mtn	Brig. Plains	Nipple Bench	East Clark Bench
Arrowweed	*Tessaria sericea*			x					
Banana yucca	*Yucca baccata*		x	x		x	x		
Barrel cactus	Cactaceae						x		
Beeweed (bee plant)	*Cleome* spp.			.			x		
Big sagebrush	*Artemisia tridentata*	x	x	x	x	x	x		x
Birdbeak	*Cordylanthus parviflorus*		x						
Blackbrush	*Coleogyne ramosissima*					x		x	
Bromegrass	*Bromus anamalus*		x				x		
Buckwheat	*Eriogonum* spp.		x	x			x		
Buffaloberry	*Shepherdia rotundifolia*	x	x	x	x	x	x		
Bulrush	*Scirpus* spp.			x			x		
Cheatgrass	*Bromus tectorum*			x			x		x
Chokecherry	*Prunus virginiana*			x					
Cliffrose	*Purshia mexicana*	x	x	x	x	x	x	x	
Columbine	*Aquilegia* spp.		x						
Cottonwood	*Populus* spp.		x	x	x			x	
Fir	*Abies* spp. (poss. *concolor*)		x						
Four-wing saltbush	*Atriplex canescens*					x	x	x	x
Fremont barberry	*Barberis fremontii*	x	x	x	x	x	x	x	
Galleta grass	*Hilaria* spp.								x
Gambel oak	*Quercus gambelii*	x	x	x	x		x		
Giant dropseed	*Sporobolus giganteus*								x
Globemallow	*Sphaeralcea* spp.								x
Grama grass	*Bouteloua* spp.		x	x	x		x		x
Greasewood	*Sarcobatus vermiculatus*			x					x
Greenleaf manzanita	*Arctostaphylos patula*	x	x						
Hedgehog cactus	*Echinocereus* spp.						x		
Horsetail	*Equisetum* spp.				x				
Indian paintbrush	*Castilleja* spp.		x	x					
Indian ricegrass	*Stipa hymenoides*		x	x	x	x	x	x	x
Locoweed	*Oxytropis* spp.			x			x		
Mat saltbush	*Atriplex corrugata*								x
Mest dropseed	*Sporobolus flexuosus*								x
Milkvetch	*Astragalus* spp.			x					
Milkweed	*Asclepias* spp.			x					
Mormon tea	*Ephedra* spp.	x	x	x	x	x	x	x	x
Mountain mahogany	*Cercocarpus* spp.	x	x	x	x	x	x		
Mustard	Brassicaceae			x			x		
Narrow-leaf yucca	*Yucca angustissima*	x	x	x	x	x	x	x	x
Needle-and-thread grass	*Stipa comata*						x		x
Oregon grape	*Berberis repens*	x							
Penstemon	*Penstemon* spp.		x						
Peppergrass	*Lepidium* spp.		x						
Pinyon pine	*Pinus edulis*	x	x	x	x	x	x		
Plaintain (Indian wheat)	*Plantago patagonica*						x		x
Ponderosa pine	*Pinus ponderosa*	x	x						
Prickly pear / cholla	*Opuntia* spp.	x	x	x	x	x	x	x	x
Primrose	*Primula* spp.		x	x					
Purslane	*Portulaca oleracea*		x						
Rabbitbrush	*Chrysothamnus* spp.	x	x	x	x	x	x	x	x
Ring muhly grass	*Muhlenbergia* spp.			x					
Russian thistle	*Salsola iberica*				x		x		x
Sand dropseed	*Sporobolus cryptandrus*								x
Sand sagebrush	*Artemisia filifolia*			x				x	x
Shadscale	*Atriplex confertifolia*			x		x	x	x	x
Singleleaf ash	*Fraxinus anomala*	x	x	x	x	x	x	x	
Snakeweed	*Gutierrezia sarothrae*	x	x	x	x	x	x	x	x
Snowberry	*Symphoricarpos* spp.	x			x	x			
Spike dropseed	*Sporobolus contractus*								x
Spiny hopsage	*Grayia spinosa*					x		x	
Stickleaf	*Mentzelia pumila*			x				x	
Tamarisk	*Tamarix* spp.	x	x	x	x	x		x	
Thistle	*Cirsium* spp.		x						
Three-leaf sumac	*Rhus trilobata*			x	x	x	x	x	
Timothy grass	*Phleum* spp.			x					
Utah juniper	*Juniperus osteosperma*	x	x	x	x	x	x	x	x
Utah serviceberry	*Amelanchier utahensis*	x	x	x	x	x	x		
Wild rose	*Rosa* spp. (*arizonica?*)	x							
Willow	*Salix* spp.	x	x		x				
Winterfat	*Ceratoides lanata*								x
Wolfberry	*Lycium andersonii*						x		

Sampling Strata

Collet Top

Given its distance from the coal-bearing units of Nipple and Fourmile Benches and Smoky Mountain, the Collet Top area was little studied by Murdock et al. (1974), and current information was not available from the BLM on vegetation in the NNAD survey frame. In general, it falls within the pinyon-juniper habitat type (see Figure 2.3), but with per-acre tree densities that are sometimes considerably higher than the lower benches; the understory still tends to be open and widely spaced, with few grasses. There are also fewer large, open stands of sagebrush in the units themselves, except in the western third of Unit 28, and Unit 58, which was 90 percent sage. Chaining (dating from the 1960s and 1970s), has created open sage, shrub, and grasslands in Units 35, 44, 81, and 132 (about 70 percent of the latter). In chained areas regrowth was in the form of shrubs, such as serviceberry, buffaloberry, Fremont barberry, mountain mahagony, and snakeweed, cactus (usually *Opuntia* sp.), and grasses, now heavily grazed. With the increase in elevation, occurrences of mountain mahogany, cliffrose, and scrub oak are more common.

Small riparian microenvironments are relatively common on Collet Top, which had more potable water sources, or evidence of subsurface water, than any other sample stratum (see Table 2.1). Seeps tend to emanate from the heads of canyon tributaries, and sites sometimes were clustered in these areas, though there was not a strict one-to-one correlation (sites were sometimes clustered around drainage heads regardless of current water availability). Unit 30, for example, had two active seeps in one drainage: the north seep (designated "Ponderosa Seep" by the crew) was located in a small, perhaps relic ponderosa pine forest and was surrounded by several sites; the south seep ("Grateful Seep") fed a small pool, even in a severe drought year, but no sites were situated nearby. Drainages with seeps and subsurface water supported willows, tamarisks, sumac, wild roses (*Rosa* spp.), Oregon grape (*Berberis repens*), and Gambel oak.

Horse Mountain

The Horse Mountain stratum is firmly within the pinyon-juniper habitat type of Murdock et al. (1974), again with openings of sagebrush. On the west flank of Horse Mountain is a northwest to southeast stretch of badlands with little vegetation cover. Badland exposures occur in several of the Horse Mountain survey areas, such as Units 30, 45, 68, and 75. Unit 62 is somewhat unique in that it straddles Paradise Canyon and contains riparian species, such as cottonwood, tamarisk, rabbitbrush, willow, Indian paintbrush (*Castilleja* spp.), and columbine (*Aquilegia* spp.). Much of Unit 75 is sheet washed and deflated, with sagebrush dominating meadows to the exclusion of other understory shrubs and grasses. The rest of Paradise Bench consists of pinyon-juniper woodlands with relatively sparse understory. This is also true for Unit 30 on Horse Mountain, which has very dense pinyon-juniper and little forage. Nearly half of Unit 45 consists of open sagebrush and badlands. Unit 13, at 2134 m (7000 feet), is the highest unit in the sample, and, as previously stated, is one of the few units to contain ponderosa pine (relict stands of fir also occur in several west-facing drainages). There were also many extensive areas of natural burns on the Paradise Bench portion of the stratum.

Long Flat

Murdock et al. (1974) categorized this area as rimrock pinyon-juniper and pinyon-juniper habitat types; pinyon-juniper woodlands are common to almost every survey unit. But the Long Flat stratum contains a great variety of topographic settings, from high ridges to broad washes to badlands, with associated variability in plant species observed. Unit 160 is a nearly treeless expanse centered on the washes and low dune ridges of Tommy Smith Creek and various tributaries, with riparian species such as tamarisk and bulrush (*Scirpus* spp.) present. Tommy Smith Creek also cuts through the west part of Unit 162, creating high floodplains with dense stands of tall sagebrush, tamarisk, cottonwood, rabbitbrush, and other shrubs and grasses. Wahweap Creek bisects Units 7 and 15, which contain low streamside terraces with cottonwood, tamarisk, bulrush, Russian thistle, and greasewood (*Sarcobatus vermiculatus*), but also with pinyon-juniper covering high dune ridges. Blue Wash passes through Unit 111, which otherwise consists of badland soils with sparse pinyon-juniper and shadscale understory (see Figure 2.4). Badland terrain also occurs in Units 164 and 165. Several units (7, 40, 51, 111, 155, and 164) also have intermittent to extensive exposures of Quaternary cobbles and gravels overlying ridgetops, with relatively sparse shrub and grass understory but sometimes dense stands

of pinyon-juniper. With the increase in elevation, occurrences of mountain mahogany, singleleaf ash, and cliffrose are more common.

Horse Flat

Rimrock pinyon-juniper and pinyon-juniper habitat types comprise the bulk of the Horse Flat stratum, with open stands of sagebrush, according to the Kaiparowits baseline study. As the name implies, the stratum is located upon a level bench, although several of the units are situated near the edges of more dissected rims. Murdock et al. (1974:266) considered the overstory forest to be virgin, "where trees and dead wood are little disturbed by man or fire." On Horse Flat, however, large areas had been chained during the 1960s. About 80 percent of Unit 5 and 60 percent of Unit 41 had been chained, transforming woodlands into stands of large shrubs, such as Utah serviceberry (*Amelanchier utahensis*), buffaloberry, and Fremont barberry (*Barberis fremontii*), and grasses. In unchained units, the pinyon-juniper woodland dominates, with scattered openings of sagebrush and shrubs. Grasses are not abundant (except in chained portions). Several units (15, 28, and 40) contain Gambel oak and more water-dependent plants such as cottonwood and tamarisk in drainages.

Fourmile Bench

Good vegetation information was available from the BLM for the USGS *Fourmile Bench* quadrangle, which encompassed most of the NNAD survey units for this stratum. Although specific soil and vegetation descriptions change somewhat from south (Units 51, 52, 66, and 111) to north (between Units 149 and 115), the vegetation composition is generally pinyon pine, juniper, Mormon tea, buffaloberry, cliffrose, rabbitbrush, barberry, snowberry (*Symphoricarpos* spp.), sagebrush, and various grasses.

The Fourmile Bench stratum is firmly within the pinyon-juniper habitat type of Murdock et al. (1974), interspersed with openings of sagebrush. This was a floristically homogeneous survey frame, with pinyon pine and juniper present, to a greater or lesser degree, in every unit (Units 8, 51, 52, 115, 131, and 160 were described as having "open" or "sparse" pinyon-juniper woodlands). Murdock et al. (1974:266) remarked that "all the understory species" of this habitat type, "except perhaps cactus ... are extremely hedged," i.e., grazed, by deer and cattle; this condition was also observed by NNAD crews ("all plants tend to be widely spaced with much open ground" noted one surveyor). The overstory itself was considered to be "virgin" when not disturbed by humans or fire.

The "ecotone" aspect of sagebrush stands on Fourmile Bench was noted by the Kaiparowits baseline study as well. The grass species in the understory, when present, are dominated by galleta grass and blue grama. Open sage stands were most prominent in Units 51, 66, 111, 141, and 149, which cluster in the south-central and southeast part of the survey frame. Unit 111 had sage flats with deep eolian sand, which may have been farmable; several sites, including a Pueblo habitation, were found in the vicinity. In Unit 149 sites were almost always located in two settings: on dune ridges and along sage and pinyon-juniper ecotones. Two Virgin Anasazi sites occupied opposite sides of a dune-covered saddle that separated two watersheds and overlooked a broad sagebrush expanse, clearly a congruence of several optimizing factors. In other units sites were concentrated around drainage heads, particularly those with water sources (e.g., 118 and 145).

Smoky Mountain

According to Murdock et al. (1974) the Smoky Mountain survey area grades from communities of blackbrush and spiny hopsage on the southern half of the landform to primarily juniper and rimrock pinyon-juniper habitat types to the north. No vegetation data were available for this area from the BLM, but the southern portion of Smoky Mountain is not unlike Nipple Bench, with the addition of scattered junipers. Open stands of sagebrush are scattered throughout the pinyon-juniper woodland. Murdock et al. (1974:265) reported that the sagebrush understory often consists of galleta grass and blue grama, with a preponderance of annual forbs. In some cases, the sage may act as an ecotone between the woodland and hopsage-blackbrush communities.

On the southern projection of Smoky Mountain, NNAD crews observed a landscape dominated by shrubs and grasses with scattered junipers. In Unit 97, for example, blackbrush was dominant in the western two-thirds of the unit, and sagebrush, blackbrush, and four-wing saltbush were most prevalent in the eastern third. Further north on Smoky Mountain, pinyon pine was observed, junipers became somewhat more dense, and species such as blackbrush and hopsage declined (Units 65, 66, 75, and 94). Other plants, such as cliffrose, Mormon tea, snakeweed,

buffaloberry (*Shepherdia rotundifolia*), and three-leaf sumac (*Rhus trilobata*) increased in frequency, and open sagebrush valleys were also observed. Blackbrush dominates in Unit 80, and much of Unit 63 was slickrock. Unit 1, on the far western edge of the frame, had more in common with Nipple Bench communities just across John Henry Canyon to the south, and consisted of open shadscale and blackbrush. Indeed, as mentioned in Chapter 4, knowing what we do now about the local environment, we would have drawn some of the sample frame boundaries slightly differently, with one modification being to limit the Smoky Mountain stratum to east of Wesses Canyon and the tributaries that drain Wesses Cove.

There was clear evidence of extensive natural burns on Unit 94, with charcoal-stained soil and oxidized sandstone at many site and non-site locations. Virtually no water, in the form of seeps, springs, or runoff, was observed on Smoky Mountain.

Brigham Plains

According to the Kaiparowits baseline study the Brigham Plains survey area primarily consists of the rimrock pinyon-juniper habitat type, characterized by rocky soils near the edges of plateaus. "This type is floristically rich" claimed Murdock et al. (1974:266), as "the rocky nature of the surface simulates a mosaic of microwatersheds, thereby often increasing the amount of moisture available for plant growth." Open stands of sagebrush are scattered throughout the pinyon-juniper woodland (see Figure 2.5). Murdock et al. (1974:265) reported that the sagebrush understory often consists of galleta grass and blue grama, with a preponderance of annual forbs.

On Brigham Plains the pinyon-juniper woodland co-occurs with Great Basin Desertscrub, with sagebrush being the principal understory plant. Other important associates can include rabbitbrush, winterfat, shadscale, and various grasses (depending on soil and rangeland conditions).

Within this survey stratum, the NNAD sample units consist of various proportions of pinyon-juniper, sagebrush, and other shrubs. The topography is an admixture of shaley-sandstone outcrops, ridges, benches, mesitas, drainages, canyon rims, clay badland slopes, and open sage valleys. Units 10, 18, and 25 on Brigham Plains proper have large stands of open sagebrush; grasses are sparse, with the exception of Unit 10, where numerous micro-grasslands of ricegrass and needle-and-thread are scattered within larger sagebrush valleys. Units 35, 41, and 46 are essentially pinyon-juniper woodlands with numerous shrubs and few grasses. Unit 62 is uniquely placed at the toe of Coyote Point, and thus consists primarily of barren ridges and slopes. Pinyon-juniper woodlands dominate Units 81, 98, 103, and 107 on Jack Riggs Bench, with a mostly non-sage understory of shrubs and sparse grasses.

Nipple Bench

Per BYU's Kaiparowits baseline study, the Nipple Bench survey area consists primarily of the mixed shrubs–galleta grass habitat type (on the northern two-thirds of the bench) and the spiny hopsage (*Grayia spinosa*)–blackbrush (*Coleogyne ramosissima*) type (on the southern third), with a small concentration of blackbrush on an eastern projection of the landform (seen in Units 98 and 122). These saltbush (*Atriplex canescens*)-type communities typically survive on rocky soils or soil with subsurface hardpan that causes soil moisture to quickly evaporate, stunting new growth and prohibiting the growth of many forbs, especially in dry years. In particular, blackbrush stands are so stable "that most of the plants are in a half dead condition" (Murdock et al. 1974:259); this was certainly the case during the Phase 2 survey, an especially dry year. Where soil depth and texture permit, blackbrush co-occurs with spiny hopsage, with grass species such as galleta and blue grama becoming more important (although this aspect was not observed by NNAD on Nipple Bench, probably due to grazing).

Limited vegetation data compiled by BLM range conservationists were available for the western third of the Nipple Bench survey frame. Units 3, 16, and 17 fall within soil and vegetation mapping units typified by shadscale, galleta grass, rabbitbrush, snakeweed, big sagebrush, cliffrose (*Purshia mexicana*), singleleaf ash (*Fraxinus anomala*), ricegrass and various species of dropseed; this was almost exactly what was observed by NNAD crews. Table 2.9 lists other grasses, forbs, and shrubs observed on Nipple Bench. NNAD crews also observed occasional junipers on mesa tops, particularly on the north end of the bench, as well as a blackbrush-dominant community on the southern tip of Nipple Bench in Units 118 and 126. Cottonwoods and other riparian species occur around Tibbet and Nipple Springs and other smaller seeps. In general, NNAD's observations agreed well with those of previous researchers.

East Clark Bench

According to BYU's Kaiparowits baseline study, the East Clark Bench is situated within three communities or habitat types: the northern margin of the grasslands community and the mat-saltbush (*Atriplex corrugata*) and shadscale/Mormon tea (*Ephedra* spp.) habitat types. The grasslands can include galleta grass (*Hilaria* spp.), blue grama (*Bouteloua gracilis*), ricegrass (*Stipa hymenoides*), needle-and-thread grass (*Stipa comata*), three-awn grass (*Aristida* spp.), and sand dropseed (*Sporobolus cryptandrus*). NNAD archaeologists also observed several other species of dropseed: giant (*S. giganteus*), mest (*S. flexuosus*), and spike (*S. contractus*). Perennial grasses such as ricegrass and dropseed were of especial economic importance prehistorically. The mat-saltbush habitat type is common to exposures of Tropic Shale and is typified by little diversity and several types of endemic plants, such as Tropic goldeneye (*Viguiera soliceps*). The shadscale-Mormon tea habitat type characterizes the remainder of the bench, with associated species such as winterfat, snakeweed (*Gutierrezia sarothrae*), sagebrush (*Artemisia* spp.), and prickly pear cactus (*Opuntia* spp.).

In Brown and Lowe (1983) the East Clark Bench survey area consists of both the Plains Grassland (142.1) and Great Basin Desertscrub (152.1) communities. The Plains Grassland, in this area, is composed of mixed or short-grass communities. Within Great Basin Desertscrub, the major series is dominated by shadscale.

Our own field observations demonstrated that the Kaiparowits vegetation map best represents the vegetation communities of the low benchlands. Previous survey on shale badlands within the Glen Canyon National Recreation Area (Geib 1989) demonstrated that these barren landscapes had virtually no archaeological sites. For this reason, the survey stratum on East Clark Bench purposely excluded the Tropic Shale badlands with its mat-saltbush habitat. The nine units surveyed are located within communities dominated by *Atriplex* species, such as shadscale and saltbush, and various grasses. In general, units in sandy, level, or slightly sloping areas (31, 59, and 83) are typified by grasses, such as ricegrass, dropseed, and needle-and-thread, with grazing reducing the number of useful species (although Unit 83 is less disturbed and constituted a relatively intact grassland community). Units 2, 6, 10, 33, 69, and 76—located in more dissected terrain with washes and badlands—are typified by shadscale, mat-saltbush, snakeweed, Mormon tea, sparse grasses, and invasive species such as Russian thistle (*Salsola iberica*) and cheatgrass (*Bromus tectorum*). Unit 76 has a small riparian section along Wahweap Creek with several species of dropseed.

Archaeological Implications

One of the advantages of a benched, "staircase" landform such as the Kaiparowits Plateau is the variety of vegetation communities, habitats, climate zones, and water sources available within a relatively constricted space. Within 1–2 day's walk one could have traveled from lush grasslands on the lowest benches to dense pinyon pine forests in the highest reaches, with commensurate changes in associated flora and fauna. Foragers could also have staggered their harvests by moving up in elevation as plants ripened in turn. Foraging for ricegrass and dropseed, for example, was probably most fruitful on East Clark Bench, Nipple Bench, and perhaps the southern half of Smoky Mountain, with cool-season grasses such as ricegrass ripening first on East Clark in late spring. In fact, the lower benches would have harbored the first maturing "starvation foods" such as cacti, roots, and spring greens, which are especially important as stored foodstuffs ran out near the end of winter. During the summer warm season grasses such as dropseed would have become important, plus ripening cactus fruits and Cheno Ams. All of these plant remains were identified in macrobotanical samples from tested Formative and Post-Formative sites on the plateau (see Chapter 5). The upper benches, where woodlands transition from juniper to pinyon pine, provided pinyon nuts (in "good" years), juniper berries, yucca fruit, and other staples in early to late fall. The substantial Formative settlement that NNAD recorded on Collet Top may have been related to the availability of pinyon nuts (for a possible example of this kind of relationship see Sullivan 1992), although it seems more likely that inhabitants were taking advantage of a dry-farming zone with decent supplies of domestic water. It is not known if Formative populations over-wintered on the Kaiparowits, but hunter-gatherers, such as the Paiute, apparently returned to lower elevation winter camps by the end of autumn.

CHAPTER 3

PREVIOUS RESEARCH AND CULTURE HISTORY

Several large-scale cultural resource inventories have been conducted either on the Kaiparowits Plateau or in immediately adjacent areas. The first section in this chapter summarizes the history of archaeological research on or near the plateau. Each project is discussed in approximate chronological order. Although we acknowledge here the early exploratory work of Judd (1926), Morss (1931), Steward (1941), Beals, Brainerd and Smith (1945), and others, this section emphasizes what Hauck (1979:104) called "salvage ... and industrial development archaeology" that began with the Glen Canyon Project in the late 1950s and early 1960s. This tradition continued throughout the 1970s and 1980s in response to proposed coal development in southern Utah, and CRM work related to Glen Canyon's new role as a national recreation area. The section ends with a summary of NNAD's recent sample survey of the Big Water Trust Land Block on East Clark Bench. And, because it is central to NNAD's work on the Kaiparowits Plateau, but was never reported, we include a more detailed summary of the Museum of Northern Arizona's work for the Kaiparowits Power Project in the mid 1970s. The second section of this chapter is a summary of the culture history of the region, with findings from projects relevant to specific time periods. This section emphasizes Native American history of the area; for a description of Euro-American settlement and development see Chapter 9.

PREVIOUS RESEARCH

Glen Canyon Project–Kaiparowits Plateau

Between 1956 and 1963 the University of Utah (U of U) and the Museum of Northern Arizona (MNA) conducted extensive cultural resource inventories and excavations in the Glen Canyon region of the Colorado River in northeastern Arizona and southeastern Utah (Jennings 1966). The project was part of a multidisciplinary study of the cultural and natural history of the canyon that would be largely flooded by the impounded waters of the proposed Glen Canyon Dam. Although work was conducted throughout the canyon and adjacent uplands (including Harris Wash [Fowler 1963]), of particular interest here are the U of U investigations into the prehistory of Fiftymile Mountain (what Fowler and Aikens [1963] called the "Kaiparowits Plateau"). Small-scale surveys were conducted on Fiftymile Mountain by Jennings in 1951 and Jennings and Lister in 1957 (mentioned in Lister 1958). A more intensive sample survey was performed in 1958 in the central portion of the plateau (Gunnerson 1959a), followed by additional work on foot and horseback in unsurveyed areas to the northwest and southeast in 1961 (Aikens 1963). Although the intensity and coverage of the above-mentioned surveys varied, all were essentially unsystematic reconnaissance forays.

Out of a pool of some 300 known sites, 11 were selected for either testing or complete excavation in 1961 (Fowler and Aikens 1963). The sites chosen for excavation were all architectural habitations, generally with one or two rooms, although one site (Three Forks Pueblo, 42KA331) could be classified as a small pueblo. Of the sites recorded in 1961, all but one had a preponderance of what were classified as Kayenta Anasazi ceramics. Fremont and Virgin Anasazi types were often found intermingled with Kayentan ceramics, but in lesser frequencies. On the basis of the ceramic evidence, Lister (1962) concluded that the plateau was occupied by Puebloans only during Pueblo II and early Pueblo III; the surveys revealed no particular Archaic or Basketmaker II–III occupation, and only sporadic use by subsequent Ute–Paiute populations. The research focus of the Glen Canyon Project was Puebloan prehistory, however, and open, preceramic sites were simply not investigated with the same rigor; more recent research has detailed extensive use of the canyons and uplands by preceramic hunter-gatherers and early farmers (see Geib [1996] for an overview.)

Navajo-McCullough Transmission Line

During 1972–1973, MNA archaeologists surveyed the right-of-way for a 500 kV transmission line from the Navajo Generating Station at Page,

Arizona, to the Nevada border southwest of St. George, Utah. The line continued south to the McCullough switching station near Boulder City, Nevada, but this portion of the line corridor was surveyed by the Nevada Archaeological Survey. Moffitt, Rayl and Metcalf (1978) reported the results of the MNA survey and subsequent excavations.

The MNA part of the line was divided into six named segments. The Cedar Mountain and Buckskin divisions were the first two segments west of Page. The Cedar Mountain Division roughly paralleled the Paria River, running between it and State Highway 89a along a northwest bearing into Utah. The line then turned southwest within the Buckskin Division as it crossed Buckskin Mountain and returned to Arizona. These two segments are just outside the Kaiparowits Plateau study area to the south and southeast. Sites associated with the two segments were typified by nonpermanent seasonal residences and logistical camps.

Sixty-two sites were recorded during the Navajo-McCullough Project, of which 32 were partially or fully excavated. Several cultural traditions were identified, but the project's greatest contribution is in the number of Southern Paiute sites recorded and investigated. Data from the project were also used to generate site density and type estimates for the transmission line corridors proposed for the Kaiparowits Power Project (see below), which would have largely paralleled the Navajo-McCullough line.

Kaiparowits Power Project

The Kaiparowits Power Project (KPP) was an attempt in the mid 1970s to generate electrical power from known coalfields in the south-central portion of the Kaiparowits Plateau. The project was financed by a consortium of three Arizona and California utilities: Southern California Edison Co. (acting as lead agency), San Diego Gas and Electric, and Arizona Public Service. MNA was contracted to conduct cultural resource inventories at various levels of intensity within a 2300 sq mile study area. Most of the work occurred during the summer of 1974, but it continued intermittently through 1975. In the spring of 1976, the two California utilities pulled out of the project, citing increased costs; APS withdrew thereafter, as it was unable to fund the undertaking on its own. With the collapse of the project, archaeological work ended as well.

MNA's archaeological effort had five phases: (I) field survey and reconnaissance to help determine suitable facility locations; (II) additional survey when specific locales had been identified; (III) major excavation in areas of direct impact; (IV) completion of reports for clearance recommendations; and (V) completion of final report. MNA produced a preliminary report on its Phase I findings (Fish n.d.), and a number of interim, progress, and final reports on various aspects of the KPP survey and related projects (e.g., Bradford 1974; Davidson 1975; Hunt 1974, 1975a, 1975b, 1975c, 1975d; Lindsay 1974; Zier 1974a, 1974b; Zier and Davidson 1974). Phases II through V were never completed.

During Phase I, the MNA team used several investigative methods to determine potential impacts in the project area. Each method was oriented toward a different physical component (e.g., coal fields) or facility (e.g., power plants) in the project area. The methods consisted of (1) a "simulation approach" to identify cultural resources along proposed transmission line corridors; (2) archaeological survey in the areas of two proposed power plants and a coal mining and processing area; and (3) archaeological survey in areas of related facilities and support structures, such as drill holes, coal conveyers, water lines, access roads, borrow pits, and aggregate sites.

Simulation Approach for Transmission Lines

Two transmission line corridors were originally proposed to serve the Kaiparowits Power Project: the Moenkopi–Lake Mohave and Kaiparowits-Eldorado 500 kV lines. Later in the project, MNA was directed to investigate an alternate corridor to the Moenkopi–Lake Mohave line (Fish n.d.). All three of the proposed corridors largely paralleled the existing Navajo-McCullough transmission line which MNA had worked on previously (see Moffitt, Rayl and Metcalf 1978). Using data collected during the Navajo-McCullough study, MNA constructed "a predictive model utilizing an ecological approach" to estimate site densities and site types within the newly proposed corridors (Fish n.d.:131).

The proposed corridors for the new lines were divided into 2-mile segments for evaluation purposes. The propensity for human use of each segment was estimated based on five environmental variables: presence of arable land, rainfall, growing season, water potential, and elevational diversity. Each unit was given "a relative rating of archaeological sensitivity based on a score derived from ... all variables considered together" (Fish

n.d.:137). Units were grouped into three levels of sensitivity: low, moderate, and high. The predictions were then tested via on-the-ground field reconnaissance of selected corridor areas (Hunt 1975c). The result was that "a tentative confirmation of the segment ratings ... seem[ed] to be indicated" (Fish n.d.:148).

Archaeological Survey

Coal from the Kaiparowits fields was to be converted into electricity at two nearby power plants: the Nipple Bench plant and the Fourmile Bench plant. These facilities were never constructed, but during the summer of 1974 MNA performed what was termed "intensive" archaeological surveys at each plant site area, including half-mile "buffer zones" (Figure 3.1; Fish n.d.). Because of low vegetation and greater visibility, crew members were spaced 150 to 200 yards apart during the Nipple Bench survey. On the more heavily wooded Fourmile Bench, transect width was reduced to 100 yards, but even this proved problematic; the dense vegetation "rendered communication difficult ... and visual contact nearly impossible" (Fish n.d.:110). With survey intervals this wide the effort is more correctly termed reconnaissance survey (see comparison of MNA and NNAD results at the end of Chapter 4). Fifty-two sites were recorded within the plant site boundaries, plus another 34 sites within the buffer zones. The Fourmile Bench site had 20 percent more sites than Nipple Bench, but the latter had more "substantial" resources, including sheltered sites (Fish n.d.:121). Most of the sites recorded from both surveys were lithic scatters or lithic campsites.

The other survey that MNA conducted was for the proposed coal mine area and related facilities (see Figure 3.1). This survey, which took place in August of 1974, was never reported; there is some documentation available in the MNA archival files, including site forms and a map of the survey area with site plots. There is no information on survey methods, but presumably it was similar to that conducted for the power plant locations. The survey was divided into three discontinuous blocks situated on John Henry Bench and a portion of the Smoky Mountain benchland east of North Branch Creek. The survey blocks encompassed areas reserved for tailings and clear water ponds, a refuse dump, coal storage and washer sites, water tanks, a conveyer line, and coal mining areas. Twenty-nine sites were recorded, primarily lithic scatters of unknown affiliation, although several rockshelter sites were also observed. The majority of the sites were located in the coal mine area, clustered around the head of a Warm Creek tributary.

Reconnaissance and Point-Specific Survey

The remainder of the MNA's fieldwork for the KPP consisted of reconnaissance-level and point-specific survey of related facilities, performed intermittently through 1974 and 1975. Several of these studies were conducted for Southern California Edison Co., and others were carried out at the request of various energy and resource extraction firms affiliated with the Kaiparowits Power Project. Drill hole and associated access road survey was conducted for the Resources Company (Keller 1974; Davidson 1974), El Paso Natural Gas Company (Bradford 1974; Zier 1974a), El Paso Energy Resources Company (Hunt 1975b), Kaiser Engineers (Davidson 1975; Hunt 1975d; Keller 1976), and Southern California Edison (Zier 1974b). Additional drill hole and road right-of-way survey was conducted within the Nipple Bench and Fourmile Bench plant sites for Southern California Edison (Hunt 1975a; Zier and Davidson 1974). Hunt (1974) also conducted archaeological investigations in proposed aggregate source areas north of Fourmile Bench.

As part of the Phase I process, MNA also investigated "the 2300 sq mile impact study area not physically affected by construction" (Fish n.d.). This portion of the study was conducted in three ways: (1) an "aerial overview of the region," (2) an "intensive survey of the existing literature," and (3) "an examination and synthesis of survey records in institutional and governmental files" (Fish n.d.:74–75). The aerial survey was accomplished using a helicopter provided by Southern California Edison; the crew spent 2 days getting a feel for the "environmental diversity and kinds of human resource potential." A few promising areas were selected for "foot" reconnaissance, with evidence found "for a variety of sites" (Fish n.d.:76). The literature and institutional file search generated information on more than 600 sites in the impact study area, although most of these sites are located on Fiftymile Mountain.

Southern Coal Project

In 1977 and 1978 the Archaeological-Environmental Research Corporation (AERC) under contract to the BLM conducted a cultural resource survey of the Southern Coal Project (SCP) in south-central Utah to "correlate the cultural data base with the adverse impact potential related to

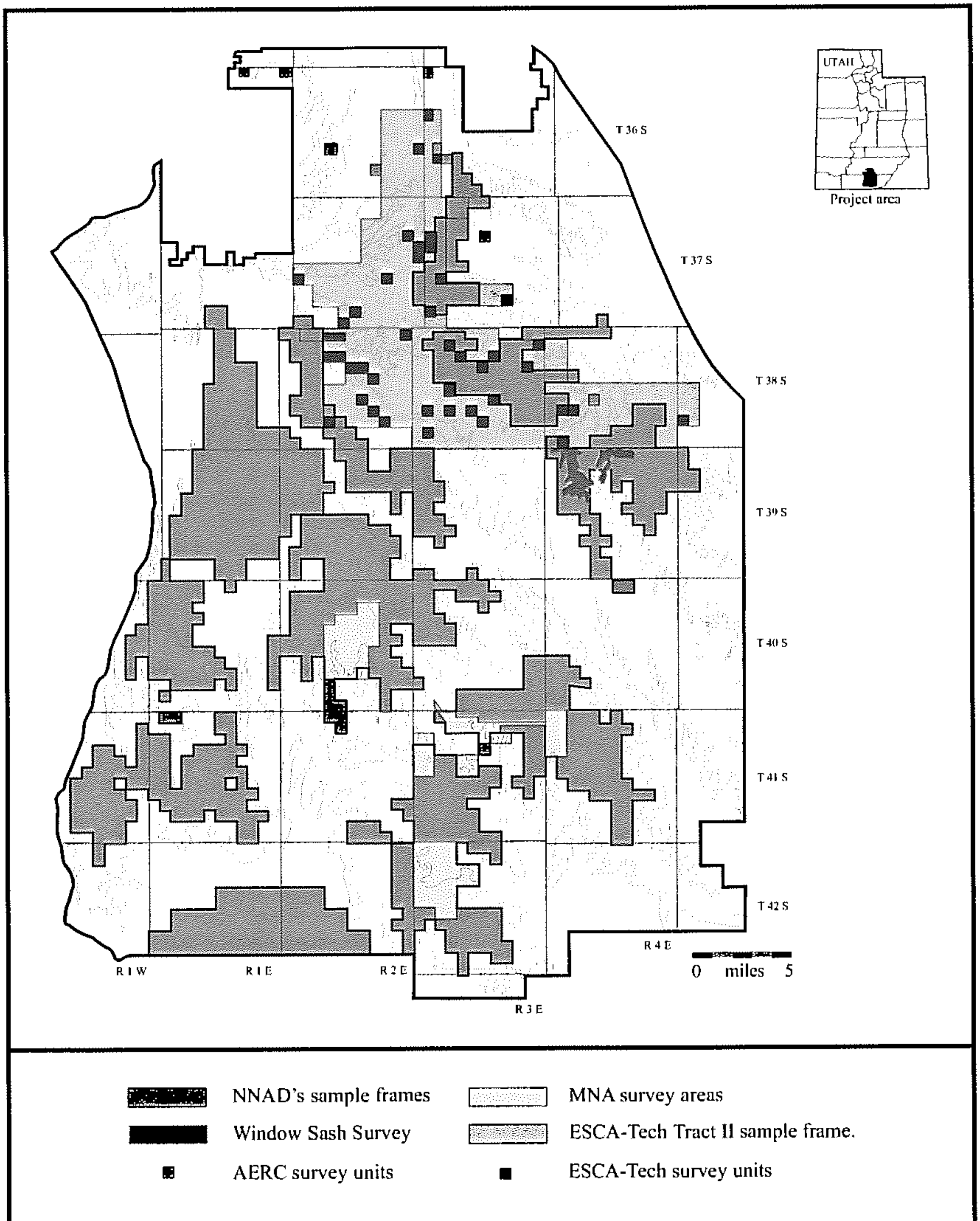


Figure 3.1. Previous block surveys of the Kaiparowits Plateau study area and NNAD's sampling frames.

the development of the coal mining industry in the project area" (Hauck 1979:1). The project area consisted of 10 planning units on Bureau of Land Management and U.S. Forest Service lands—a total of about 2,981,000 acres. The SCP was segmented into two research stages: a Class I survey of previously recorded sites from the project area and a Class II inventory of on-the-ground cultural resources. Of the 10 planning units, portions of three units are located within or near the Kaiparowits Plateau Survey area: Escalante, Paria, and Paunsaugunt-Sevier. The Escalante planning unit covered Fiftymile Mountain and Collet Tops and the Paria planning unit encompassed much of the remainder of the Kaiparowits Plateau west to the Paria River and south to the state line. Only a small part of the Paunsaugunt-Sevier planning unit encroaches into the Kaiparowits Plateau study area.

The Class II survey area consisted of a 1 percent sample—stratified by vegetation type—of the project area. The sample amounted to 168 quarter sections, for a total of 27,680 acres. The sampled areas produced 348 cultural sites. Of the three planning units considered here, only the Escalante and Paunsaugunt-Sevier units were sampled during the Class II survey, not the Paria unit. Seventy-two quarter sections were surveyed in the Escalante planning unit, including several units on Collet Top and Fiftymile Mountain. Of the 199 newly recorded sites, most were lithic scatters and temporary camps. Most of the handful of survey units in or near the Kaiparowits Plateau study area contained no sites; a few units contained single lithic scatters. The surveyed sample units actually within the Kaiparowits Plateau study area are shown in Figure 3.1.

The Southern Coal Project instituted one of the most wide-ranging sample surveys of any cultural resource inventory in southern Utah. Nevertheless, Hauck (1979:329–330) concluded that the survey "failed to adequately sample the full range" of environmental variables and "differing cultural-environmental adaptive strategies" in the project area, a failure attributed to a "generalized emphasis on vegetation" and the "biased nature of the sample area designations as ... initially delineated by the Forest Service." Hauck (1979:330) also suggested that the 1 percent sample level was "below the level of confidence for developing any statements" and that the survey would have benefited from a problem-oriented research design.

The Cockscomb Project

In 1979 the Utah Power and Light Company proposed upgrading the Glen Canyon to Sigurd, Utah transmission line from 230 kV to 345 kV, necessitating a cultural resources inventory along the existing right-of-way. The line began near Page, Arizona, passed southwest of Glen Canyon City, crossed the Paria River, followed the Cockscomb east of Henrieville, and then paralleled Johns Valley and Otter Creek to its final destination at the Sigurd substation in central Utah. The University of Utah Archaeological Center discovered 23 prehistoric sites within the right-of-way (Simms 1979). In 1980, the center excavated the Gnatmare Site (42Ka1978), a Virgin-Kayenta Anasazi PII–III "horticultural homestead" midway up the Cockscomb along Cottonwood Creek (Metcalfe 1982). Additional testing and surface collecting was conducted at nine other sites in 1980 and 1981. The Glen Canyon–Sigurd corridor lies along the west and southwest margins of the Kaiparowits Plateau Survey area. Site types were similar to those found during the Navajo-McCullough transmission line survey, with camps and lithic-sherd scatters predominating.

Alton Coal Project

The Alton Coal Project (ACP) is actually located some distance west of the Kaiparowits Plateau Survey area, but deserves mention as one of the largest intensive inventories in southern Utah. The project area was south and southeast of the community of Alton, among the "low mesas and benchlands in the Gray Cliffs area, following exposures of the ... Dakota and Tropic Shale formations in a broad area south and west of the Pink Cliffs" (Keller 1987:8). As was the case in other cultural resource surveys in this part of Utah, the project was conducted in anticipation of coal mining and related development, in this case by Utah International, Inc. The Museum of Northern Arizona under contract to the BLM conducted an intensive inventory of cultural resources in a 19,000-acre permit area.

Work began in 1979 and 1980 with a 7325-acre survey of two parcels, a coal preparation plant site, and associated haul roads. Archaeologists recorded 107 sites, with all but one comprising surficial artifact scatters with few features. "These sites have been interpreted as relating to a seasonal hunting-gathering subsistence strategy during the summer-fall months, with an emphasis on

hunting game, especially mule deer and jackrabbits" (Halbirt and Gualtieri 1981:viii). The investigators also detected a relationship between topography and hunting–mixed subsistence site types, and a difference in the locations of Archaic and Paiute sites "related to the efficiency of hunting weapons" (1981:64). The report is notable in that it advanced some behavioral explanations based on the empirical evidence generated.

Several years later MNA returned to the ACP permit area to survey another 12,500 acres, resulting in the documentation of 103 additional sites. Although not a random sample, the findings were still considered to be useful "as a management tool to predict site type densities and locations in adjacent unsurveyed areas" (Keller 1987:36). Again, most of the sites were artifact scatters with few domestic structures, although numerous hearths and roasting pits were present. "Prehistorically, the area appears to have been a hunting and gathering resource zone of major importance," with sites reflecting Archaic, Virgin-Western Anasazi and Southern Paiute use (1987:1). Keller's 1987 report is highlighted by a summary of research issues for each cultural group suggested by the Alton survey data.

Escalante Project

In 1980 and 1981, the threat of coal development initiated yet another large Class II sample survey of BLM and Forest Service administered lands. The survey was conducted within three study tracts in south-central Utah (Kearns 1982). Dubbed the Escalante Project, it consisted of an unstratified 10 percent random sample drawn from 149,920 acres, amounting to 95 quarter-section sample units (15,200 acres). The project was conducted by the ESCA-Tech Corporation of Albuquerque, New Mexico, under contract with the BLM. The survey recorded 258 sites within the sample units and another 72 sites located outside these but within the sample universe, for a total of 330 archaeological sites.

Of the three study tracts, Tract II is located in the northern portion of the Kaiparowits Plateau study area, south of the community of Escalante. Tract II straddles the boundary between Kane and Garfield Counties, bounded by Coal Bed Canyon to the north, the Straight Cliffs to the east, and Canaan Peak to the west. The tract totaled 73,600 acres and contained 46 quarter-section sample units (see Figure 3.1). As such, it was the largest of the tracts and contained the greatest number of sample units; it also had the greatest number of sites and a site density higher than Tract I but lower than Tract III. Kearns (1982) reported that 120 sites were recorded in Tract II, representing 134 components. Of these components, the vast majority were Archaic or unknown affiliation (n = 112), with a few Fremont-Anasazi, Paiute, and historic components noted. For the project as a whole, 87.5 percent of the sites were aceramic lithic scatters; this was true for Tract II as well. The tract had a higher proportion of Archaic sites than expected, but a "startling" lack of Kayenta Anasazi and Fremont sites.

Tar Sands Project

In 1983, P-III Associates completed a cultural resource inventory of three separate study tracts in southeast Utah (Tipps 1988). The work was conducted for the BLM as part of an environmental impact statement concerning tar sands development in the region. Of the three study tracts (Circle Cliffs, San Rafael Swell, and White Canyon), the Circle Cliffs tract is closest to the Kaiparowits Plateau, lying to the northeast on the opposite side of the Escalante River drainage. About 27 square miles were surveyed for the entire project, with crews documenting 166 previously unrecorded sites. In the 50,300-acre Circle Cliffs tract, two 5 percent samples totaling 30 quarter sections were surveyed, resulting in the recording of 54 prehistoric and historic sites. Forty-three of the 54 sites were not identified as to any time period or culure group; the rest were primarily Archaic sites. The absence of Anasazi sites was attributed to "the ubiquity of poor residual soils and the general lack of arable land" (Tipps 1988:138). For these reasons, "if the Anasazi used the Circle Cliffs study tract, it was for ... hunting, gathering and resource procurement rather than long-term habitation." It is worth mentioning that a cluster of Anasazi habitations in the north portion of the Circle Cliffs (Janetski and Talbot 1998; Douglas McFadden, personal communication 2001) indicates more intensive use in select areas of this region.

A distinguishing feature of the study was the development of two site location models to predict site presence or absence in each of the Circle Cliffs and San Rafael tracts. The first model—a multivariate discriminant analysis of map-readable variables—was considered "extremely successful" at predicting whether a quadrate in the study tracts would have no sites, one site, or two or more sites (Tipps 1988:133). The second model—using Landsat imagery data—was judged less successful, and was thus less useful for management

purposes. Although the modeling approaches may have utility beyond the Tar Sands Project area, the results of the modeling, as applied, are specific to the Circle Cliffs and San Rafael study tracts.

Lower Glen Canyon Benches

Northern Arizona University conducted numerous archaeological surveys throughout the Glen Canyon National Recreation Area in the late 1980s. Of relevance to this report was a sample survey of four broad, flat benches on the north side of Lake Powell bordering the southeast edge of the current study area (Geib 1989). These benches are next-to-lowest in a series of giant steps that extend down from the Kaiparowits Plateau highlands on the north to the Glen Canyon gorge of the Colorado River on the south. Grand Bench, the easternmost feature, delimited the eastern extent of the project area; to the west are Sit Down Bench and Romana Bench. The westernmost bench of the project area has no proper name, but was designated Lone Rock Bench in Geib (1989).

A principal goal of the Lower Glen Canyon Benches survey was to understand where sites were located and what types of sites were located in which areas. The modeling approach focused on general site location—understanding why an environmental zone was occupied rather than a geographic point. Modeling site locations on this basis required partitioning the study area into environmental zones that might have conditioned prehistoric use, non-use, and type of use. The best environmental data available for modeling purposes consisted of soil units defined by the Soil Conservation Service. Because soil properties are important determinants of plant growth, the units provided a proxy measure for primary production in the ecosystem. The difference between expected and observed site frequencies per soil unit revealed the extent to which soils directly or indirectly influenced site distributions.

To this end, a simple random sample of 16 quarter sections was drawn from a sample frame of 292 160-acre blocks (1/4 sections), or 46,720 acres, to provide a 5.5 percent sample. Intensive survey of the 16 units resulted in the documentation of 61 sites, reflecting use from the Early Archaic through the Late Formative period (ca. 7000 B.C. to A.D. 1300). Geib (1989:61) concluded that during the roughly 8000 years of human occupation, the Lower Glen Canyon Benches area was used by "small groups that moved frequently and did not reside there on a yearly basis. The benches were probably used for gathering wild seeds ... and for hunting large and small animals. The basic use of the area as a resource extraction zone did not change appreciably through time; what may have changed was the organization of such extraction tasks."

The modeling analysis revealed that sites *were* differentially distributed on the Lower Glen Canyon Benches according to soil units. The relationship between soil unit properties and site frequencies appeared to reflect how these properties influenced the availability of crucial subsistence resources. Another factor was how the four benches fit into a regional pattern of settlement organization: "Highlands of the Glen Canyon region were the centers of permanent occupation during most of the Formative period. Nevertheless, subsistence resources of the mid-elevation benches were important to the survival of these highland populations; consequently, groups were continually traveling to the midlands for specific extractive purposes" (Geib 1989:62).

As an example, Grand Bench is situated close to the Kaiparowits Plateau highlands and has a direct, easily negotiated access route to this area. As such, it received considerably more prehistoric use than the other three benches. The findings of the Lower Glen Canyon Benches survey are quite similar to the survey results of the Navajo-McCullough Transmission Line (Cedar Mountain and Buckskin divisions). It is interesting to note that members of the Kaiparowits Plateau Project deemed this region "the least promising in potential for prehistoric human occupation" (Fish n.d.: 76). Viewed in terms of permanent occupancy, this is probably correct, but it now appears that this area had its own relative value as a resource extraction zone for highland residents.

Glen Canyon to Paria Powerline Upgrade

In 1989 the Nielson Consulting Group (NCG) conducted an archaeological inventory of the existing Glen Canyon to Paria 69 kV powerline for Garkane Power Association (GPA). The survey was implemented because GPA planned to upgrade the line to 138 kV status. The 38-mile upgrade extended from Glen Canyon Dam, near Page, Arizona, to the Paria substation near U.S. 89, Kane County, Utah. Results of the Arizona portion of the survey were reported in Nielson (1993a), and the more extensive Utah portion was detailed in Nielson (1993b). In addition, a proposed alternative line was surveyed from the Cockscomb, over

the Buckskin Mountains, to a new substation location; this was reported separately in Nielson (1989).

Fifty-nine sites were recorded within the Utah portion of the line. Little summary data concerning the sites are available in tabular form. The majority of the sites are lithic scatters of unknown cultural affiliation, but a number of Anasazi sites and a few historic camps were recorded as well. Three features that would be impacted by a new access road were tested at site 42KA3426. The features were defined as roasting or cooking hearths. Each feature was radiocarbon dated, yielding calibrated midpoints of A.D. 1420, 1430, and 1820, suggesting either Paiute or Navajo affiliation. The dates are of interest considering the similar results obtained by MNA during the Navajo-McCullough Project.

Big Water Trust Land Block

In May of 2000, NNAD conducted a sample survey and reconnaissance of archaeological resources within the East Clark Bench portion of the Big Water Trust Land Block, located near the community of Big Water (Collette and Spurr 2001). The land block is administered by the Utah School and Institutional Trust Lands Administration in Salt Lake City, and was received (along with other parcels and money) in exchange for ca. 180,000 acres of former school trust land within the Grand Staircase–Escalante National Monument (GSENM).

NNAD-NAU conducted a simple random sample survey, using 160-acre quarter-sections as observation units. Ten units (1600 acres, 648 ha) were randomly selected from a sample frame of 121 units (ca. 8% of the total acreage under consideration). Following this, NNAD personnel conducted a week-long reconnaissance of judgmentally selected areas within the east half of the sample frame, targeting geologic and topographic settings with the potential for habitable rockshelters and rock art panels. Thirty-three archaeological sites were recorded within the 10 observation units and another four sites were recorded during the reconnaissance, for a total of 37 newly discovered sites. Most of the sites were open lithic scatters.

The survey identified prehistoric remains dating from the Archaic period (ca. 8000–1000 B.C.) to the Pueblo II Formative period (ca. A.D. 1050–1150), and perhaps the Post-Formative period (ca. A.D. 1300 to the mid-late 1800s). Sites of "unknown" affiliation were most numerous (n = 22), followed by 11 sites with known or suspected Archaic–BMII artifact assemblages. Two sites had ceramics that indicated a Formative-Virgin Anasazi affiliation, and one site may date to either the Formative or the Post-Formative period. The historic site and two historic components consist of trash scatters from short-term camps, probably related to livestock herding in the first half of the twentieth century.

All Native American culture groups appear to have used East Clark Bench principally for hunting and foraging, with most sites oriented toward some form of processing. Ground stone (grinding slabs and manos) and expedient cobble tools were the most common tool types or classes observed, which suggested two kinds of basic processing: milling of grass seeds, and processing of animal parts, such as hide working. Sites appeared to concentrate near drainages that provided water and alluvial cobbles for stone tools, bedrock outcrops that afforded ground stone raw material, and stands of grass.

CULTURE HISTORY

The following culture history is divided into six general periods: Paleoindian, Archaic, Early Agricultural, Formative, Post-Formative, and Euro-American. We briefly discuss the defining characteristics and temporal range of each period, as generalized from data across the Colorado Plateau. We then summarize the archaeological evidence from three of the previously discussed large projects (Southern Coal, Escalante, and Kaiparowits Power projects) conducted within or near the Kaiparowits Plateau Survey area.

Paleoindian

The first Native American occupation of the study area probably occurred during the Paleoindian period at the late glacial Pleistocene-Holocene boundary (ca. 11,500 B.P. to 9000 B.P.). The term "Paleoindian" is often used interchangeably to mean both a lifeway and a time period. As a lifeway, Paleoindians have traditionally been defined as big-game hunters with distinctive projectile points and large mammal associations. These Paleoindians subsisted primarily by hunting large, now extinct herbivores such as mammoths, horse, camel, and bison. The extent to which plants supplemented the diet is uncertain both because this early time period is known mostly from kill sites rather than base camps and because of poor botanical preservation. Paleoindians likely lived in small nomadic family groups, traveling often in search of game. In the northern Colorado Plateau, this big-game hunting lifeway probably

did not persist much past 10,000 B.P.; by 9000 B.P., inhabitants were clearly following an Archaic pattern of fairly broad spectrum foraging (Geib 1996; see also Schroedl 1991).

No sites with *unequivocal* evidence of Paleoindian occupation have been discovered in or around the project area, especially no Paleoindian artifacts in association with extinct fauna. In fact, only a few Paleoindian sites have been documented anywhere on the Colorado Plateau (Schroedl 1991). Recently excavated sites in Utah with Paleoindian assemblages include the Lime Ridge Clovis site (Davis and Brown 1986; Davis 1989), the Montgomery Folsom site (Davis 1985), the Hell 'n Moriah Clovis site (Davis, Sack and Shearin 1996), and site 42Md300 (Simms and Lindsay 1989). Paleoindian assemblages have also been found at Danger Cave (Jennings 1957), Hogup Cave (Aikens 1970), and the Silverhorn site (Gunnerson 1956). There have been several surface finds of isolated Clovis and Folsom points in northeastern Arizona (e.g., Morris 1958; Ayres 1966; Geib 1995), but "no intact early-period Paleoindian sites with stratified deposits" are known (Hesse, Parry and Smiley 1996:2). There is a curious lack of post-Folsom evidence for this region, with the notable exception of the Badger Springs site south of Navajo Route 16 and State Highway 98 in Arizona. The Badger Springs assemblage, which was surface collected by MNA archaeologists, includes Plano-like projectile points (Hesse, Parry and Smiley 1996).

The most ubiquitous evidence for an early Paleoindian presence consists of the numerous fluted projectile points recovered as isolated surface finds throughout southern Utah (Copeland and Fike 1988; Schroedl 1991). Copeland and Fike (1988) summarized the data on 43 Clovis and Folsom projectile points from 40 locations within Utah. Sixty-two percent of the points were from the southeast quarter of the state. Several additional points have been reported by Schroedl (1991) and Kohl (1991). None of the above finds, however, are from within the study area.

Archaic

The Archaic is generally viewed as a hunting-gathering lifeway that developed after the extinction of the Pleistocene megafauna and the evolution of post-glacial environments. During this time, plant gathering and hunting of smaller fauna took on increased importance. Point types and other aspects of material culture differ markedly from the preceding Paleoindian period. Based on dated occupations from surrounding regions (e.g., Geib 1996), the Archaic period in the project area probably extended from about 9000 to 2000 B.P., at which time corn and squash were introduced to the region. On the scale of the Colorado Plateau generally, crops first started to be used shortly before 3000 B.P. The preceramic interval during which crops were initially used is accorded separate treatment as a temporal period, herein labeled the Archaic-Formative transition. The Archaic period is commonly partitioned into three intervals—early, middle, and late—each of which has an assemblage of distinctive projectile point types. There are also point types that span these intervals.

Archaeological Evidence

The cultural-historic framework applicable to Archaic remains in the study area is one derived from stratigraphically controlled excavations at various caves and shelters in Utah and northeastern Arizona (e.g., Ambler 1996; Geib and Davidson 1994; Janetski, Crosland and Wilde 1991; Jennings 1980; Jennings, Schroedl and Holmer 1980; Lindsay and Lund 1976; Winter and Wylie 1974). These types of sheltered settings occur less frequently in the project area, and none have been excavated for Archaic remains. At this time we are dependent on survey-level data of open sites to infer patterns of Archaic use. The following projects have reported Archaic sites or components:

Southern Coal Project. The Class I survey conducted by the Archaeological-Environmental Research Corporation (AERC) documented six Archaic sites in the Paria planning unit out of a total of 354 sites (Hauck 1979:128, 130); this unit roughly corresponds to the western two-thirds of the Kaiparowits Power Project study area. No Archaic sites were noted for the Escalante planning unit, which includes Fiftymile Mountain. Although no summary statistics are available for the Class II survey concerning cultural-temporal affiliation, it appears that three Archaic sites were recorded in the Escalante unit. The Paria planning unit was not included as part of the Class II inventory.

Escalante Project. During a Class II cultural resource inventory by ESCA-Tech, 51 Archaic "components" were recorded out of a total of 134 in the Tract II sample unit (Kearns 1982:244), part of which is situated in the northernmost corner of the Kaiparowits Power Project area. Of the three sample units surveyed, Archaic sites were best

represented in Tract II. All Archaic periods (early, middle, and late) were represented in Tract II, although most sites were typed "undetermined Archaic" due to their association with Elko-style projectile points, which are poor temporal diagnostics (Holmer 1978, 1986).

Kaiparowits Power Project. The KPP database is difficult to tabulate regarding cultural or temporal affiliation from any period, as no summary statistics are available in the preliminary report (Fish n.d.). The report states that "no sites in the impact area have been positively identified as either Paleoindian or Archaic, [although] there are a number of possible candidates" (Fish n.d.:80). Intensive surveys for the Nipple Bench and Fourmile Bench power plant sites revealed numerous lithic scatters and "lithic campsites." A dry cave on Nipple bench (NA12,858), considered to be "the most significant archaeological site in... the area," contained lithic and perishable items that might be affiliated with a preceramic component. Another "15 known shelters have only lithic artifacts on the surface" (Fish n.d.:81), also suggestive of Archaic or Basketmaker II occupations.

Archaic-Formative Transition

To provide a conceptual break between the Archaic and Formative periods, Huckell (1995) advocated using the term "Early Agricultural period" as a label for the interval during which agriculture was first practiced but ceramics were not yet in use. In the Four Corners region this period is frequently referred to as Basketmaker II, but because this term has different meanings to different people, a more neutral label seems advisable. For this report we use the term "Archaic-Formative Transition" to designate the period when farming began to be practiced but pottery was not yet used. The beginning of this period is dependent upon the dating of domesticates. It is now well established that corn dates to at least 1200 cal. B.C. across the southern Colorado Plateau (Gilpin 1994; Matson 1991; Smiley 1994; Wills 1988). No domesticates are yet known to have this antiquity on the northern Colorado Plateau or north of the Colorado River in Utah (Geib 1996; Janetski 1993). This period ended about A.D. 500, by which time ceramics were in general use throughout the Colorado Plateau. The earliest dates associated with ceramics come from Fremont sites of the Escalante River basin where pottery initially appeared between A.D. 400 and 500 (Geib 1996). In the Glen Canyon region, which includes the Kaiparowits Plateau study area, a possible ethnic or behavioral boundary during the Archaic-Formative Transition may be indicated by the distribution of perishable materials, rock art, and burials (Geib 1996).

Archaeological Evidence

There is little direct evidence of occupancy on the Kaiparowits Plateau during the Archaic-Formative Transition, but this is not unusual in regions lacking excavated shelters and alcoves. As it is, the vast majority of data *anywhere* from this period derives from sheltered sites, and all of these are outside of the study area (e.g., Cave DuPont near Kanab, Utah [Nusbaum 1922] and Sand Dune Cave at the foot of Navajo Mountain [Lindsay et al. 1968]). By their nature, *open* sites from this transitional interval tend to be lumped into what Bruce Huckell facetiously called that "long static prelude to the ceramic... cultures of the Christian era" (1996:306). Until the last 20 years this meant that Archaic and Basketmaker II sites were routinely overlooked during survey; on Arizona's northern Black Mesa, for example, surface Basketmaker II sites went unrecognized until the last few seasons of the 15-year Black Mesa project (Christenson and Parry 1985). Open preceramic sites can be difficult to identify or even observe, buried as they often are beneath layers of eolian and alluvial deposition. And, open Archaic-Formative Transition sites—which typically do not contain diagnostic perishables—can be confused with earlier Archaic occupations. In recent years archaeologists have become more attuned to the surface attributes of sites dating to this interval (e.g., quantities of fire-cracked rock in the Navajo Mountain area).

Southern Coal Project. The Class II survey of the Escalante planning unit reported no sites belonging to the Archaic-Formative Transition (Basketmaker II). In his review of the prehistory of the area, however, Hauck (1979:82) stated that "the cultural manifestations ... [of the project area] show definite associations with a phase or phases that are transitional from an Archaic to a Formative stage. Early Basketmaker-like sites can be seen as well as those of a later Pueblo kind with Kayenta influence."

Escalante Project. Kearns (1982:267) used the designation "Post-Archaic" as "a catch-all category for sites represented by projectile points not considered indicative of an Archaic or Paiute occupation," although he further stated that "most of the sites labeled post-Archaic [probably] represent

Fremont, Anasazi or Paiute use of the area." If the latter is the case, then Post-Archaic cannot be equated with the Basketmaker II or Archaic-Formative Transition, and is not otherwise useful as a preceramic determinant. Nine such sites were identified in the Tract II sample unit.

Kaiparowits Power Project. No information is readily available from the preliminary report by Fish (n.d.) on Archaic-Formative Transition (Basketmaker II) sites in the KPP area. The 11 lithic scatters or lithic campsites recorded in the Nipple Bench power plant site area, and 24 lithic scatters or lithic campsites noted in the Fourmile Bench plant area, can date to any preceramic period; some may even be nonceramic occupations by Puebloan and Protohistoric peoples. Four of the 12 rockshelter sites located in and around the Nipple Bench survey area lacked ceramics and, as mentioned, the single dry cave site is a good candidate for preceramic occupations. No cultural remains were found in any of the Fourmile Bench rockshelters.

Formative

The Formative period (A.D. 500-1300) is a stage of cultural developement characterized by a strong reliance on agriculture (e.g., Decker and Tieszen 1989; Minnis 1989), permanent or semipermanent habitations, and pottery production. Formative cultures identified within the Kaiparowits Plateau study area include Puebloan or Anasazi and Fremont. Fremont material culture is largely distinctive from that of the Anasazi (cf. Madisen 1982:23-25,19889), and current evidence indicates that the Fremont occupied the Kaiparowits Plateau during the first millennium A.D. but were mostly replaced by about A.D. 1000 (Geib 1996; McFadden 1999).

Previous Formative Chronologies

The Formative Anasazi occupation on the Colorado Plateau is generally discussed with regard to Pecos developement stages, e.g. Pueblo I, II, III,. The Pecos Classifacation is now widely regarded as a convenient temporal (as opposed to developemental) framework, and ceramics are used to assign sites to the Pecos stages. Glen Cayon Project archaeologists regarded most so-called Kayenta Anasazi sites on Fiftymile Mountain and in Boulder Valley as Pueblo II, with abandonment occurring by A.D. 1200 at the latest. Lipe's (1970: 87) phases of Formative period occupation on the Red Rock Plateau (Klethla, A.D. 1100-1150 and Horsefly Hollow, A.D. 1210-1260) are generally applicable to most of the Glen Canyon lowlands, but they do not appear relevant to the Kaiparowits Plateau. These phases reflect the apparent lack of Anasazi habitation in Glen Canyon during Basketmaker III and Pueblo I, and a postulated hiatus between Pueblo II and Pueblo III. Virgin Anasazi sites in the GSENM have traditionally been classified with reference to Pecos time periods, and this scheme continues today (see below).

Temporal periods for Fremont cultural development in the area have, until recently, been nonexistent. A tentative three-phase sequence for the San Rafael Fremont proposed by Black and Metcalf (1986:13-15; cf. Brown 1987) was never intened to be used in south-central Utah, but may have utility as a reference point. Black and Metcalf defined a Proto-Formative phase from A.D. 150 to A.D. 700 during which domestics were added to a hunting- gathering subsistence base. They compared this phase to the Anasazi Basketmaker II development. This is followed by the Muddy Creek phase, A.D. 700-1000, which is characterized by plain grey pottery and increased sedentism. The final Bull Creek phase, A.D. 1000-1200 includes decorated Fremont pottery and Anasazi tradewares. Geib (1996) proposed a broad chronology for the Fremont of the Escalante River basin (see also McFadden 2000: Figure 3), but with no intended applicability to the Kaiparowits Plateau.

Proposed Formative Chronologies

McFadden's (2000) recent volume on Formative chronologies and site distribution in the GSENM is the best attempt thus far to introduce some temporal order and standard nomenclature to Anasazi and Fremont time periods and phases in the GSENM. The volume is a synthesis of radiometric assays and tree-ring dates from more than 100 sites, many collected and analyzed only in the last 20 years. His Figure 59, reproduced here as Figure 3.2, shows proposed phase or period names for the Anasazi of the Grand Staircase, the "Kayenta" of the Kaiparowits Plateau, and the "Fremont" of the Escalante drainage.

The Virgin sequence continues to use familiar Pecos time periods, adjustedd as necessary to reflect local developemental markers such as ceramic types. The Kayenta chronology has only one named phase-Fiftymile Mountain-encompassing all known Anasazi sites on Fiftymile, none of which appear to predate the late A.D. 1000s. The numerous Anasazi sites recorded by NNAD on Collet Top fall within this phase as well, although they are not considered to be Kayentan on the

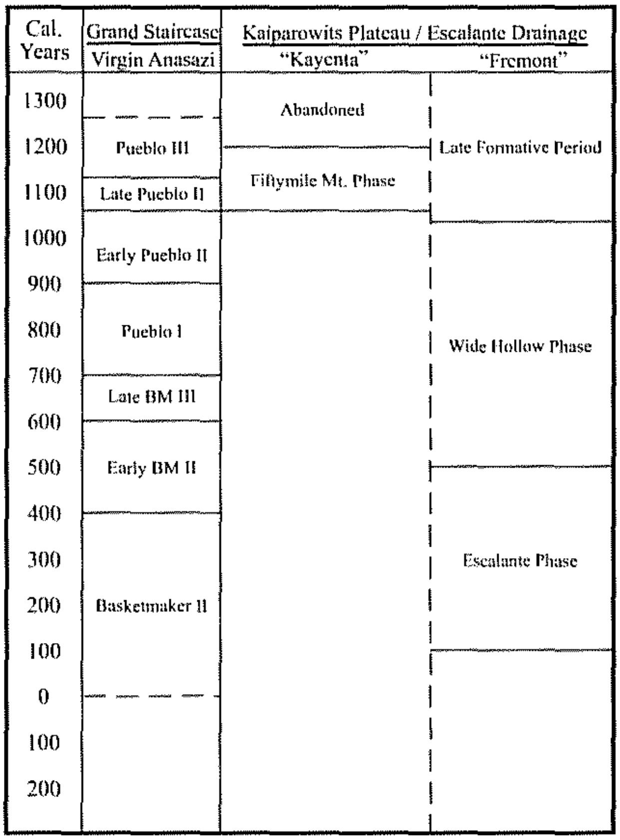


Figure 3.2. Proposed Formative chronologies for the GSENM (after McFadden 2000: Figure 59).

basis of artifactual and architectural traits. The Fiftymile Mountain phase spans a roughly 100-year period between A.D. 1100 and 1200. The Fremont phase sequence begins with the Escalante Phase (ca. A.D. 100–500) retained from Schroedl (1991), but with beginning and ending dates appropriate to the GSENM. The phase corresponds with the latter half of Geib's (1996) Early Agricultural period (which begins about 400 B.C.). McFadden introduced, for the first time, a named phase for the A.D. 500–1050/1100 period called the Wide Hollow Phase, which corresponds with Geib's (1996) Early Formative period. McFadden did not propose a named Fremont phase for the post-A.D. 1100 period, but simply referred to it as "Late Formative," as did Geib. McFadden (2000:157) explained as follows:

> This is because the Wide Hollow Phase (A.D. 500–1050/1100) represents an indigenous long-term adaptation; on the other hand, the Fiftymile Mt. Phase appears suddenly as an adaptation employing Kayenta ceramic, projectile point and architectural styles. At this juncture, it is not clear whether sites and strategies identifiable as Fremont continued into the 12th century in the Escalante drainage. The continuity, or lack of it, between the Wide Hollow and Fiftymile Phases remains to be demonstrated.

Archaeological Evidence

As might be expected, the Formative period is well represented in parts of the GSENM (e.g., Fiftymile Mountain). The most obvious reason for this is that Anasazi-Fremont sites can be readily identified based on diagnostic ceramic types; but it may also be that this period represents a peak in population and use. Nevertheless, the frequency of observed Formative sites usually runs a distant second to sites with an unknown cultural affiliation. Until we can get a better handle on the cultural-temporal affiliation of nonceramic artifact scatters and camps, there will always be questions as to the breadth and intensity of preceramic and post-Formative use of the Kaiparowits Plateau study area.

It now appears that in the Escalante River basin—and perhaps in the Kaiparowits Plateau study area—the Early Formative (i.e., Basketmaker III–Pueblo I) occupation was by carriers of Fremont culture, who occupied the region during a time when it was little used by the Anasazi. Until recently the Fremont occupation of the region was thought to be contemporaneous with a Late Formative (Pueblo II–III) Anasazi occupation; at this point, it is clear that Fremont occupancy began centuries earlier (see Geib 1996). Likewise, the co-occurrence of Fremont and Anasazi ceramic types on sites does not necessarily indicate cultural interaction. At several excavated sites that yielded mixed assemblages it appears that coarse excavation techniques, loose easily disturbed sediments, and a lack of intervening natural layers masked what was actually *sequential* occupancy. For the purposes of this summary, it simply means that we should not make too much of Puebloan cultural affiliations assigned by 15 to 20-year-old inventories to surface artifact assemblages.

As a final note, none of the following projects appeared to integrate Virgin Anasazi ceramic data into their cultural affiliations. Hauck (1979:83) stated only that "Virgin branch ceramics were found at some sites in the area," and Virgin ceramics are merely mentioned in the site descriptions of MNA's preliminary report (Fish n.d.).

Southern Coal Project. During the Class I inventory of the Escalante planning unit, 298 Pueblo sites and 9 Fremont sites were identified out of a total of 698 sites from previous surveys. In the Paria planning unit, 61 Pueblo sites and 2 Fremont

sites were known from a total of 354 sites. In the Class II inventory of the Escalante unit, 6 sites were considered to be Fremont, 3 were Fremont-Kayenta Anasazi, and 70 were categorized as Anasazi. The temporal assignment of all of the Fremont sites and components was about A.D. 800, whereas the vast majority of the Anasazi sites were considered to have been occupied around A.D. 1050.

Escalante Project. Out of 134 components in the Tract II sample unit, only 5 were considered to be Fremont-Anasazi and 3 were Kayenta Anasazi; no strictly Fremont sites were identified. The "sparseness of the ceramic assemblage[s]" of the five Fremont-Anasazi sites "negates positive identification" as to cultural affiliation, but "all or several of these presumably represent Fremont occupation" (Kearns 1982:268–269). In terms of land use, "the Fremont/Anasazi occupation of Tract II appears to have been seasonal ... no permanently occupied sites (e.g., surface pueblos or villages) are documented within the tract" (1982: 400).

Kaiparowits Power Project. No summaries of cultural affiliation are available for sites recorded in the Nipple Bench and Fourmile Bench areas, and the majority of the appended site descriptions in Fish (n.d.) are of unknown affiliation. A closer look at individual site descriptions, however, shows that Fremont, and Kayenta and Virgin Anasazi ceramics were observed at a number of sites on both benches (although nonceramic lithic scatters were still the most ubiquitous site type). On Nipple Bench, crews recorded two lithic-ceramics scatters, eight rockshelters with ceramics, and a dry cave with ceramics; no masonry sites were observed. On Fourmile Bench, Puebloan sites included one ceramic scatter, two lithic-ceramics scatters, and one masonry storage structure. MNA concluded that "in terms of cultural affiliations and temporal placement ... there [was] a good deal of similarity" between the two survey areas (Fish n.d.:121).

Post-Formative

In previous descriptive reports for this project (Geib, Huffman and Spurr 1999; Geib, Spurr and Collette 2001) we used the cumbersome term "Late Prehistoric-Protohistoric" to refer to Native American remains dating to the interval between the Anasazi abandonment of the general Four Corners region around A.D. 1300 and the recent historic period. In this report we use the term "Post-Formative" to designate these remains. We were motivated to use this term for several reasons. For one, it is clear from radiocarbon dating of site 42KA4662 on Horse Flat (see Chapter 5) that some of the Native American remains on the Kaiparowits Plateau could be as recent as the early 1900s, and thus not actually Protohistoric at all. We also hoped to avoid the Eurocentric baggage attached to "prehistoric" and "historic", with the implication that history did not begin in the Southwest until the arrival of Euro-Americans.[1] We are not entirely sure that using Post-Formative is the solution, but prefer it to other, alternative designations such as "Neo-Archaic," a term initially proposed by Thompson (Wallling et al.1986:24) and subsequently used on occasion (e.g., Altschul and Fairley 1989). We acknowledge that there is both behavioral and historical meaning to the devisions of Late Prehistoric and Protohistoric, plus a great deal of precedent for the use of those or similar terms in the archeological literature (e.g., Wilcox and Masse 1981). Our hope is that a unique term appropriate to today's social milieu-preferably without reference to preceding cultures-will soon come into common, agreed-upon usage.

Within the Post-Formative period, Native American remains might belong to three temporal subdivisions. The late Prehistoric interval extends from A.D. 1300 to about A.D. 1500, when indirect influences from early Spanish settlers in Mexico presumably first reached the Southwest. The Protohistoric interval extends from A.D. 1500 to 1850, ending roughly coincidental with the Mormon colonization of Utah, and the initiation of U.S. Government exploratory expeditions across the southern Colorado Plateau. The pioneering exploration of the Southwest by the Spanish friars Dominguez and Escalante during 1776 (Bolton 1950) provides a convenient dividing point between early (A.D. 1500-1775) and late (A.D. 1776-1850) phases of the Protohistoric interval. The historic interval of Native American use of the Kaiparowits Plateau extends from 1850 through the early 1900s.

In the following discussion, the Post-Formative occupants of the Kaiparowits Plateau study area are referred to as Southern Paiute because this was their recognized territory during the historic period (Kelly 1964). Southern Utes (Schroeder 1965; Steward 1941) are known to have occupied

[1]Note, however, that we still use the casual terms "prehistoric" and "historic" for "Native American" and "Euro-American," respectively, in this report.

terrain immediately to the east and may have on occasion visited the Kaiparowits Plateau. The separation of Southern Paiutes and Utes prior to the historic era is debatable (Pierson 1981:65). Although the distinction between Utes and Paiutes may have preceded the historic era (Goss 1965:80), differentiation of the two in the archaeological records is usually difficult. The Southern Paiutes apparently were the principle inhabitats of the Kaiparowits Plateau study area during the Post-Formative period. Other historically defined ethnic groups, including Navajo, Hopi, and Havasupai, are also known to have made periodic use of the area.

The chief temporal and cultural diagnostics of this period are Southern Paiute Brown Ware and Desert Side-notched projectile points.[2] Occasional sherds of Jeddito and Awatovi Yellow Ware are also found throughout the general region. The occurrence of Pueblo IV Hopi ceramics in southern Utah is frequently attributed to Hopi visitors on pilgrimages to shrines or trading expeditions to the Southern Paiute (e.g., Adams, Lindsay and Turner 1961; Sharrock, Day and Dibble 1963; Lipe 1970). It is equally possible, if not more so, that the vessels were carried into the region by the Southern Paiutes or by Havasupai middlemen as documented historically (Bolton 1950). Hopi pottery at Kaiparowits Plateau sites most likely indicates Post-Formative Southern Paiute occupancy.

Dating of the Southern Numic expansion onto the Colorado Plateau remains speculative, as does the cause of the expansion (see review in Madsen and Rhode 1994). Radiocarbon dates recovered from a Paiute midden overlying a Kayenta Anasazi stratum place the Southern Paiute in the Grand Canyon by A.D. 1400 (Jones 1986). The Sitterud Bundle from Castle Valley is dated at A.D. 1350 (Benson 1982) and might represent an earlier Numic occupation to the northwest of the project area. A brush structure in central Glen Canyon northeast of the Kaiparowits Plateau has a radiocarbon age of roughly A.D. 1300 to 1400 (Geib and Fairley 1992). Thus, currently available evidence confirms the presence of Southern Paiutes around the study area by the beginning of the fifteenth century, but the earliest date of their arrival in the area remains in question.

Kelly (1964) provided the most comprehensive summary of traditional Southern Paiute culture. Unfortunately, her research was conducted in the 1930s, many decades after abandonment of traditional hunting and gathering lifeways. Consequently, much of her information was based on informants' vague childhood memories or stories told to her informants by parents and grandparents, rather than on firsthand adult experience. Equally important, the memory of these people would have been of lifeways already drastically impacted by the presence of Mormon colonists and other Anglos, Navajo and Ute slave raids, and epidemic diseases. By the late 1800s it is likely that the Southern Paiutes had become restricted to the harsher, less productive areas of their traditional territories, with consequent readjustments to the traditional subsistence cycle.

From Kelly, we know that Southern Paiutes practiced a subsistence strategy based on seasonal transhumance. Highland areas such as the Kaibab, Kaiparowits, and Aquarius plateaus were occupied during late summer and fall for the purpose of gathering berries, seeds, and pinyon nuts and hunting large game. Extended family groups would aggregate into lager units at this time of year. Surplus food was cached in sheltered granaries for later use. As winter drew near, small extended family groups would split off and move to base camps at lower elevations in or immediately adjacent to the pinyon-jumper zone where winter fuel wood was plentiful. Proximity to springs (probably 1-3 km distant) was the primary factor controlling the selection of winter base camps. As winter abated and autumn food stores began to dwindle, the family groups moved to lower elevations in and adjacent to the major river canyons where agave, cacti, and early spring greens could be procured. During the summer, the scattered families moved back to winter residences to gather and hunt in vicinity. Small patches of corn and squash were casually cultivated by some band members, and periodic foraging trips to higher elevations were undertaken. As summer waned, small groups began to abandon their base camps and move on the plateaus again.

[2]Pottery provides a reliable indication of Southern Paiute affiliation because it is fairly distinctive, and due to its rather crude construction, we can safely assume that it was not widely traded or reused by other cultural groups. Southern Paiute Brown Ware (also called Southern Paiute Utility) was originally described by Baldwin (1950) with subsequent revisions by Euler (1964), Hunt (1960), and Fowler and Matley (1978). The common vessel form is a thick-walled jar with pointed base, low shoulders, and wide, slightly flaring mouth; vessel rims are frequently decorated with fingernail impressions. The vessels are formed by coiling and thinning with paddle and anvil, with surfaces that are usually irregular and plain or wiped. The vessels range from reddish brown to black in color and are usually tempered with poorly sorted, predominantly quartz sand.

The traditional territory of the Kaiparowits band of the Southern Paiute included the entire study area. The Kaibab and San Juan bands of the Southern Paiute evidently also visited the study area on occasion. According to Kelly, the Kaiparowits band ranged between the Paria River on the west, the Colorado River on the south, Waterpocket Fold on the east, and Aquarius Plateau on the north. Kelly's informants considered the region north of the San Juan River and east of Waterpocket Fold as Ute territory. Kelly reported that one economic cluster of the Kaiparowits band known as the Kwaguiuavi lived in the current project area. Based on her descriptions and map, it appears that this group had its winter base along Wahweap Creek centered among Long Flat, Fourmile Bench, and Jack Riggs Bench. They would travel to higher portions of the plateau (Collet Top and Fiftymile Mountain) during the summer and fall and then return to Wahweap Creek for the winter. This is certainly a rather truncated account of their annual subsistence round, no doubt because of a lack of reliable informants for the Kaiparowits band, as Kelly emphasized (for additional information see Chapter 8).

Archaeological Evidence

A general summary of the archaeological data pertaining to the Post-Formative Southern Paiute presence in southern Utah is presented by Lyneis (1994). Sites within the Kaiparowits Plateau study area attributed to the Southern Paiute are actually quite sparse, and include the following:

Southern Coal Project. The Class II survey of the Escalante planning unit reported four Paiute-Shoshonean sites (Hauck 1979:Table 4-15). In addition, 23 sites of this temporal and cultural affiliation were reported in the Class I overview associated with this project (Hauck 1979:Table 3-4). Most of the previously recorded Paiute sites were documented during the Glen Canyon Project.

Escalante Project. Kearns (1982:273) listed three Paiute sites within the Tract II sample area. He found that "the paucity of Paiute sites ... is somewhat incongruous with the ethnographic literature (Kelly 1964). This may be a product of low site visibility, or the lack of well developed criteria (except ceramics and Desert Side-notched points) for identifying Paiute sites" (Kearns 1982: 405).

Kaiparowits Power Project. None of the sites that MNA archaeologists recorded for this project was attributed to the Southern Paiute. Based on our previous experience in the general region, it is likely that some of the small rockshelter habitations with middens date to the Post-Formative period.

Euro-American

A summary of the general history for the Kaiparowits Plateau region is provided in Chapter 9. Historic remains are relatively few compared to those of the prehistoric period; a literature search revealed the following information.

Southern Coal Project. The Class II survey of the Escalante planning unit reported one historic site. No conclusions were reached about the historic archaeological remains of the area.

Escalante Project. Kearns (1982:254) reported two single-component historic sites and two other sites with historic components for the Tract II sample area. One of the sites is a locale of inscriptions dated 1904 and 1925. Two of the other sites may predate the 1930s, with the third younger than this. Probably all of the historic sites are associated with ranching.

Kaiparowits Power Project. A single historic site was reported in the preliminary report by Fish (n.d.), a single historic inscription dated to 1920.

CHAPTER 4

SAMPLING

The overall objective of this project was to provide inferences about the nature and distribution of cultural resources—both sites and isolated occurrences—on the vast Kaiparowits Plateau. The specific population characteristics of interest to the BLM included the distribution, diversity, and density of cultural remains. Additional interests included the range and distribution of functional site classes (site types), the temporal spans of occupancy, and potential patterning in the distribution of sites by physiographic features. These data had to be secured from survey of only a small portion of the overall study area. The most effective way to obtain this sort of information for an area as immense as the Kaiparowits Plateau was to examine a selected fraction of the study area using spatial units of some size and shape, and then extrapolate the observations from that fraction to the unexamined remainder of the plateau. The utility and broad applicability of inferences drawn from small samples are closely linked to how one selects the areas that will be examined (i.e., the sampling design). For statistical certainty and objectivity, a probabilistic sampling strategy was desirable.

ORIGINAL DESIGN

After considering a variety of probabilistic sampling techniques (Cochran 1977), we concluded that a stratified random approach would provide BLM managers with the best information. Given the objectives of this project, stratified sampling seemed appropriate because it entailed subdividing the Kaiparowits Plateau study area and then selecting independent simple random samples for each division. Foremost among the benefits of this approach, stratified sampling allowed us to study the distribution, diversity, and density of cultural remains within each stratum and to make comparisons among strata. In technical terms each stratum can be treated as a unique population or it can be combined to make inferences about the Kaiparowits Plateau study area as a whole. For instance, managers might want to know about the types of cultural remains that occur on Horse Flat at the west-central edge of the area, and compare them to cultural remains on Smoky Mountain. Using these physiographic features as the basis for defining strata provided an objective means for making such comparisons with determinable precision. A simple random sample for the entire Kaiparowits Plateau could not have accomplished this, except with post stratification. More important, simple random sampling was ill advised due to problems inherent in using such an approach for terrain that is as heavily dissected as the Kaiparowits Plateau. Such an approach invariably results in many observation units on terrain that is both difficult to access and difficult to traverse. Moreover, such units often have a poor cost:benefit ratio in that they frequently contain no sites and seldom more than a few. Large expenditures of time and money can result in little information about prehistory.

A second important reason for our use of stratified random sampling was its potential to increase precision because cultural remains may be more homogeneous within each stratum than in the study area as a whole. Subdividing an area into units of differential site density allows more precise predictions. For example, the number of sites per 160-acre quadrate on the Kaiparowits Plateau might vary from 0 to 20 and have a highly skewed distribution. If we take a single physiographic feature, however, such as Nipple Bench, the number of sites per 160-acre quadrate may be far less variable and more closely approach a normal distribution. Because the observations of interest can vary less from one unit to another, a more precise estimate of any stratum mean can be calculated and these can be combined into more precise estimates for the entire study area.

Third, stratification can optimize costs in at least two important ways: (1) it reduces time lost to travel and other logistical difficulties; and (2) it allocates effort where it is most needed. Regarding time and logistics, an inordinate amount of time can be squandered in accessing,

locating, and surveying sample units where roads are absent and the terrain is extremely rough and often impossible to survey in a systematic and intensive fashion. A sampling strategy that indiscriminately scatters survey parcels across the entire Kaiparowits Plateau could result in units that are so far off the beaten track that it takes a day or two just to access and find them. If such problematic units are simply omitted from a sample after selection and alternative units are substituted, then the statistical validity of the sample is compromised to an unknown degree. It is better to devise a strategy that explicitly excludes certain areas from the sample frames.

Regarding allocation of effort, the limited survey funds available for this project were better spent, we believe, on terrain that was more conducive to human occupancy than 20+ degree eroded slopes. For verification we can turn to the ESCA-Tech sample survey (Kearns 1982), which demonstrated that survey parcels consisting of steep and dissected land often contain no sites, or at most, a site or two (see footnote 1 of Chapter 1). The AERC sample survey for the Southern Coal Project (Hauck 1979) obtained similar results. BLM managers currently have a greater interest in learning about the large areas of seemingly habitable terrain that archaeologists have yet to study than a further demonstration that horrible terrain is often poorly suited to cultural use. The stratified sample design allowed us to focus our survey effort on the portions of the Kaiparowits Plateau that seemed most suitable to human occupancy.

DEFINING SAMPLING STRATA

The observation units for this study were 160-acre quadrates, or quarter sections. This size of unit is optimal (i.e., reasonable returns for effort expended) in several respects, including ease of survey, ability to tie in the units to section markers, and less "edge effect" with sites and with terrain that cannot be surveyed. Small units, such as 40-acre quadrates, can enhance the sample distribution, but they also increase the amount of field time because of travel and difficulties with ground location of units. The size and shape of the sampling units play an important role in determining the final configuration of the sampling frame. Units that are 160 acres in size require that the boundary jogs in the sampling frames are no less than half a mile in length.

Stratum definition is the most important aspect of implementing an effective stratified random sample. It also can be a most difficult task because it requires drawing boundary lines to separate a study area or population into non-overlapping strata or sampling frames. For a sample survey such as the current project, strata could be defined by any number of variables, such as physiographic divisions, elevation, vegetation, geology, slope, and soil, to name several. In most cases, effective use of these variables for stratification purposes requires detailed maps, which may not be available. In this particular case, not only were detailed environmental maps lacking, but there was an evident suitable alternative means for stratification.

As mentioned in Chapter 1 and discussed in greater detail in Chapter 2, the Kaiparowits Plateau consists of a series of benches and tablelands that are separated from each other east to west by canyons and north to south by escarpments. Cliff scarps and canyons mark natural boundaries to these topographic features, which thus serve as definable and effective sampling strata. Besides providing for internal environmental homogeneity, the strata defined by this method also have a good degree of environmental contrast with one another. The descending series of broad benches and tablelands effectively furnish self-defined strata for implementing a stratified random sample for surveying the Kaiparowits Plateau. The nine principal strata so delimited are shown in Figure 4.1, and Table 4.1 summarizes some pertinent information about them. Comparing environmental characteristics among physiographic features is a fruitful way to examine patterning in cultural remains that may reflect settlement and land-use strategies. Topographic features also provide a means to monitor changes in cultural remains on both north to south and east to west gradients that could relate to cultural or adaptive boundaries.

As Table 4.1 reveals, the nine sample frames have received differing amounts of prior survey coverage. Although the amount of survey coverage for some strata such as Nipple Bench and Smoky Mountain appears good compared to Long Flat and East Clark Bench, prior survey is of variable quality. The proportion of each sample frame previously surveyed should be viewed with caution because of the exceedingly wide survey intervals (ca. 150–200 yards) used by Museum of Northern Arizona (MNA) archaeologists on Nipple Bench, Fourmile Bench,

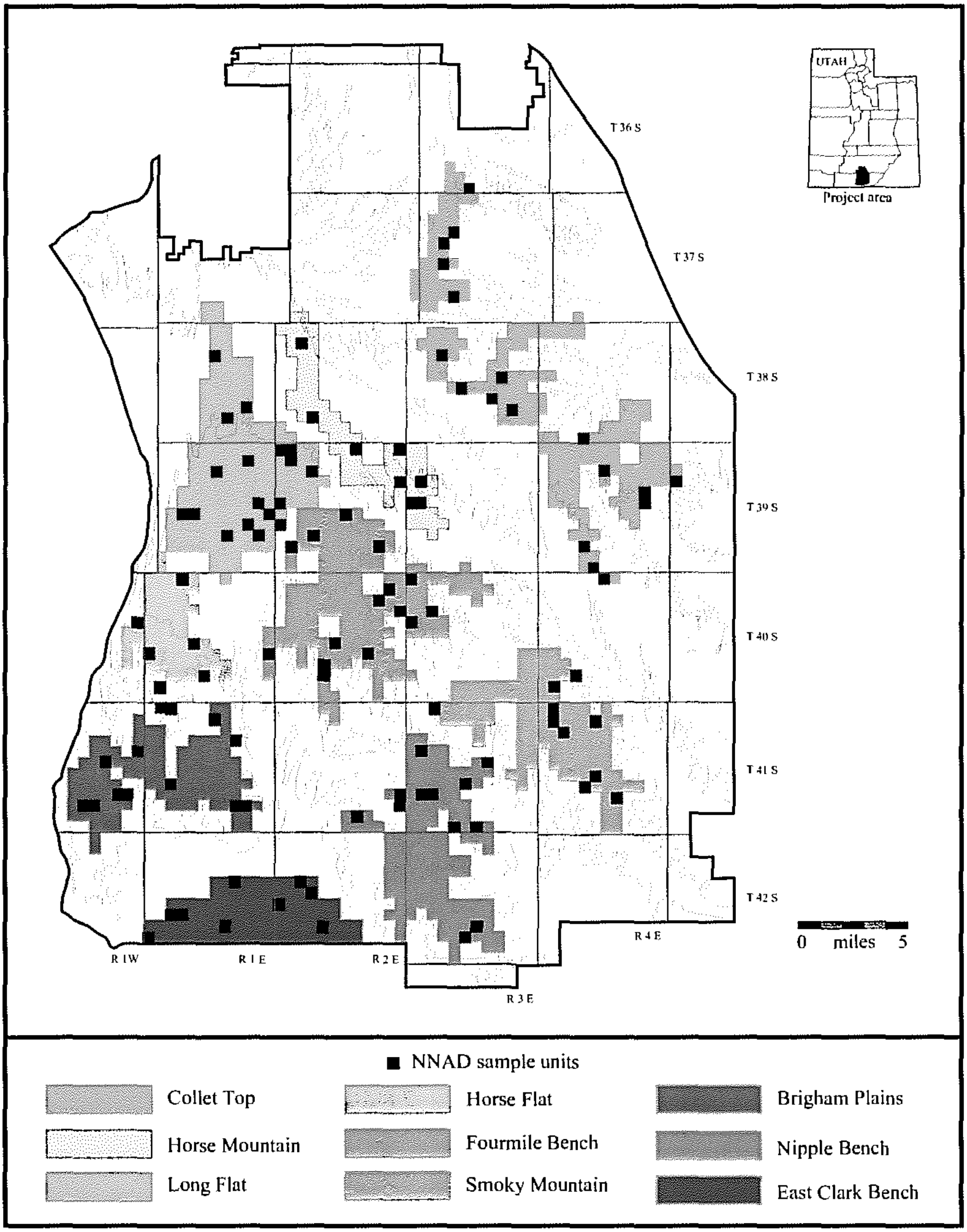


Figure 4.1. Sample frames and surveyed sample units for NNAD's stratified random sample of the Kaiparowits Plateau.

Table 4.1. Sampling strata for NNAD's survey of the Kaiparowits Plateau.

Sampling Stratum	Avg. Elev. (feet)	Geologic Formation	Vegetation	Acreage	No. of 1/4 Sections	Percent of Universe[1]	Acreage Prev. Surveyed[2]	Percent Prev. Survey
Collet Top	6475	Wahweap Sandstone	pinyon-juniper	32,000	200	17.2	1280	3.6
Horse Mountain	6500	Kaiparowits Formation & Wahweap SS	pinyon-juniper	12,960	83[4]	7.1	160	1.2
Long Flat	6075	Kaiparowits Formation	pinyon-juniper	28,960	182[5]	15.6	0	0.0
Horse Flat	6000	Kaiparowits Formation & Wahweap SS	pinyon-juniper	10,360	65[3]	5.6	0	0.0
Fourmile Bench	6075	Wahweap Sandstone	pinyon-juniper	27,840	174	15.0	3680	7.6
Smoky Mountain	5400	Straight Cliffs Formation	pinyon-juniper	19,040	119	10.2	2640	13.9
Brigham Plains	5390	Straight Cliffs Formation	pinyon-juniper	17,600	110	9.5	0	0.0
Nipple Bench	5075	Straight Cliffs Formation	grass & low shrubs	22,160	139[6]	11.9	6400	29.5
East Clark Bench	4375	Entrada and Dakota SS	grass & low shrubs	14,720	92	7.9	0	0.0
Totals				185,640	1164		14,160	

[1]Percents based on count of quarter sections per stratum divided by total number of quarter sections; percentages calculated on the basis of acreage are no different except for Horse Mountain (7.0%) and Smoky Mountain (10.3%).

[2]This percentage must be viewed skeptically for Fourmile Bench, Nipple Bench, and Smoky Mountain because of wide spacing between surveyors (100–200 yards).

[3]Two units are ca. 140 acres in size because of small sections.

[4]Four units are ca. 80 acres in size because of small sections.

[5]Two units are ca. 80 acres in size because of small sections.

[6]One unit is ca. 80 acres in size because of state trust land.

and Smoky Mountain (see Chapter 3). As discussed later, these surveys failed to disclose many traces of past occupancy. The extent to which the MNA surveys underrepresent cultural resources may interest BLM managers, and our survey effort provides an objective means for characterizing this (see the end of this chapter).

We chose to exclude Fiftymile Mountain and the extreme northwestern part of the Kaiparowits Plateau from the present sample. Fiftymile Mountain is inaccessible by vehicle, making survey logistics cost prohibitive given the funds that were availible for this project. More important, Fiftymile Mountain has been the focus of considerable past research, chiefly during the Glen Cayon Project (see review in Chapter 3), and is doubtless the best-known portion of the study area (at least prior to our study). We excluded the far northwestern portion of the Kaiparowits Plateau because it is extremely rugged and because the previous ESCA-Tech survey provides a comparatively good sample of this terrain, except for the more level portions around the head of Collet Cayon. Furthermore, much of this area consists of the various cayon tributaries of Alvey Wash, which have received quite a bit of reconnaissance-level inventory (Douglas McFadden, personal communication 1998).

The boundaries for the sampling frames (Figure 4.2) correspond with quarter sections, sections, and township and range lines. Given

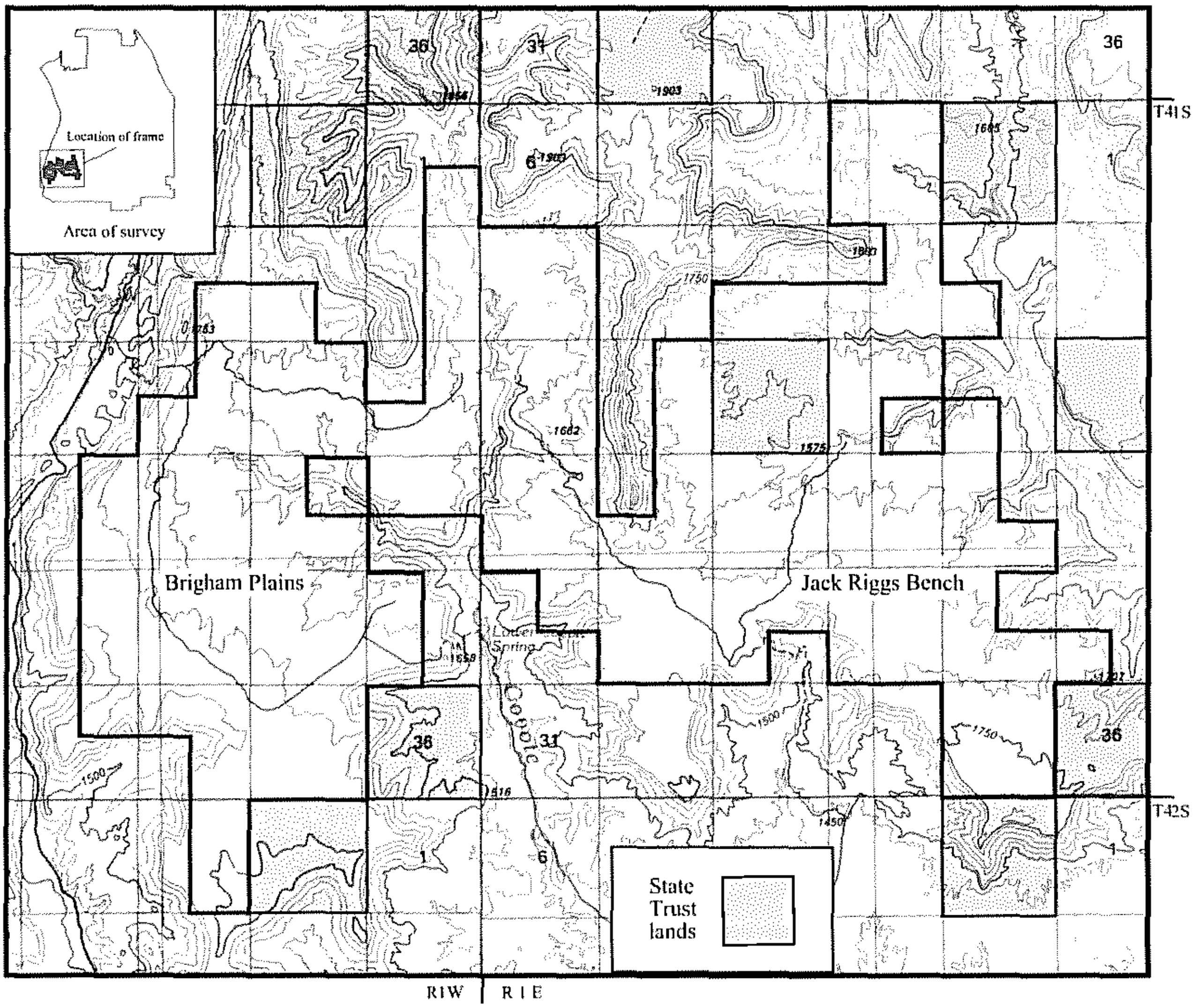


Figure 4.2. The Brigham Plains sample frame illustrating how the frame was drawn by excluding cliff scarps, canyons, and State Trust lands.

the use of 160-acre sample units, any jog in a stratum boundary had a minimum length of half a mile. In drawing the boundaries around tablelands and benches we tried to exclude cliff edges, steep slopes, and canyon bottoms that would be very troublesome to survey. In general, if at least 75 percent of a given 160-acre sample unit contained terrain identical to the bulk of its stratum, then the unit was included in the frame for that stratum. If not, then the unit was included in one of two residual strata designated as cliff scarp–slope–badlands and canyons. In addition, Utah School and Institutional Trust Lands were excluded from the sample frames (see below). We did not select any survey units within these two residual strata at this time for reasons outlined later.

Figures 4.3 through 4.11 show the nine sample frames and the number sequence for each; the sample strata are shown in general north-south sequence. In all cases the frames were numbered starting in the northwest corner and proceeded down the rows from top to bottom (north to south), and across the columns from west to east. A table of random numbers (Tai 1978) was used to draw independent simple random samples for each of the nine strata. Sufficient numbers were drawn to allow for at least a 30 percent sampling fraction for each stratum (see Appendix A). This is a far higher sampling fraction than NNAD needed for this project, but these extended sample draws might

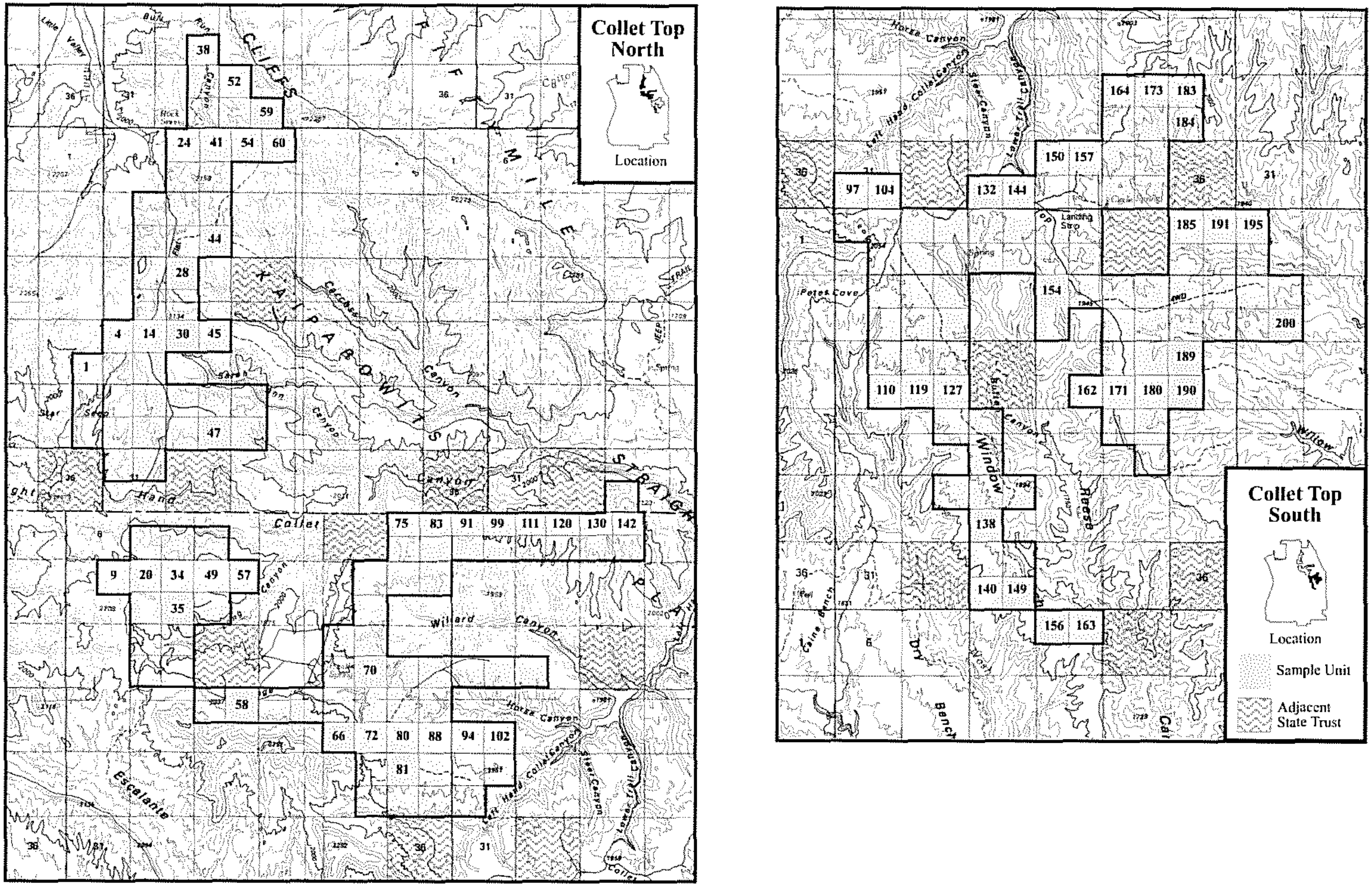


Figure 4.3. The Collet Top sample frame showing the 200 160-acre sample units and the 18 units that were surveyed.

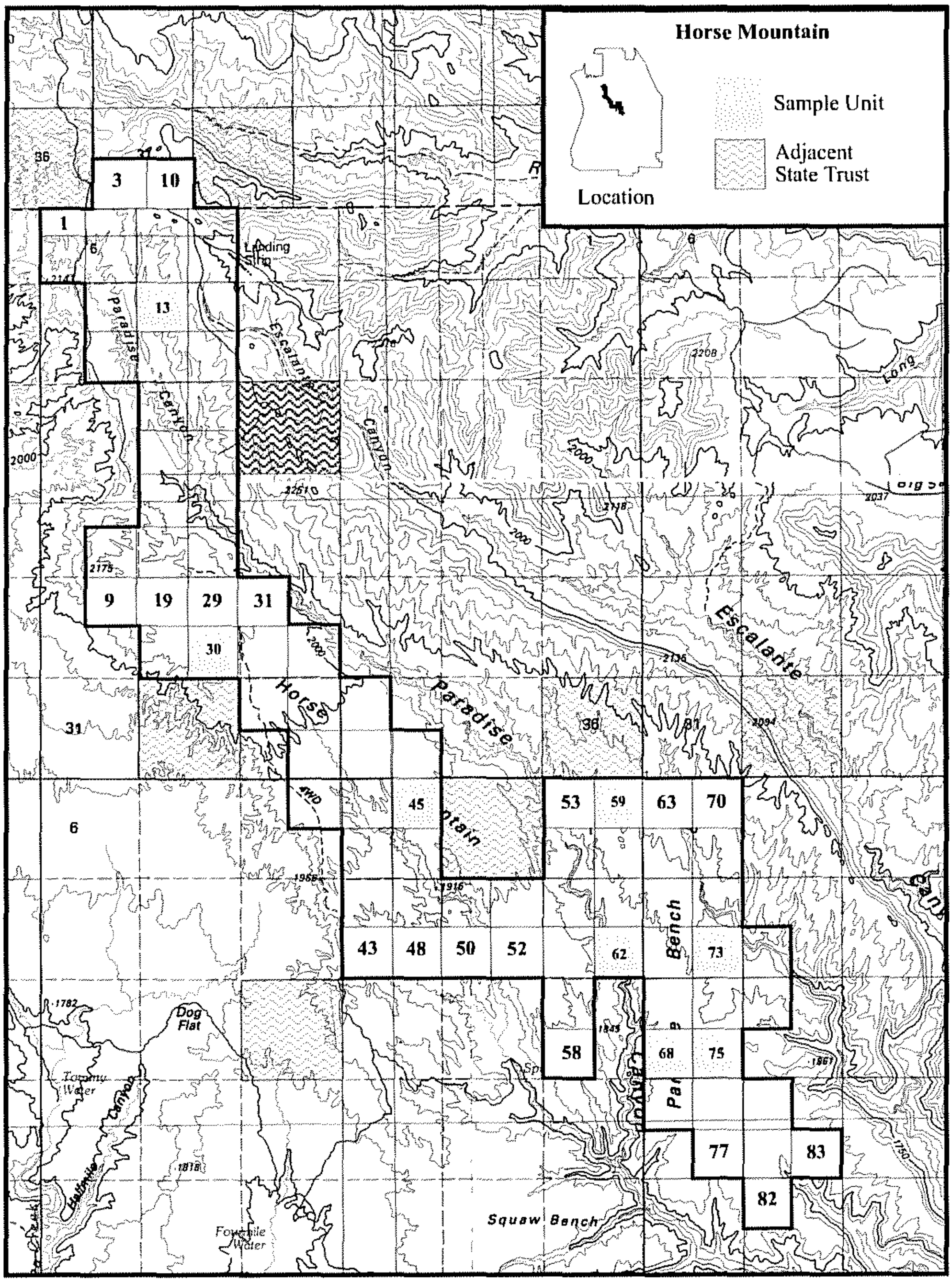


Figure 4.4. The Horse Mountain sample frame showing the 83 160-acre sample units and the 8 units that were surveyed.

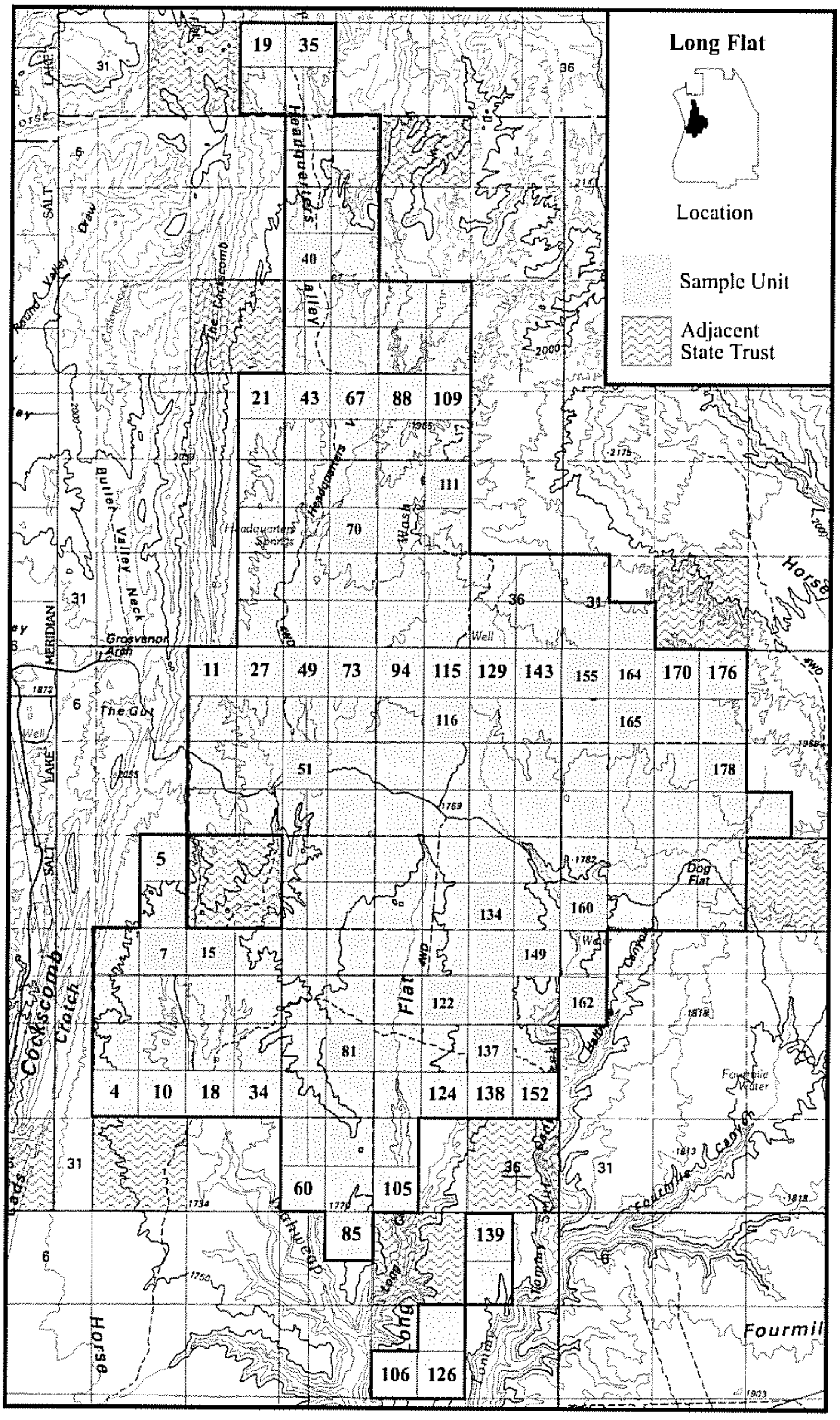


Figure 4.5. The Long Flat sample frame showing the 182 160-acre sample units and the 18 units that were surveyed.

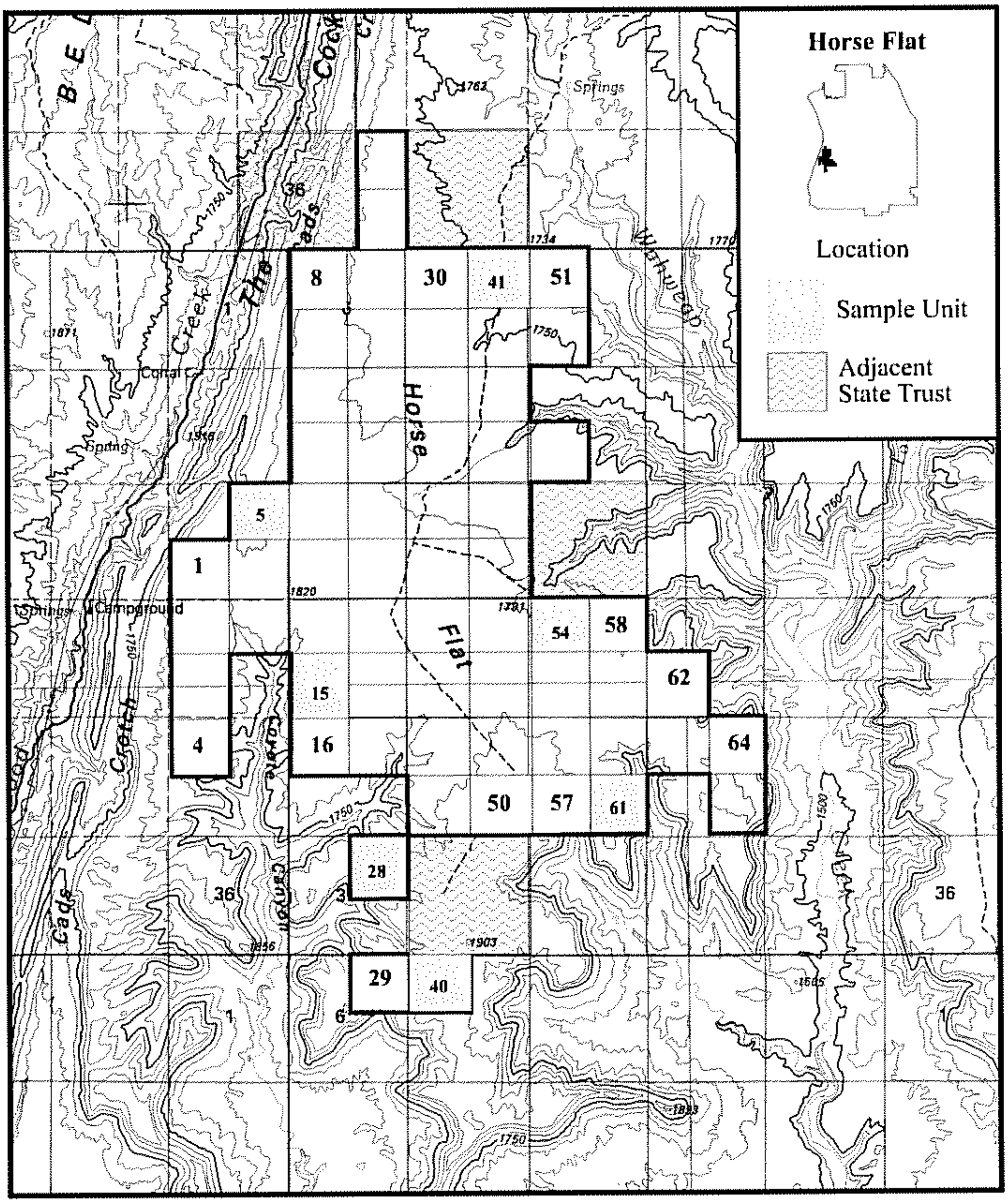


Figure 4.6. The Horse Flat sample frame showing the 65 160-acre sample units and the 7 units that were surveyed.

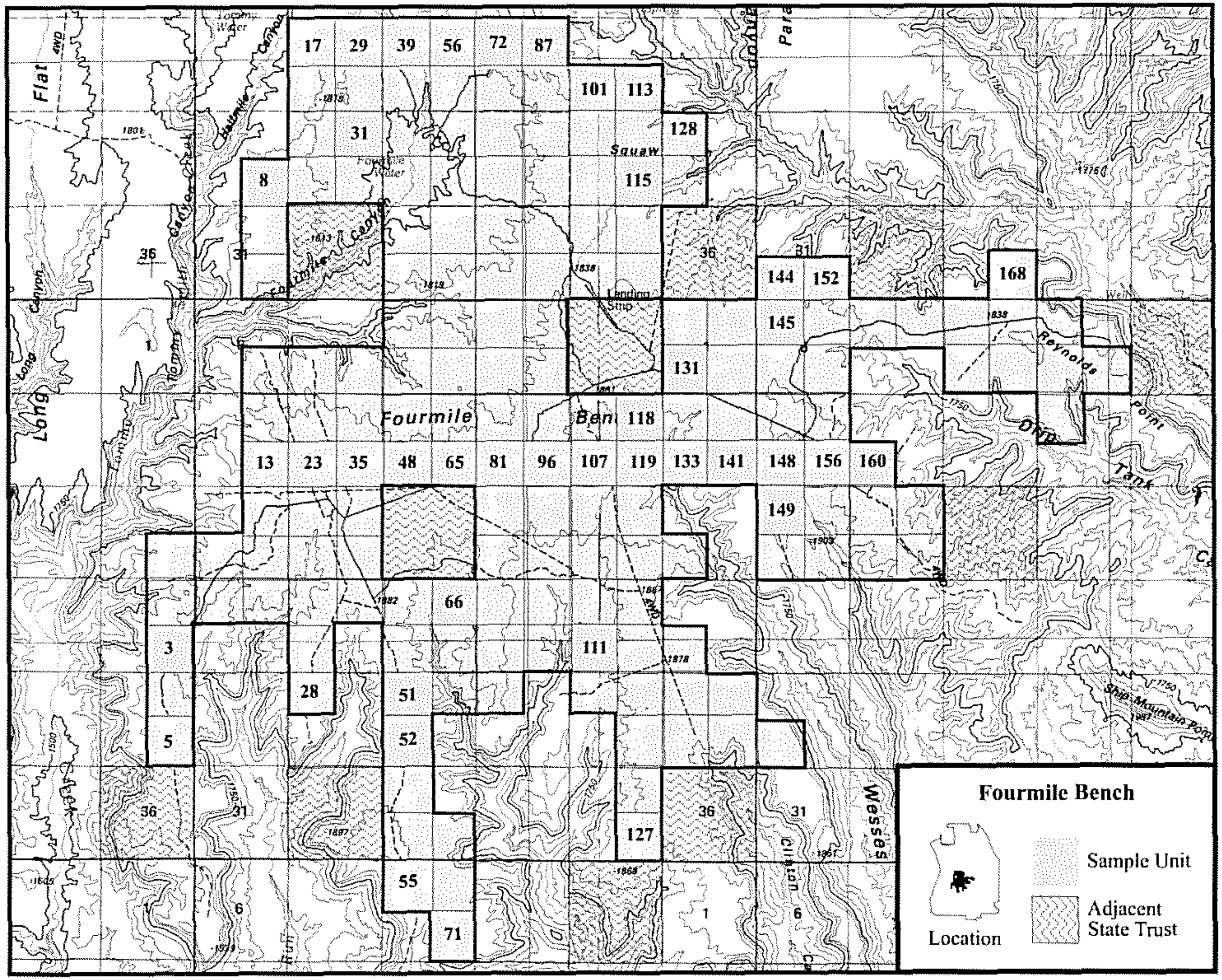


Figure 4.7. The Fourmile Bench sample frame showing the 174 160-acre sample units and the 15 units that were surveyed.

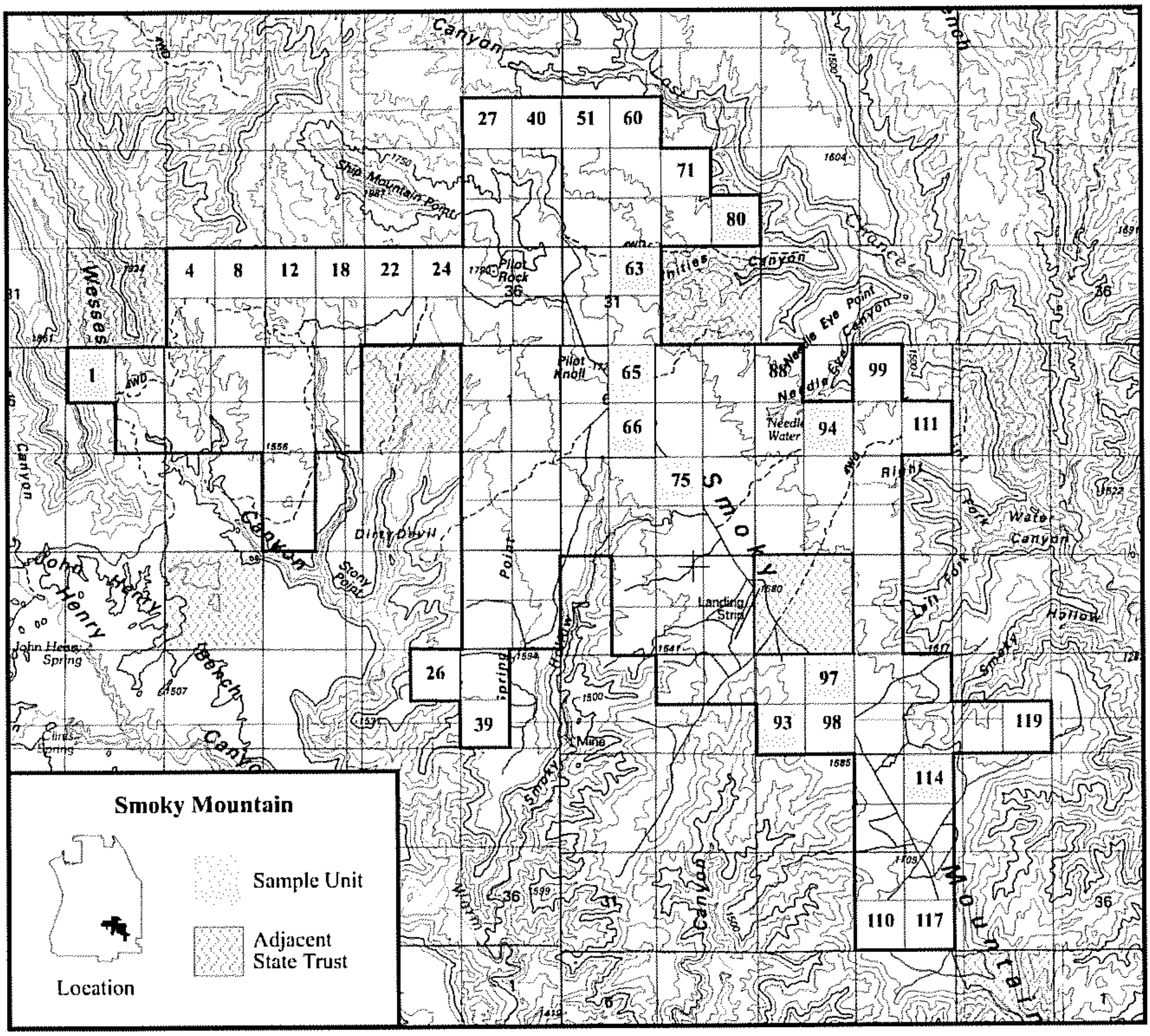


Figure 4.8. The Smoky Mountain sample frame showing the 119 160-acre sample units and the 10 units that were surveyed.

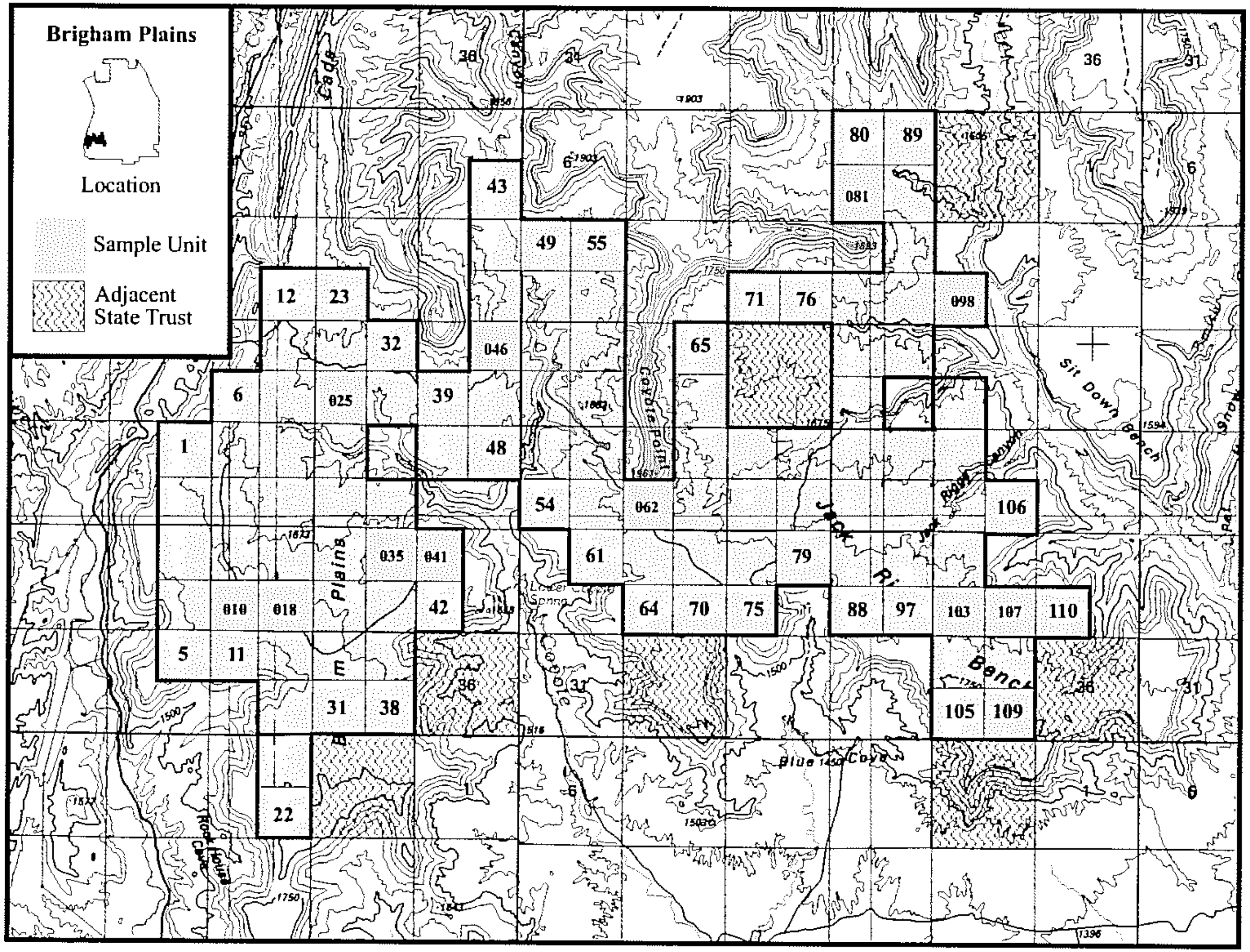


Figure 4.9. The Brigham Plains sample frame showing the 110 160-acre sample units and the 11 units that were surveyed.

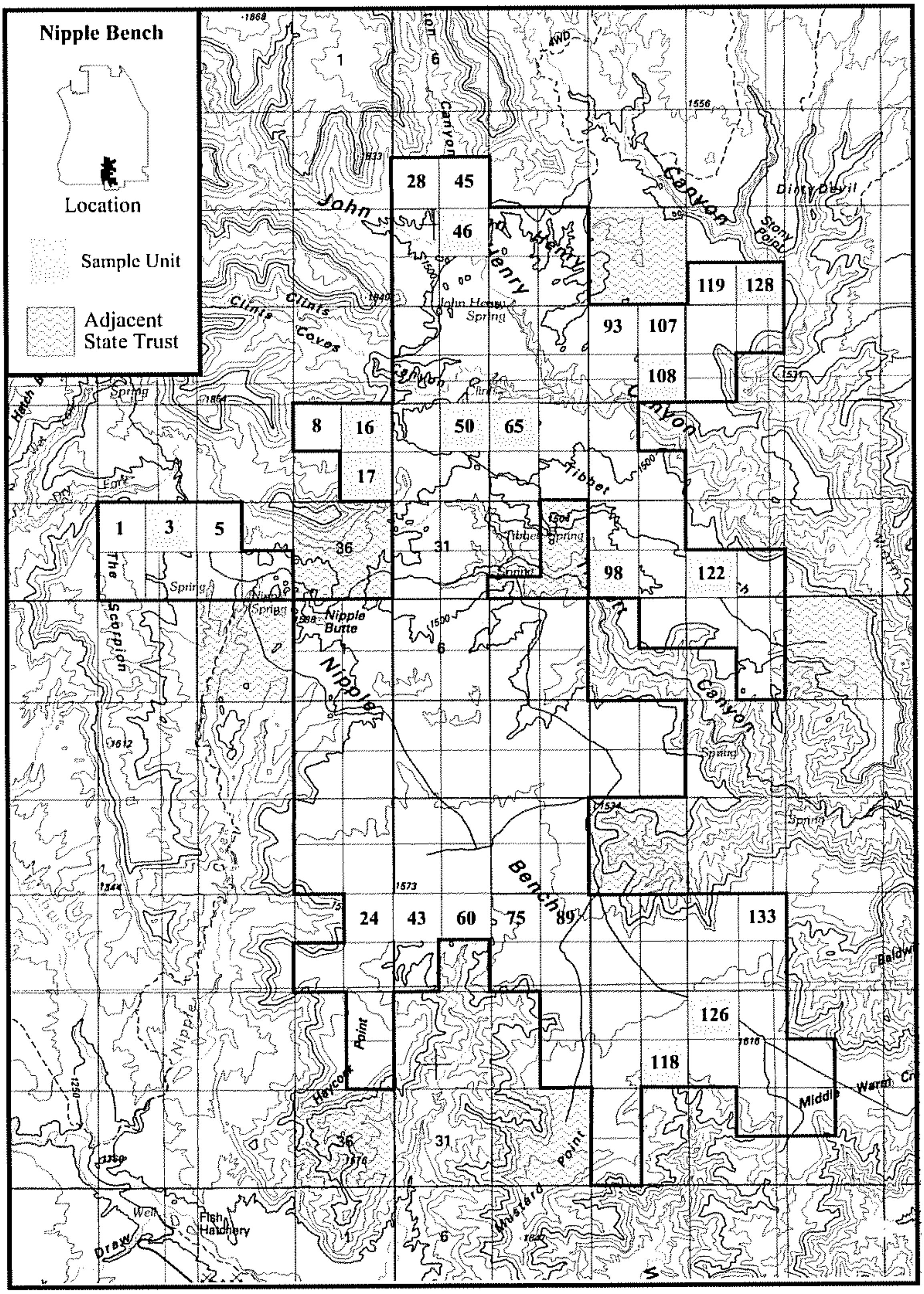


Figure 4.10. The Nipple Bench sample frame showing the 139 160-acre sample units and the 12 units that were surveyed.

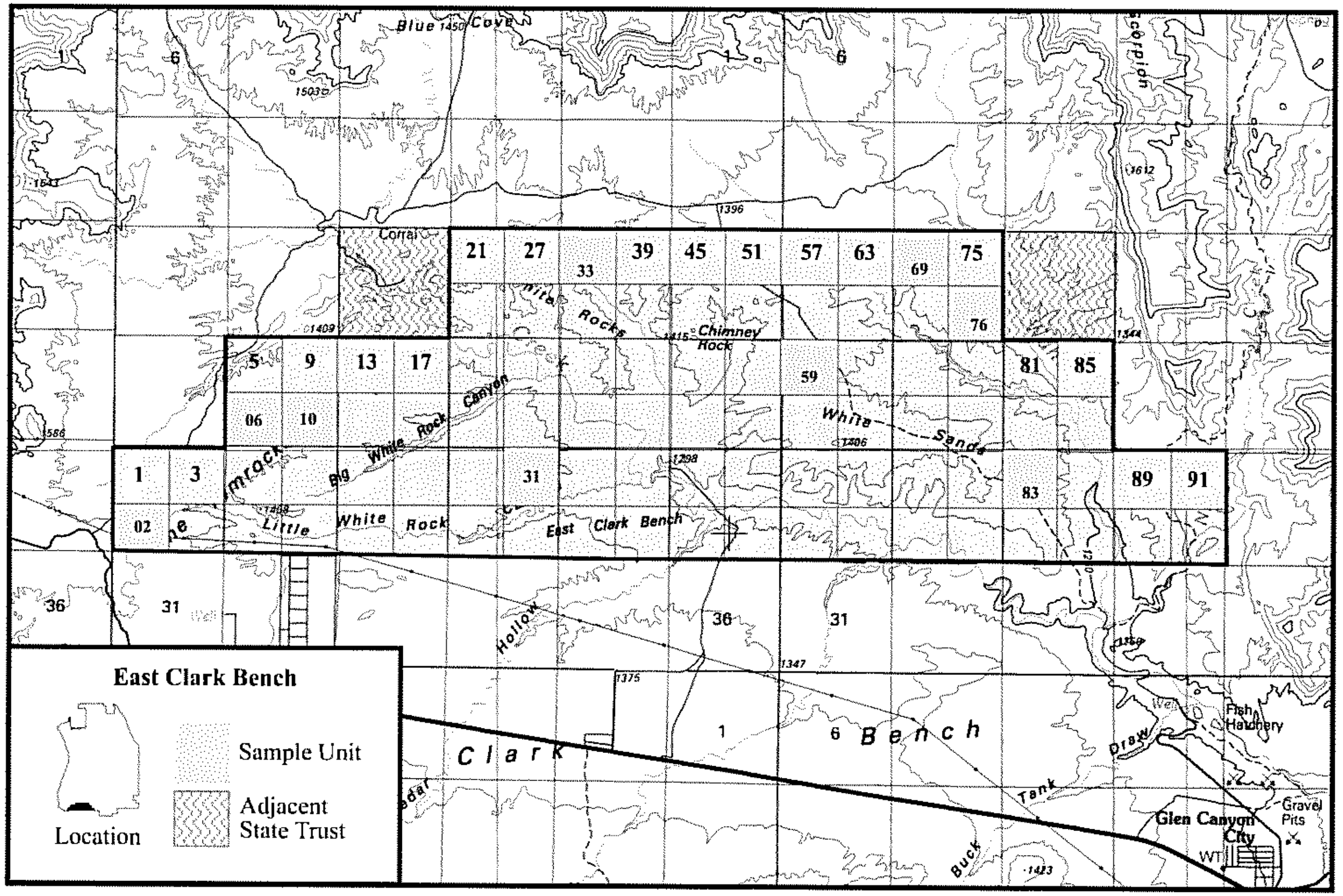


Figure 4.11. The East Clark Bench sample frame showing the 92 160-acre sample units and the 9 units that were surveyed.

prove helpful to the BLM should they want to increase the sample size for any stratum in the future.

As shown in these figures, we purposefully excluded the two residual strata of cliff scarp–slope–badlands and canyons. Existing survey data in and just outside the Kaiparowits Plateau study area are sufficient to make inferences about sites in the cliff scarp–slope–badlands stratum at present. Both the ESCA-Tech and AERC surveys demonstrated that when observation units coincide with steep and rugged terrain, more than half lack sites. The exceptions with sites occur mainly because a moderate-size drainage or level ridge occurs within a sample unit, creating micro-settings conducive to human use. There are extensive badlands across the southern portion of the Kaiparowits Plateau study area, mainly coinciding with exposures of the Tropic Shale. The Lower Glen Canyon Benches survey (Geib 1989) and Big Water Trust Land survey (Collette and Spurr 2001) adequately demonstrated that sample units on this terrain seldom contain cultural remains unless there is some exceptional circumstance such as a spring or small canyon.

We also did not allocate sample units in the canyons stratum, because we opted to focus the limited funds where they could maximize returns. Canyons are more difficult to access and harder to thoroughly survey. Surveying the canyon terrain would have increased the per-acreage costs and thus reduced the amount of acreage that was surveyed for this project. Eventually it will be important to survey some of the canyon terrain, but this might best be done at a reconnaissance level, or if intensively, not by 160-acre quadrates, but rather by more naturally defined units. Keller's (2000) work in the Escalante River canyon provides a good example of recent canyon survey in the monument, and could serve as a model for how to approach similar work on the Kaiparowits Plateau.

It should be apparent from Figures 4.3–4.11 that our sample frames excluded Utah School and Institutional Trust Lands. When the sampling design was developed, the transfer of these parcels to the monument had not yet occurred. The land exchange is now finalized, adding 180,000 acres to the monument, roughly a third of which is within the Kaiparowits Plateau study area. Much of this acreage consists of rugged terrain that was not part of our sample scheme, but a modest number of the annexed sections are on flat terrain and would have been part of our sample frames, thereby increasing their size. Based on a quick estimate it appears that about 19,200 acres likely would have been added among all nine strata, with this total distributed roughly proportional to the acreage of each stratum.

Our sampling design clearly emphasized terrain that seemed most conducive to human occupancy, yet we excluded several small areas on benches and narrow ridges from the nine sample frames. An example includes Sit Down Bench on the east side of Wahweap Creek, which is situated between the higher Fourmile Bench to the north and lower East Clark Bench to the south. Such excluded small areas were mainly those poorly connected, if at all, to the other nine strata, or where we were uncertain as to their environmental match with an adjacent stratum. Some of these areas, such as Sit Down Bench, also were quite inaccessible. After conducting the survey and becoming intimate with the entire area, we now see where some stratum boundaries could have been drawn slightly differently, but not to the extent that our results would have been improved.

SAMPLE ALLOCATION

Sample allocation refers to how the total number of sample units (N) are divided into the individual strata sample sizes ($n_1, n_2, \ldots n_L$). When the RFP for the Kaiparowits Plateau Survey was issued, the BLM requested survey of 100 quarter sections (16,000 acres). Limited funds required a downward adjustment of acreage based on the per-acreage survey cost by whomever was awarded the contract. Despite this, the survey design had to reflect the BLM's ultimate goal of survey coverage of 16,000 acres, because even if current funding allowed just a portion of this acreage to be examined, new fiscal budgets could eventually allow survey of the remaining acreage. The BLM therefore required a plan that would readily accommodate this possibility, instead of one focused simply on present funding levels. The probability of acreage adjustment and the need to allow for continued survey were additional reasons for NNAD's proposed sampling approach. Because each stratum is treated as an independent sample, the results of which can be analyzed alone or combined to discuss the entire Kaiparowits Plateau study area, acreage increases or de-

creases could be allocated depending on situational needs or constraints.

In strictly statistical terms, sample allocation is affected by (a) the total number of sample units in each stratum, (b) the variability of observations within each stratum (the variance), and (c) the cost of obtaining an observation in each stratum (Scheaffer, Mendenhall and Ott 1979: 68). For this project, survey costs were roughly the same from one stratum to another and initially we lacked a good basis for estimating the variance within each stratum. Consequently, proportional allocation was the method used, at least for the first phase of survey. Proportional allocation means that sample units are distributed in proportion to the size of the strata. Conceptually, the larger the stratum, the more variable it is and consequently the larger the sample should be. Thus, the Horse Flat stratum, which contains 65 sample units, would have fewer actual acres surveyed than the adjoining Long Flat stratum, which contains 182 units (see Table 4.1). Hypothetically, if funds had been available to survey all 100 sample units, they would have been allocated to the nine sampling strata as shown in Table 4.2.

The original specifications for the project called for surveying one hundred 160-acre units (16,000 acres) and a sampling design for allocating this many units. Limited annual funding, however, meant that only about half of the 100 units could actually be surveyed during the first year of the project. This did not present a problem because the survey could be split into two separate fieldwork phases. NNAD's stratified sampling approach effectively accommodated acreage reduction because rather than spreading the reduced number of units more thinly over the entire project area, they could be allocated to a reduced number of sampling strata, thereby maintaining relatively robust sampling fractions. The sampling strategy was well suited to multiple phases of fieldwork.

IMPLEMENTATION

Phase 1

The amount of available funds divided by per-acre survey cost allowed NNAD to examine 53 quarter sections for a total of 8480 acres during Phase 1 of the project. Fortunately, our proposed sampling approach accommodated this level of acreage adjustment without seriously compromising the results. Various alternatives were considered for how to implement the sampling strategy with reduced survey acreage. After consultation with Douglas McFadden, the approach mutually agreed upon called for allocating all effort to the five sample frames that had previously received virtually no systematic survey. These five frames were Horse Mountain, Long Flat, Horse Flat, Brigham Plains, and East Clark Bench. Excluded from the Phase 1 effort were Collet Top, Fourmile Bench, Smoky Mountain, and Nipple Bench. The five sampling strata of the Phase 1 effort comprise the western portion of the Kaiparowits Plateau.

Allocating the 53 quarter-section survey units to the five sample frames followed the proportional method outlined previously. Table 4.3 presents the calculations for this approach and the resulting sampling fractions for each stratum, which average about 10 percent. Long Flat, the largest stratum, was allocated 18 quarter-section survey units whereas the smallest stratum, Horse Flat, was allocated 7 units. Because acceptable limits on the error of estimation had not been specified and the underlying population variability was unknown, there was nothing inherently adequate or inadequate about the sampling fraction. Sample adequacy is statistically evaluated later in this chapter based on project findings. On an intuitive level it seemed that sampling fractions of around 10 percent would be sufficient to provide good, first-order estimations of the cultural remains for each physiographic feature or stratum. Table 4.4 gives the legal descriptions of the 53 units surveyed during Phase 1. The distribution of these units within each sampling stratum are shown in the appropriate maps of Figures 4.3 to 4.11, as well as overall in Figure 4.2.

Phase 2

The funds available for the second phase of the project were sufficient to survey 55 quater sections. After consultation with Douglas McFadden, we decided to allocate all 8800 new acres to the four survey strata not examined during Phase 1, specifically Collet Top, Fourmile Bench, Smokey Mountain, and Nipple Bench. During Phase 1 we lacked a good basis for estimating what stratum variances might be for the project area, thus we used simple proportional allocation. The Phase1 effort, however, provided a means for estimating variance within the four Phase 2 sampling strata (Geib, Huffman and Spurr 1999:7-29). For example, Fourmile

Table 4.2. Hypothetical proportional allocation of 100 quarter sections across the nine sampling strata for the Kaiparowits Plateau.

Sampling Stratum	Acreage	No. of 1/4 Sections	Percent of Total	Allocated Units	Allocated Acreage
Collet Top	32,000	200	17.2	17	2720
Horse Mountain	12,960	83	7.1	7	1120
Long Flat	28,960	182	15.6	16	2560
Horse Flat	10,360	65	5.6	6	960
Fourmile Bench	27,840	174	15.0	15	2400
Smoky Mountain	19,040	119	10.2	10	1600
Brigham Plains	17,600	110	9.5	10	1600
Nipple Bench	22,160	139	11.9	12	1920
East Clark Bench	14,720	92	7.9	8	1280
Totals	185,640	1164	100.0	101*	16,160

*Rounding to whole quarter sections increased the total from 100 to 101.

Table 4.3. Proportional allocation of 53 Phase 1 quarter sections among the five sampling strata of the western portion of the Kaiparowits Plateau.

Sampling Stratum	Acreage	No. of 1/4 Sections	Percent of Total	Allocated Units	Allocated Acreage	Sampling Fraction
Horse Mountain	13,000	83[1]	15.6	8	1280	9.9
Long Flat	28,960	182[2]	34.2	18	2880	9.9
Horse Flat	10,360	65[3]	12.3	7	1120	10.8
Brigham Plains	17,600	110	20.7	11	1760	10.0
East Clark Bench	14,720	92	17.4	9	1440	9.8
Totals	84,600	532		53	8480	

[1]Four units are ca. 80 acres in size because of small sections.
[2]Two units are ca. 80 acres in size because of small sections.
[3]Two units are ca. 140 acres in size because of small sections.

Bench appeared comparable to Long Flat in terms of elevation, plant cover, and geology; moreover the strata lay adjacent to each other. It therefore seemed reasonable to expect similar variance values for the two strata. Factoring in both sample frame variance and size should provide the best results for a given amount of survey acreage because units are allocated where they are most needed (strata with higher variance), with less survey in areas with relatively uniform site distributions. One caveat, of course, is that there is always a potential for unexpected patterns when dealing with remains of human activity. If a particular bench offered specific desirable resources not available on an adjacent, similar bench, we would likely find an anomalously high frequency of sites.

If the site variance for Fourmile Bench could be approximated from the Long Flat sample frame, what about the other three Phase 2 sample frames? Using similar environmental comparisons, we extrapolated the variance for Horse Flat to Smoky Mountain and that of Brigham Plains to Nipple Bench. For Collet Top, however, we faced a quandary as to the appropriate variance estimate. The Phase 1 report suggested that the variance value for Horse Mountain might be appropriate, but with further thought this seemed problematic because of the exceedingly high site densities in two survey units of the Horse Mountain stratum. These densities were at least in part the result of local stone tool resources, which might not occur on Collet Top. Moreover, the site densities in these two units, which greatly increase the variance, far exceed site densities for previously surveyed units on Collet Top. As a result, we used the Long Flat variance estimate for Collet Top. As it turned out, our variance estimates were not as optimal as we would have liked, especially for

Table 4.4. Legal descriptions for the 108 quarter sections within nine sampling strata that NNAD surveyed on the Kaiparowits Plateau.

Sampling Stratum	Seq. No.	Unit No.	1/4	Sec.	Town.	Range	USGS Quad
Collet Top							
	1	28	NW	17	37S	3E	Carcass Canyon
	2	30	NW	20	37S	3E	Carcass Canyon
	3	35	SE	8	38S	3E	Carcass Canyon
	4	44	SE	8	37S	3E	Carcass Canyon
	5	47	SE	29	37S	3E	Carcass Canyon
	6	58	NE	21	38S	3E	Petes Cove
	7	59	SE	33	36S	3E	Dave Canyon
	8	66	SW	23	38S	3E	Petes Cove
	9	70	SE	14	38S	3E	Carcass Canyon
	10	81	NW	25	38S	3E	Petes Cove
	11	132	SW	33	38S	4E	Collet Top
	12	138	SW	28	39S	4E	Collet Top
	13	149	SE	33	39S	4E	Collet Top/Needle Eye
	14	154	NW	10	39S	4E	Collet Top
	15	156	NW	3	40S	4E	Needle Eye
	16	189	NW	13	39S	4E	Collet Top
	17	190	SW	13	39S	4E	Collet Top
	18	200	SE	7	39S	5E	Collet Top
Horse Mountain	1	59	NE	1	39S	2E	Horse Mountain
	2	13	NW	8	38S	2E	Death Ridge
	3	62	SE	12	39S	2E	Horse Mountain
	4	68	SW	18	39S	3E	Horse Mountain–Petes Cove
	5	75	SE	18	39S	3E	Petes Cove
	6	45	NE	3	39S	2E	Horse Mountain
	7	30	SE	29	38S	2E	Horse Mountain
	8	73	SE	7	39S	3E	Petes Cove
Long Flat	1	149	NE	24	39S	1E	Butler Valley–Horse Mtn
	2	111	NE	26	38S	1E	Butler Valley
	3	165	SE	6	39S	2E	Horse Mountain
	4	007	NE	20	39S	1E	Butler Valley
	5	051	NW	10	39S	1E	Butler Valley
	6	155	NW	6	39S	2E	Horse Mountain
	7	070	SE	27	38S	1E	Butler Valley
	8	015	NW	21	39S	1E	Butler Valley
	9	040	SW	10	38S	1E	Canaan Peak
	10	116	SE	2	39S	1E	Butler Valley
	11	122	SE	23	39S	1E	Butler Valley
	12	081	NE	27	39S	1E	Butler Valley
	13	160	SW	18	39S	2E	Horse Mountain
	14	162	SW	19	39S	2E	Horse Mountain
	15	137	NW	25	39S	1E	Butler Valley
	16	178	NE	8	39S	2E	Horse Mountain
	17	164	NE	6	39S	2E	Horse Mountain
	18	134	SW	13	39S	1E	Butler Valley
Horse Flat	1	54	NW	21	40S	1E	Horse Flat
	2	15	SW	19	40S	1E	Horse Flat
	3	61	SE	28	40S	1E	Horse Flat
	4	05	NE	12	40S	1W	Horse Flat
	5	41	NE	5	40S	1E	Horse Flat
	6	28	NE	31	40S	1E	Horse Flat
	7	40	NW	5	41S	1E	Horse Flat
Fourmile Bench	1	3	SE	24	40S	1E	Fourmile Bench
	2	8	SE	30	39S	2E	Horse Mountain
	3	31	NE	29	39S	2E	Horse Mountain
	4	51	NW	28	40S	2E	Fourmile Bench

Table 4.4, continued

Sampling Stratum	Seq. No.	Unit No.	1/4	Sec.	Town.	Range	USGS Quad
(Fourmile Bench continued)	5	52	SW	28	40S	2E	Fourmile Bench
	6	66	NE	21	40S	2E	Fourmile Bench
	7	72	NW	22	39S	2E	Horse Mountain
	8	111	SW	23	40S	2E	Fourmile Bench
	9	115	SE	26	39S	2E	Horse Mountain
	10	118	NE	11	40S	2E	Fourmile Bench
	11	131	SW	1	40S	2E	Fourmile Bench
	12	141	SE	12	40S	2E	Fourmile Bench
	13	145	NW	6	40S	3E	Fourmile Bench/ Ship Mountain
	14	149	NW	18	40S	3E	Fourmile Bench/ Ship Mountain
	15	160	SW	8	40S	3E	Ship Mountain
Smoky Mountain	1	1	NW	5	41S	3E	Ship Mountain
	2	63	NE	31	40S	4E	Ship Mountain
	3	65	NE	6	41S	4E	Ship Mountain
	4	66	SE	6	41S	4E	Ship Mountain
	5	75	NW	8	41S	4E	Ship Mountain/Needle Eye Point
	6	80	SE	29	40S	4E	Needle Eye Point
	7	93	SW	21	41S	4E	Smoky Hollow
	8	94	SE	4	41S	4E	Needle Eye Point
	9	97	NE	21	41S	4E	Smoky Hollow
	10	114	NE	27	41S	4E	Smoky Hollow
Brigham Plains	1	41	NW	25	41S	1W	Lower Coyote Spring–Horse Flat
	2	46	NE	13	41S	1W	Lower Coyote Spring–Horse Flat
	3	18	SE	27	41S	1W	Fivemile Valley
	4	103	SW	26	41S	1E	Lower Coyote Spring
	5	62	SW	20	41S	1E	Lower Coyote Spring
	6	25	SW	14	41S	1W	Fivemile Valley
	7	81	SW	3	41S	1E	Horse Flat
	8	35	NE	26	41S	1W	Lower Coyote Spring–Fivemile Valley
	9	10	SW	27	41S	1W	Fivemile Valley
	10	98	SW	11	41S	1E	Horse Flat
	11	107	SE	26	41S	1E	Lower Coyote Spring
Nipple Bench	1	3	NE	34	41S	2E	Nipple Butte
	2	16	NE	25	41S	2E	Nipple Butte
	3	17	SE	25	41S	2E	Nipple Butte
	4	46	NE	18	41S	3E	Tibbet Bench/ Ship Mountain
	5	50	NE	30	41S	3E	Tibbet Bench
	6	65	NW	29	41S	3E	Tibbet Bench
	7	98	SW	33	41S	3E	Tibbet Bench
	8	108	SE	21	41S	3E	Tibbet Bench
	9	118	SE	28	42S	3E	Tibbet Bench/Lone Rock
	10	122	SW	34	41S	3E	Tibbet Bench
	11	126	NW	27	42S	3E	Tibbet Bench
	12	128	SE	15	41S	3E	Tibbet Bench
East Clark Bench	1	06	SW	20	42S	1E	Lower Coyote Spring
	2	10	SE	20	42S	1E	Lower Coyote Spring
	3	59	NW	19	42S	2E	Nipple Butte
	4	33	NW	14	42S	1E	Lower Coyote Spring
	5	31	NE	27	42S	1E	Lower Coyote Spring
	6	76	SE	17	42S	2E	Nipple Butte
	7	83	NW	28	42S	2E	Nipple Butte
	8	02	SW	30	42S	1E	Lower Coyote Spring–Bridger Point
	9	69	NW	17	42S	2E	Nipple Butte

Nipple Bench, but also somewhat for Smoky Mountain. This is discussed in more detail later in this chapter.

Optimal allocation of the 55 survey units to the four Phase 2 sample frames is presented in Table 4.5. The distribution of the 55 units within each stratum is shown in the appropriate maps of Figures 4.3–4.11, and Table 4.4 gives the legal descriptions of these units. It is important to mention that three units (8, 115, and 184) within the Collet Top stratum had to be replaced because they fell within previously surveyed areas: Unit 115 had been surveyed during project BLM 82-16,[1] and Units 8 and 184 had been surveyed by ESCA-Tech (Kearns 1982). These units were replaced by the next three units in the sample draw (66, 81, and 132). We did not have the same concern about resurveying areas that MNA archaeologists had previously examined on Nipple Bench, Fourmile Bench, and Smoky Mountain because MNA used exceedingly wide survey intervals (ca. 150–200 yards) that undoubtedly failed to disclose less obvious traces of past occupancy. Indeed, Douglas McFadden (personal communication 1998) never considered the MNA surveys as systematic inventories. The extent to which the MNA surveys underrepresent cultural resources should interest BLM managers, and the Phase 2 effort provides this information because several of our sample units fell within the MNA survey areas: Units 51 and 66 on Fourmile Bench, Units 65 and 66 on Smoky Mountain, and Unit 46 on Nipple Bench. A brief discussion is provided at the end of this chapter about the differences between the results of the MNA and NNAD surveys.

SAMPLING RESULTS

Estimates of Site Density

The nine sampling strata of NNAD's Kaiparowits Plateau survey are Collet Top, Horse Mountain, Long Flat, Horse Flat, Fourmile Bench, Smoky Mountain, Brigham Plains, Nipple Bench, and East Clark Bench. This is in approximate north-south sequence and generally corresponds with decreasing elevation. Before estimating the frequency and spatial distribution of archaeological sites for the entire Kaiparowits Plateau study area, we examine the distribution of sites within the sample frames. The data used for the following discussion were based on calculations presented by Cochran (1977), which we present in Figure 4.12. Calculations for site density are given for total sites, historic sites, and prehistoric sites for each sampling stratum; East Clark Bench contained no historic sites so it is omitted from the relevant data table.

The first step in estimating site density is to extrapolate from the 160-acre sample units to the larger sample frame. Tables 4.6 through 4.8 present the mean, variance, and standard deviation of sites within each sample frame for total, prehistoric, and historic sites. The mean number of total sites per unit ranges from fewer than 1 on East Clark Bench to just over 12 for the Horse Mountain stratum. Fourmile Bench, Smoky Mountain, and Collet Top have similar mean numbers of sites, between 8 and 9. Long Flat has 7 sites per unit, whereas Brigham Plains and Horse Flat have 4 to 5 sites per unit. It is evident from Table 4.6 that there is a dramatic decrease in site density on a rough north-south transect, one that mostly corresponds as well with a general decrease in elevation, from a high of 1980 m (ca. 6500 feet) on average for Collet Top, roughly 1860 m (ca. 6100 feet) on Fourmile Bench, 1645 m (ca. 5400 feet) on average for Smoky Mountain, 1555 m (ca. 5100 feet) for Nipple Bench, to a low of 1340 m (ca. 4400 feet) on average for East Clark Bench. There are several likely reasons for this pattern, as discussed later. The two-sigma confidence intervals calculated from the mean number of sites for each sample frame provide a relative measure of how precise the estimates are with regard to population variability and sample size. Translated, there is a 19 in 20 chance, for example, that the total number of sites within the Long Flat sample is 1284 ± 335 (from 949 to 1619).

Another potentially useful estimate for management purposes that can be derived from the Kaiparowits Plateau Survey is an overall approximation of the total number of archaeological sites for the entire survey area. Table 4.9 presents the estimates of the mean number of sites per sample stratum and total number of sites overall for the entire project area. Separate estimates are made for all sites, prehistoric sites, and historic sites. These figures are calculated from the mean and variance of sites within each sample frame. Based on the data from the survey, we predict that approximately 7730 sites exist within the nine sampling frames, the vast majority of which are prehistoric camps of various sorts and reduction loci. The predicted

[1]This project was not known about when the sample frame was devised.

Table 4.5. Optimal allocation of 55 Phase 2 quarter sections among the four sampling strata of the central portion of the Kaiparowits Plateau.

Sampling Stratum	Acreage	No. 1/4 Sections	Percent Total	Variance Estimate[1]	Allocated Units	Allocated Acreage	Sampling Fraction
Collet Top	32,000	200	31.7	4.193	18	2880	9.0
Fourmile Bench	27,840	174	27.6	4.193	15	2400	8.6
Smoky Mountain	19,040	119	18.8	3.861	10	1600	8.4
Nipple Bench	22,160	139[2]	21.9	4.290	12	1920	8.7
Totals	101,040	632			55	8800	

[1]Extrapolated from Phase 1 survey results.
[2]One unit is ca. 80 acres in size because of state trust land.

Table 4.6. Estimates for each sample stratum of the mean number of sites per sample unit and total sites.

Sampling Stratum	Units in Frame	Surveyed Units	Sites Rec'd	Sample Unit			Sample Frame			95% CI
				Mean	Var.	SD	Mean	Var.	SD	
Collet Top	200	18	151	8.4	32.37	5.69	1678	65457.31	255.85	± 501
Horse Mountain	83	8	97	12.1	128.41	11.33	1006	99918.21	316.10	± 620
Long Flat	182	18	127	7.1	17.59	4.19	1284	29156.64	170.75	± 335
Horse Flat	65	7	33	4.7	14.91	3.86	306	8024.64	89.58	± 176
Fourmile Bench	174	15	135	9.0	32.71	5.72	1566	60351.36	245.67	± 481
Smoky Mountain	119	10	83	8.3	42.23	6.50	988	54782.44	234.06	± 459
Brigham Plains	110	11	44	4.0	18.40	4.29	440	18216.00	134.97	± 265
Nipple Bench	139	12	35	2.9	6.08	2.47	405	8951.84	94.61	± 185
East Clark Bench	92	9	6	0.7	1.75	1.32	61	1484.82	38.53	± 76

SD = standard deviation.

Table 4.7. Estimates for each sample stratum of the mean number of prehistoric sites per sample unit and total prehistoric sites.

Sampling Stratum	Units in Frame	Surveyed Units	Sites Rec'd	Sample Unit			Sample Frame			95% CI
				Mean	Var.	SD	Mean	Var.	SD	
Collet Top	200	18	149	8.3	33.27	5.77	1656	67281.36	259.39	± 508
Horse Mountain	83	8	92	11.5	124.29	11.15	955	96708.50	310.98	± 610
Long Flat	182	18	114	6.3	14.94	3.87	1153	24772.78	157.39	± 308
Horse Flat	65	7	32	4.6	14.95	3.87	297	8049.94	89.72	± 176
Fourmile Bench	174	15	133	8.9	33.27	5.77	1543	61371.55	247.73	± 486
Smoky Mountain	119	10	76	7.6	36.04	6.00	904	46754.39	216.23	± 424
Brigham Plains	110	11	40	3.6	17.06	4.13	400	16884.45	129.94	± 255
Nipple Bench	139	12	35	2.9	6.08	2.47	405	8951.84	94.61	± 185
East Clark Bench	92	9	6	0.7	1.75	1.32	61	1484.82	38.53	± 76

SD = standard deviation.

SAMPLE UNIT

Sample mean $\bar{y}_n = \frac{\Sigma y_{hi}}{n_h}$

Sample variance $s_h^2 = \frac{\sum\left(y_{hi} - \bar{y}_h\right)^2}{n_h - 1} = \frac{\sum y_{hi}^2 - \frac{\left(\sum y_{hi}\right)^2}{n_h}}{n_h - 1}$

Sample standard deviation $\sigma_h = \sqrt{s_h^2}$

SAMPLE FRAME

Estimated population total $\hat{Y}_h = N_h \bar{y}_h$

Estimated population variance $v\left(\hat{Y}_h\right) = \frac{N_h^2 s_h^2}{n_h}\left(1 - \frac{n_h}{N_h}\right)$

Estimated population standard deviation $\hat{\sigma}_h = \sqrt{v\left(\hat{Y}_h\right)}$

Confidence interval (95%) $\hat{Y}_{h(low)} = \hat{Y}_h - (1.95996)\left(\sqrt{v\left(\hat{Y}_h\right)}\right)$

$$\hat{Y}_{h(high)} = \hat{Y}_h + (1.95996)\left(\sqrt{v\left(\hat{Y}_h\right)}\right)$$

PROJECT AREA

Estimated unit mean $\bar{y}_{ST} = \Sigma\left(W_h \bar{y}_h\right)$ where $W_h = \frac{N_h}{N}$

Estimated unit variance $v\left(\bar{y}_{ST}\right) = \Sigma \frac{W_h^2 s_h^2}{n_h} - \Sigma \frac{W_h s_h^2}{N}$ where $W_h = \frac{N_h}{N}$

Optimal allocation of units $n_h = n\left(\frac{N_h S_h}{\sum N_h S_h}\right)$

Sample size with bound of error $n = \frac{\left(\Sigma N_h s_h\right)^2}{V + \Sigma N_h s_h^2}$ where $V = \left(\frac{d}{t}\right)^2$

and d = desired error

$t = 2$ (at 95% confidence).

Figure 4.12. Equations used to calculate descriptive and predictive statistics for the Kaiparowits Plateau Survey (after Cochran 1977).

Table 4.8. Estimates for each sample stratum of the mean number of historic sites per sample unit and total historic sites.

Sampling Stratum	Units in Frame	Surveyed Units	Sites Rec'd	Sample Unit Mean	Sample Unit Var.	Sample Unit SD	Sample Frame Mean	Sample Frame Var.	Sample Frame SD	95% CI
Collet Top	200	18	2	0.1	0.11	0.32	22	212.33	14.57	± 29
Horse Mountain	83	8	5	0.6	1.13	1.06	52	875.38	29.59	± 58
Long Flat	182	18	13	0.7	1.39	1.18	131	2303.02	47.99	± 94
Horse Flat	65	7	1	0.1	0.14	0.38	9	76.99	8.77	± 17
Fourmile Bench	174	15	4	0.3	1.07	1.03	46	1968.42	44.37	± 87
Smoky Mountain	119	10	10	1.0	1.33	1.16	119	1729.10	41.58	± 81
Brigham Plains	110	11	4	0.4	0.86	0.92	40	846.45	29.09	± 57
Nipple Bench	139	12	1	0.1	0.08	0.29	12	122.14	11.05	± 22

Table 4.9. Estimates for the entire project area of the mean number of sites per sample stratum and total number of sites overall; estimates include all sites, prehistoric sites, and historic sites.

Sampling Stratum	N[1]	n[2]	W[3]	All Sites	Prehistoric	Historic
Collet Top	200	18	0.172	1678	1656	22
Horse Mountain	83	8	0.0173	1006	955	52
Long Flat	182	18	0.156	1284	1153	131
Horse Flat	65	7	0.0558	306	297	9
Fourmile Bench	174	15	0.149	1566	1543	46
Smoky Mountain	119	10	0.102	988	904	119
Brigham Plains	110	11	0.0945	440	400	40
Nipple Bench	139	12	0.119	405	405	12
East Clark Bench	92	9	0.0790	61	61	0
Total Sites per Unit	1164	108	--	6.6	6.3	0.4
Estimated Site Total	1164	108	--	7726	7364	432
Unit variance (KPS total)	1164	108	--	0.259	0.240	0.006

[1]Units in frame.
[2]Units surveyed.
[3]N_h/N.

total number of sites per sample stratum ranges from 61 on East Clark Bench, the most sparsely used area (or area with the scarcest evidence of use), to 1678 on Collet Top, which is the largest of the sample frames.

Evaluation of Precision

One means to evaluate the adequacy of a sample is to examine the confidence intervals given in Tables 4.6 to 4.8. Narrow confidence intervals suggest that the sample estimate is likely a close approximation of the total number of sites within sampling strata and that the amount of area currently surveyed may be adequate for making certain inferences. Wide confidence intervals indicate that the sample estimate is likely to be way off because of greater population variance. The wider the interval is relative to the mean, the less precise the estimate. The only interval that seems reasonable is for Long Flat (standard deviation is 7.6% of the mean) and even it could be improved. The interval for Long Flat is the narrowest because of low population variability (i.e., most units had nearly the same number of sites). Given the number of sites discovered, the intervals for the Fourmile Bench and Collet Top are somewhat reasonable, about 15 percent of the mean, but these intervals also could be improved. The intervals for many of the sample frames are quite wide, suggesting

that larger sample fractions are needed for more precise estimates. On East Clark Bench, for example, there is the ridiculous possibility of the total site population being 61 ± 76 (a negative 15 sites).

The Kaiparowits Plateau Survey provides the data necessary to calculate the amount of additional archaeological survey work needed to achieve a desired level of confidence, to allow more precise estimates of cultural resources in the project area. By knowing the variance about the mean for each of the sample frames, we can calculate the number of additional units to be surveyed to reach a specific bound on the error of estimation. Table 4.10 presents these data, calculated with a 95 percent confidence coefficient, as well as the optimal allocation of those additional units among the sample frames. For example, to estimate the total number of sites in the entire project area within 100 sites, 895 units would need to be surveyed, and they should be distributed among the sample frames as indicated in the second column of Table 4.10. For a prediction within 500 sites, 334 survey units would be necessary, allocated as shown in the sixth column of Table 4.10. The seventh column of this table lists the number of units actually surveyed in each sample frame during the Kaiparowits Plateau Survey. Comparison with the numbers in columns 2 through 6 indicates that additional survey is needed in all but one of the nine sample frames to reduce the error of predicting the total number of sites in the project area.

Another way of deciding how much additional survey might be needed is to examine bounds on the error of estimation calculated independently for each sampling stratum. In this case we are interested in providing an estimate of the total number of sites for a single sampling stratum within a given value, for example, plus or minus 300 total sites for the Long Flat sampling stratum. Table 4.11 presents the results of these calculations. To continue with the Long Flat example, to achieve this level of precision we would need to survey 23 units, which, minus the 18 already examined, would require examination of just another 5 units. Calculating the bounds on error of estimation in this fashion shows that some of the sample frames currently have reasonable survey coverage whereas others do not, with Horse Mountain being the outstanding example of an area requiring more work.

Site Distribution

Patterns in the distribution of sites across the sampling strata can be examined using chi-square analysis of the sampling data. Basically, this is a means to statistically infer whether some portions of the Kaiparowits Plateau were preferred for settlement over other portions. The underlying logic of the approach is this: If people preferred to locate sites in one portion of the study over another, then our survey should have discovered significantly more sites in some areas and significantly less sites in other areas (see Plog and Hill 1971:27–29; Plog et al. 1978:181–182). If the physiographic features that comprise the sampling strata were used equally, then sites should occur on these features in simple proportion to their spatial extent.

Table 4.12 presents the results of this analysis. It lists the sampling strata, the observed site frequencies, and the expected site frequencies calculated from the proportion of each sampling stratum that we examined. The chi-square statistic shows that observed site frequencies are significantly different than expected. Reasons for this significant difference are presented below (see Discussion of Variance).

DISCUSSION OF ALLOCATION METHODS

At the start of the Kaiparowits Plateau Survey, because of the minimal previous archaeological work in he project area, no data were available to provide useful variance estimates for any given sampling stratum. Consequently, the 53 survey units of the Phase 1 effort were allocated to the five strata that were the focus of that year's effort by simple proportion of the sample frame size. With variance estimates in hand (Table 4.6), we calculated how the 53 units would have been allocated to the five sampling strata using optimal allocation (or Neyman allocation, Cochran 1977:96-99). Optimal allocation of sample units is designed to reduce overall variance within a sample by allocating units where they are most needed (the strat where variance is greastest). Table 4.13 reveals that, with two exceptions, the Phase 1 survey units were allocated appropriately. On Long Flat, Horse Flat, and Brigham Plains, the number of surveyed units is within two of the quantity calculated by optimal allocation. For the Horse Mountain sample frame, optimal allocation predicts that 20 units would be necessary to minimize the

Table 4.10. The number of units to be surveyed (optimal allocation) to achieve a specific bound on the error of estimation of the total number of sites in the project area (two-sigma confidence interval).

Sampling Stratum	Within 100 Sites	Within 200 Sites	Within 250 Sites	Within 300 Sites	Within 500 Sites	Surveyed (KPS)	Optimal Allocation[1]
Collet Top	175	146	130	114	68	18	21
Horse Mountain	145	121	107	95	56	8	18
Long Flat	118	98	88	77	45	18	14
Horse Flat	39	32	29	25	15	7	5
Fourmile Bench	154	128	114	100	59	15	19
Smoky Mountain	119	99	88	78	46	10	14
Brigham Plains	73	61	54	48	28	11	9
Nipple Bench	53	44	39	35	20	12	6
East Clark Bench	19	16	14	12	7	9	2
Total units	895	745	663	584	334	108	108

[1]Optical allocation of the 108 surveyed units based on the known variance in Table 4.6.

Table 4.11. Number of units to be surveyed to achieve a specific bound on the error of estimation of the number of sites in each sample frame (two-sigma confidence interval).

Sample Frame	Within 100 sites	Within 200 sites	Within 250 sites	Within 300 sites	Within 500 sites	Surveyed for KPS	Confidence Interval (95%)
Collet Top	144	79	59	45	19	18	501
Horse Mountain	68	43	34	27	12	8	620
Long Flat	103	45	31	23	9	18	335
Horse Flat	18	6	4	3	1	7	175
Fourmile Bench	121	63	46	35	15	15	481
Smoky Mountain	79	40	29	22	9	10	459
Brigham Plains	49	19	13	9	3	11	265
Nipple Bench	35	11	7	5	2	12	185
East Clark Bench	6	1	1	1	1	9	76

Table 4.12. Chi-square analysis of site distributions among sampling strata, Kaiparowits Plateau Survey.

Sampling Stratum	Observed (f_o)	Expected (f_e)	Difference ($f_o - f_e$)	$\frac{(f_o - f_e)^2}{f_e}$
Collet Top	151	122	+29	5.7
Horse Mountain	97	51	+46	21.8
Long Flat	127	111	+16	2.0
Horse Flat	33	40	–7	1.5
Fourmile Bench	135	106	+29	6.2
Smoky Mountain	83	73	+10	1.2
Brigham Plains	44	67	–23	12.0
Nipple Bench	35	85	–50	71.4
East Clark Bench	6	5 6	–50	416.7
				$X^2 = \Sigma \frac{(f_o - f_e)^2}{f_e} = 538.5$

Note: df = (n – 1) = 8 so p(0.005) = 22.0; therefore X^2 is significant at the 0.005 level.

Table 4.13. Comparison of proportional allocation of Phase 1 sample units and optimal allocation to minimize variance based on the variance estimates in Table 4.6.

Sampling Stratum	N	Mean (y)	Std. Dev. (σ)	No. Units Surveyed	Optimal Allocation[1]
Horse Mountain	83	12.1	11.33	8	20
Long Flat	182	7.1	4.19	18	16
Horse Flat	65	4.7	3.86	7	5
Brigham Plains	110	4.0	4.29	11	10
East Clark Bench	92	0.7	1.32	9	3

[1]Due to rounding error, the optimal allocation appears to require 54 units, although 53 units were actually surveyed.

number of sites per unit. Optimal allocation indicates that only three units would need to be surveyed on East Clark Bench, but clearly this is not realistic.

As described earlier, we attempted to best allocate the 55 Phase 2 survey units by extrapolating the Phase 1 variance estimates to the Phase 2 strata and thereby use the optimal allocation method. The logic for this approach involved the environmental similarities among different strata. We believed that the Fourmile Bench stratum, for example, would be quite similar to that of Long Flat. Consequently, it seemed reasonable to expect similar site densities and variance values for the two areas. Using this reasoning, we applied the variance value for Brigham Plains to Nipple Bench and that of Horse Flat to Smoky Mountain. The appropriate variance estimate for Collet Top appeared less obvious, but in the end we used that for Long Flat, rather than the exceedingly high variance value for Horse Mountain (see Table 4.5).

As a check of the effectiveness of the Phase 2 allocation model, we recalculated the optimal allocation of the 55 Phase 2 units using the variance estimates obtained from the Phase 2 survey. The results given in Table 4.14 can be seen as a comparison of "presumed" optimal allocation using the Phase 1 variance estimates and "true" optimal allocation based on the known variances as determined from survey (see Table 4.6). Table 4.13 reveals that applying the Phase 1 variance estimates for allocation of Phase 2 units worked quite well for one of the Phase 2 sample frames: Collet Top. The number of surveyed units for Collet Top is just one less than the quantity calculated by the actual Phase 2 variance estimates. Two less units were surveyed for Fourmile Bench and three less for Smoky Mountain than would have been the case under "true" optimal allocation. Smoky Mountain turned out to have far more intensive prehistoric and historic use than we had initially envisioned, with considerably more sites per unit and a much higher variance than Horse Flat. Given the known variances for the Phase 2 strata, we should have surveyed six fewer units on Nipple Bench, allocating them instead to the other three strata. Allocating more units to the other strata clearly would have been helpful, but examining just six units for a frame the size of Nipple Bench would not have been useful. As is, the calculation of the number of units needed to place a specific bound on the error of estimation (Table 4.11) reveals that the 12 units surveyed on Nipple Bench allow us to estimate the total number of sites within this stratum with a confidence threshold of ± 200 sites.

DISCUSSION OF VARIANCE

Wide confidence intervals result from sample unit variance, increasing in width as variance increases; it is conceptually easier to think of this by examining the standard deviations compared to means within each stratum (Tables 4.6 to 4.8). Although it is difficult to completely account for greater variance in some sampling strata compared to others, several factors are likely to contribute significantly. The proximate cause is that sites are often clustered in space, many in some areas and few in others. The underlying causes for clustering are usually environmental, though differential site visibility and preservation may also play a role.

On East Clark Bench, for example, site density is extremely low and most sample units contain no sites. This may result because the environment offered relatively few desirable resources to prehistoric hunter-gatherers. We doubt this was the case because below the Dako-

Table 4.14. Comparison of presumed optimal allocation of Phase 2 sample units using Phase 1 variance estimates and "true" optimal allocation to minimize variance based on the variance estimates obtained from the Phase 2 survey and given in Table 4.6.

Sampling Stratum	N	Mean (y)	Std. Dev. (σ)	Presumed Optimal	Optimal Allocation
Collet Top	200	8.4	5.69	18	19
Fourmile Bench	174	9.0	5.72	15	17
Smoky Mountain	119	8.3	6.50	10	13
Nipple Bench	139	2.9	2.47	12	6

Note: The column presumed optimal allocation lists the number of units actually surveyed during Phase 2.

ta Sandstone the area is largely a grassland community that contains a profusion of useful grasses (surveyors observed ricegrass and four different species of dropseed), weedy annuals (blazing star, sunflower), and bulbs (onions and sego lilies). Above the conglomerate the terrain is largely a shadscale badland that is far less useful in terms of subsistence resource procurement. A more likely reason for low site density has to do with the overall poor suitability of the area for camps—no firewood, no trees for shade, no water, few handy places to get rock. In contrast, nearly anywhere on Long Flat has camping amenities, and the outcomes of selecting a site location are nearly equal because one place is about as good as the next. This is not true on East Clark Bench—there are the bare, open grasslands or shale badlands, or one could locate along Wahweap Creek or a few other select locations where there is water, wood, and shelter. Broken Arrow Cave (Talbot et al. 1999) is a good example of where foragers exploiting the area likely would have stayed. The result is that any given 160-acre unit on the lower benches has a small chance of containing sites. Indeed, six of the nine survey units on East Clark Bench contain no sites. One unit, however, contains four sites. Specific environmental variables, such as proximity to a spring, a trail, or a rock unit that forms shelters, strongly correlate with sites. Because of such resources some units may contain several sites whereas most will contain none; thus the variance from the mean number of sites may be large. The only effective way of dealing with this situation is to increase the sampling fraction by surveying a substantially larger proportion of the area. It might be more productive to forego probabilistic sampling and use remote sensing (aerial photographs and other images) to sleuth ou t likely areas for occupancy and then examine these areas intensively or conduct a judgmental reconnaissance. No statistical estimates could be made, but this might be a worthwhile tradeoff because otherwise few sites would get recorded and little would be learned about prehistoric use of this stratum.

Extreme environmental patchiness appears to be a principal reason for the large variance in some sampling strata, resulting in wide confidence intervals. Many sample frames contain sharp distinctions in the suitability (or desirability) of terrain for human use. This is perhaps best typified by the findings from adjacent survey units, with two good examples being Units 103 and 107 on Jack Riggs Bench (part of the Brigham Plains stratum) and Units 189 and 190 on Collet Top (Figure 4.13). In Unit 107 on Jack Riggs Bench surveyors found but a single scatter of artifacts that just barely qualified as a site. In contrast, they recorded 11 sites in Unit 103, several of which are quite significant, being the only examples of certain types found during the Phase 1 survey effort. The local topography of this stratum is such that broad, flat benches are separated by small, steep swales and canyons that offer water and access to higher or lower benches. The canyons and adjacent slopes provide a variety of resources and desirable habitation sites. Open sage flats mixed with sparse pinyon-juniper forests offer grass and plant resources but lack protected campsites. In this sample frame, the chances of finding sites in a given unit are quite variable and depend strongly on the topography and microenvironment. The sites are not as restricted to small, isolated microenvironments as hypothesized for East Clark Bench, but are not as widely or evenly distributed as on Long Flat.

On Collet Top in Unit 190 surveyors found four small sites–a granary tucked under the canyon rim, a house, and two open sherd and lithic scatters. In contrast, the crew that

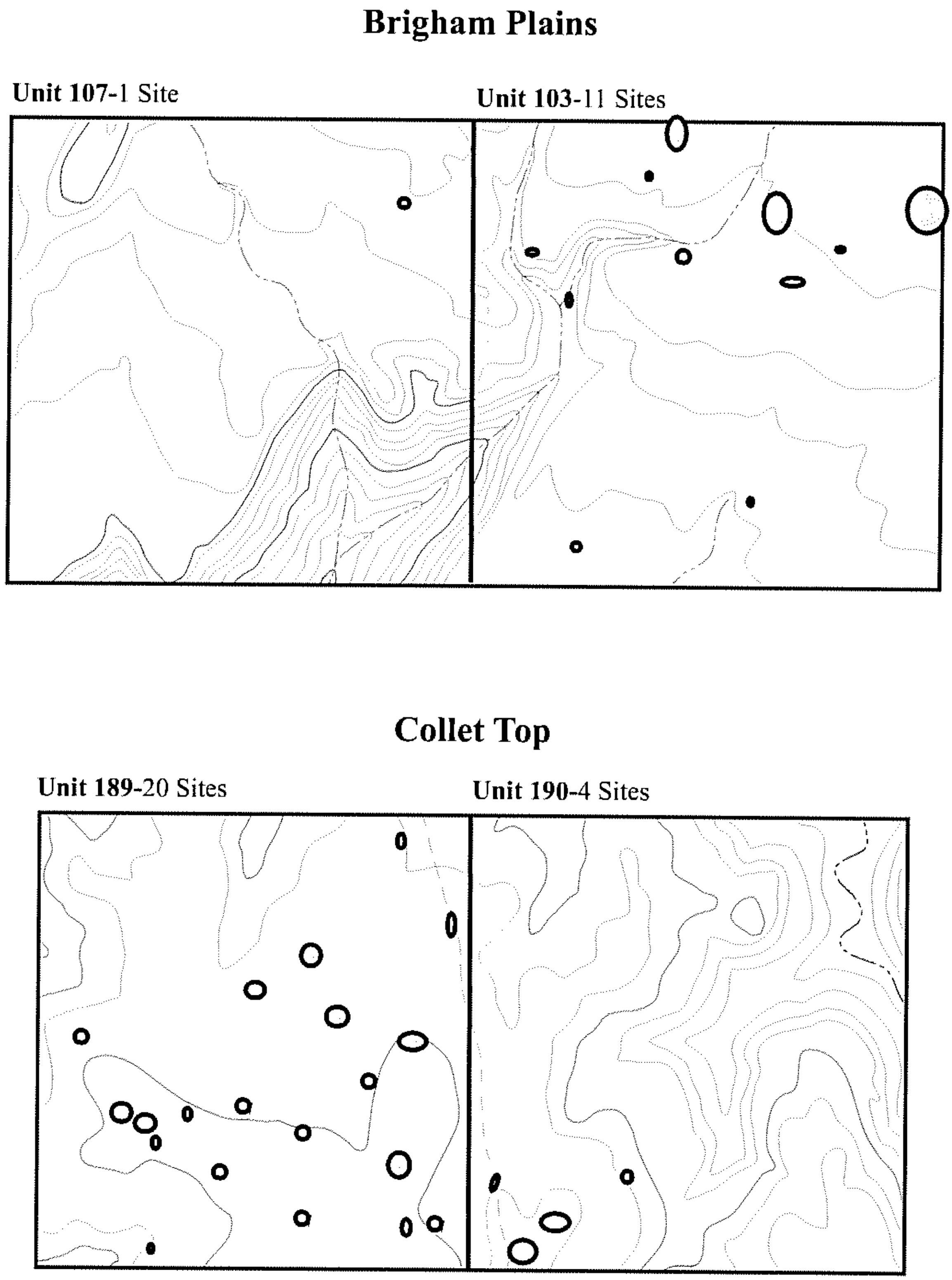


Figure 4.13. Examples of contrasting site densities within adjacent survey units on the Kaiparowits Plateau from Brigham Plains and Collet Top sample frames.

surveyed Unit 189 recorded 20 sites, more than half of which are habitations with evidence of masonry or jacal structures. In this sample stratum the important difference in the number of sites recorded per unit appears related to whether the terrain is level or dissected, and not in any obvious way to what type of vegetation is present. The ledgy cliffs of a canyon largely comprised Unit 190 whereas Unit 189 consisted of level terrain. The granary of Unit 190 was at the head of the canyon but the other three sites of the unit were on level terrain near the canyon edge, the same topography that characterized Unit 189. This particular portion of the Collet Top stratum seems to have been suitable for dry farming, hence the occurrence of Anasazi habitations; other level portions of Collet Top had high site counts, but sites were characterized by stone artifacts and occasional hearths. The land embraced by the Collet Top sampling frame is so dissected by canyons that even with careful drawing of the stratum boundary to exclude rugged terrain, much was still included and these units always contained few sites.

A sample frame with high site density but relatively low variance is Long Flat. In this area, desirable resources and camping locations are distributed relatively evenly, and any unit has a nearly equal chance of containing a similar frequency of sites. Long Flat has fewer microenvironments containing resources that are not available elsewhere, and the entire sample frame was heavily used during prehistory; it also saw relatively high use during the historic period.

Fourmile Bench lies immediately adjacent to Long Flat and appears to offer identical resources and camping locations; nonetheless it has an even higher site density (9 compared to 7) and also greater variance (18 instead of 33). This particular contrast can be attributed almost entirely to a single unit with an exceedingly high number of sites (24). On Long Flat the highest number of sites per unit was 13; this occurred in three instances and was not an extreme outlying value because there were also units with 12, 10, and 8 sites. On Fourmile Bench the next highest number of sites per unit after 24 was 14 (2 instances)—a large gap. If the unit with 24 sites is held out of the calculations, the mean for the sample frame is 7.9 sites per unit, with a standard deviation of 4.1, quite comparable to that of Long Flat (mean of 7.1, standard deviation of 4.2). The one exceptional environmental trait of the Fourmile Bench unit with a high site count was the occurrence of a permanent seep within a canyon on the eastern third of the unit. Fourmile Bench is relatively dry, especially compared to Long Flat, thus the presence of this seep was doubtless a strong attractant to using this unit; most of the sites were clustered within close proximity of the seep around the canyon's head. The canyon also might have been an attraction because it leads directly down into Paradise Canyon with its permanent water and easy access to other portions of the Kaiparowits Plateau.

The Horse Mountain sampling stratum contains the highest density of prehistoric remains. The entire area was obviously used throughout prehistory by mobile hunter-gatherers, who left behind a plethora of remains and camps that often are adjacent to or partially overlap previous camps. Certainly this density is at least partially the result of intensive use of the area, but it is quite possible that this stratum was used no more intensively than the adjacent Long Flat or even Horse Flat. What might vary is simply how abundant and obvious the evidence of use is on Horse Mountain compared to some other strata. This could result because of the occurrence of Paradise chert sources on Horse Mountain. At or near source locations foragers are likely to be little concerned with conserving raw materials and indeed would normally be working down nodules and flake blanks into transportable bifaces, cores, or other tools. This initial reduction and lack of concern for resource conservation leaves a highly visible trace and is no doubt the cause of the often remarkably high background noise of lithic artifacts in the sample stratum. On Horse Flat, Brigham Plains, and Nipple Bench, however, chert and chalcedony are not available; thus foragers should have been more conservative of raw material, and lithic reduction would entail resharpening and tool modification but not initial reduction. The resulting archaeological trace would be far less obtrusive and scattered.

The high density of artifacts and features on Horse Mountain can be dealt with in two ways: either by lumping large areas into a few sites that represent numerous episodes of use, or by finding ways to partition and create many small sites that might better correspond with individual episodes of use. The former method would result in few sites within a unit, or even a single site in the most extreme case. This would create low sample variance because most sample units

would contain just a few large sites. The other approach would result in high sample variance, because there could be far more variability in site number among units. For this project surveyors attempted to record discrete artifact loci as sites whenever possible by ignoring the background scatter that seemed to be the result of erosion and other factors (see discussion in Chapter 1). The result for the Horse Mountain stratum was one unit containing 36 sites and another with 18 sites. This contrasts with two units of this stratum in rough terrain that contained only 2 and 1 sites each. To gauge the effect of units with high site numbers we recalculated the mean and standard deviation by omitting the unit with 36 sites. By doing this, the mean for the sample frame is 8.7 sites per unit instead of 12.1, with a standard deviation of 6.4 instead of 11.3. The large standard deviation, then, is partially imposed by field methods, but also reflects the concentrated amount of flaked stone debris that occurs across most of the Horse Mountain stratum.

Smoky Mountain exhibits the next highest variance after Horse Mountain and a site density that frankly came as something of a surprise, including the highest density of historic sites. With the number of sites per survey unit ranging from 0 to 21, high variance is a natural result. Half of the units were clustered around the mean of 8 sites (between 7 and 10 sites), but there was a unit with no sites and a unit with one site—both located in steep dissected terrain—then there was a unit with 16 sites and one with 21. The units with the highest numbers of sites were situated toward the blackbrush-covered southern end of Smoky Mountain, which currently appears to be a less desirable environment than the northern portion, where pinyon-juniper woodland and sage meadows replace the blackbrush and hopsage community. Smoky Mountain has historically been used as livestock range, and intensive grazing may be partially responsible for the modern distribution of vegetation. In any event it is clear that portions of Smoky Mountain were highly favored for use and settlement, whereas other portions were poorly suited, mainly because they offered comparatively few resources.

SAMPLING BIASES

The one limitation of our sampling design, but fortunately one that is easily remedied, consists of potential inherent biases resulting from the type of terrain that we omitted from study. The most serious bias may result from exclusion of canyons, because by doing this we may have systematically excluded a small but important portion of the region's archaeological record. Canyons likely contain most of the region's rockshelters and caves. It is in canyons, if anywhere, that rock art is likely to occur (though the friability of local sandstones makes for poor preservation). Canyons may contain agricultural niches and thus harbor farmer residences and hidden granaries. Travel routes are more likely to be observed in canyons; indeed, we identified one such route in Paradise Canyon (IO165; see the discussion of isolated occurrences [IOs] in Chapter 6). Canyons also contain springs, seeps, and small catchments, which are likely to have increased the intensity of use in closely adjoining terrain. In future inventories we recommend that some means be devised to survey canyon terrain and areas around springs to enable a more complete record of the archaeological remains on the Kaiparowits Plateau.

Another potential bias of the survey may stem from excluding rough dissected terrain. As a result we may have missed flaked stone raw material sources; we know of several regions in Utah where this would have been true. This seems less of a concern because of how common flaked stone raw material was within our survey parcels. Dissected terrain, however, might contain other rare types of sites such as hunting blinds or ceremonial locations. Sites of this type, however, were not reported by Kearns (1982), who obtained a fairly good sample of talus-strewn slopes and other rugged terrain.

COMPARISON WITH MNA SURVEY RESULTS

Three of the Phase 2 sampling frames included areas previously surveyed, evidently in reconnaissance fashion, by archaeologists from the Museum of Northern Arizona. This work was done during the planning stage of a large project that included a coal mine and two coal-fired electric generators (see summary in Chapter 3). Fortunately the proposed developments never occurred. Because several of our survey units coincided with areas that MNA had examined, it seemed worthwhile to compare results.

On both Fourmile Bench and Smoky Mountain, two of our units fell within areas examined

by MNA (Units 51 and 66 on Fourmile and Units 65 and 66 on Smoky Mountain), and on Nipple Bench one whole unit (46) and part of another unit (3) fell within areas previously examined. A comparison of the site counts for these units is given in Table 4.15. The difference in results is striking, although not unexpected given the spacing between individuals as reported in Chapter 3. This exercise admirably substantiates Douglas McFadden's belief that the MNA survey was not intensive in the current sense of the term. It should serve as a strong reminder to future managers of the Grand Staircase–Escalante National Monument that the MNA surveys in the 1970s were at a reconnaissance level. If future development is ever envisioned for the project areas of the coal mine and generating plants, these sections need to be entirely resurveyed.

Table 4.15. Comparison of MNA and NNAD site counts for NNAD survey units that coincided with areas previously examined by MNA.

Sampling Stratum	Unit No.	NNAD Site Count	MNA Site Count
Fourmile Bench	51	9	1
	66	2	0
Smoky Mountain	65	8	0
	66	7	1
Nipple Bench	46	2	0
Site Total		28	2

CHAPTER 5

TESTING RESULTS FOR 13 SITES

OBJECTIVES

One recommendation of the Phase 1 report was to conduct limited and highly focused archaeological testing of select sites prior to starting the second phase of survey (Geib, Huffman and Spurr 1999:7–37). We suggested that a testing program could help further inventory on the Kaiparowits Plateau in at least four ways: (1) by evaluating the utility of the alternative dating methods used during Phase 1; (2) by acquiring a better understanding of various features such as fire-cracked rock scatters and charcoal stains; (3) by determining if sites that appeared deflated actually lack depth; and (4) by obtaining a better understanding of flaked stone tool morphological types and functions. We argued that testing could benefit any future survey work by potentially decreasing the number of sites placed in the temporally unknown category, helping to diagnose site functions and activities, and allowing more informed assessments of site and feature preservation. Moreover, if survey observations and recording procedures could be refined, this might aid in making National Register recommendations. Accordingly, the BLM included site testing as a possible task in their request for proposals for Phase 2 of the survey. The funds available for this task were limited, but sufficient to begin recovering data that would help to address the four key issues outlined above. The first three of these became the principal objectives of the testing project and we designed the program around them. Concerning the fourth issue, it became clear while designing a testing strategy that an adequate sample of stone tools would not be forthcoming from such a limited project.

Our primary interest was to examine the alternative dating methods used during Phase 1 (see Chapter 7). Field crews made every effort to locate traditional temporal diagnostics (projectile points and sherds) at archaeological sites, but as is frequently the case on survey, many sites lacked them. Therefore, during the course of fieldwork they also began to employ alternative means for judging the relative temporal placement of sites. These alternatives arose through simple pattern recognition and they seemed to hold up when crosschecks with temporal diagnostics were available. Patination of flakes and tools was one of the alternative methods, especially for artifacts of chalcedony or chalcedony-like materials (e.g., the best-quality petrified wood which we commonly referred to as agatized wood). Another important method concerned various qualities that relate to the condition and scattering of remains, especially grinding tool fragmentation and weathering and charcoal preservation on the surface of hearths. Crusts formed by carbonate accumulation on artifact surfaces also seemed to suggest some antiquity, but likely only if the crusts are relatively thick (ca. 0.5–1 mm). Laboratory analysis of collected sherds, which are relatively recent artifacts, revealed thin crusts. Sometimes several alternative methods appeared to be mutually supportive of a suggested relative age. For example, at site 42KA 4662, four characteristics of the remains supported a Post-Formative temporal assignment. A probable arrow point tip production mistake at the site suggested that the remains were no older than the late preceramic (about 100 A.D.), but other evidence seemed to limit the maximum age even more, suggesting a relatively recent origin. As originally recorded on Part B of the IMACS form for this site, these characteristics were lack of patina on flakes, charcoal chunks on the hearth surface, no (erosion) dispersion of remains, and preserved unburned bone. A Post-Formative temporal affiliation was plausible, especially through the triangulation of evidence, but was it correct? If it could be shown to be correct then we had the chance to be on much firmer ground during Phase 2 of the survey when making temporal assignments based on evidence other than traditional diagnostics.

A second thrust of the testing project was to acquire a better understanding of various features. During Phase 1 of the Kaiparowits Plateau survey NNAD archaeologists recorded 268 prehistoric features among 132 sites (44% of the Phase 1 total of 297 prehistoric sites). The most common feature types observed were charcoal stains and fire-cracked rock (FCR) concentrations, which together accounted for 87 percent of all recorded

prehistoric features; charcoal stains accounted for just over half of the features (52%), followed by FCR concentrations (35%). In the Phase 1 report we attempted to strike a reasonable balance between the extremes of function-free labels, such as "fire affected rock concentration" and function-specific nomenclature like "roasting pit." This seemed particularly important in relation to charcoal stains and FCR features because without the benefit of testing or excavation, it was impossible to gauge the function of many of these features based on surface evidence alone. Indeed, it seemed likely that these two categories masked variability and were perhaps not as mutually exclusive as their partitioned status implied. After all, many charcoal stains contained small amounts of burned and unburned rock, such as quartzite cobbles and sandstone slab fragments. It was the relative amount of burned rock and to some extent the size of the scatter that seemed important: FCR scatters were identified by large quantities of burned and unburned rock in concentrations generally 1–3 m in diameter. But without the benefit of excavation, it seemed entirely possible that these two feature "types" simply represented the remains of similar features that appeared different due to the vagaries of surface exposure, or perhaps ends of a functional continuum. Limited testing, it seemed, would help us to better understand these features, which in turn would lead to more informed recording during Phase 2.

Somewhat related to the previous topic, particularly with regard to whether FCR scatters are eroded hearths, and clearly implicated in assessing site significance, is the extent of site deflation. A moderate proportion of the Phase 1 sites, especially those proposed to have an Archaic temporal affiliation, appeared badly deflated, with artifacts resting as a lag deposit. The best evidence for this during survey was provided by large flat artifacts, such as fragmented grinding slabs, which are less subject to erosional displacement. These frequently occurred on low sediment pedestals, indicating that they had functioned as small cap stones, minimally protecting the underlying sand while the surrounding sediment blew away. Smaller artifacts or those easily rolled as the sand moved away, such as flaked cobble tools, failed to provide protective covers and thus they were left on a common deflation surface. Although this scenario seemed to explain the condition of many sites, testing could conclusively demonstrate this one way or another. More important, testing might reveal that despite deflation some sites retained certain aspects of integrity that made them important sources of archaeological data for understanding prehistory, thus making them Register eligible.

We initially proposed that testing could help us better understand flaked stone tool morphological types and functions. But in devising the testing strategy it became obvious that this goal was less likely to be achieved with such a limited and highly focused program. Because our collection of artifacts was restricted to remains present within test units, we had to depend on recovering certain tools within one or two test units that accounted for a very small proportion of any given site—an exceedingly fortuitous event. There is considerable merit to investigating the functions of the stone tools commonly seen during the Kaiparowits Plateau survey, but the testing program was not the ideal venue.

SITE SELECTION

As explained in Chapter 2, site selection was something of a compromise between logistics, especially having to horse-pack into areas, a budget that allowed for only 8 days of fieldwork, and our research interests. Our initial plan presented a list of 30 sites as potential candidates for testing (Geib, Huffman and Warburton 1999:Table 2). These 30 covered a range of time periods, from Archaic through Post-Formative, and appeared appropriate to the three primary objectives guiding the testing program. Exactly how many and which of these 30 would be tested was left open and would depend upon how the fieldwork progressed. As it worked out, we managed to test 13 sites, one of which (42KA4549) was not on the initial list. It was added shortly before the fieldwork began because of having to adjust the testing schedule to better accommodate horse transport.

The 13 sites included five of probable Archaic age (42KA4547, 4548, 4549, 4552, and 4655), three of probable Formative age (42KA4749, 4750, and 4794), and five of probable Post-Formative age (42KA4575, 4612, 4662, 4732, and 4797). Because examining alternative dating methods was a primary interest, all 13 sites had the potential to produce carbon samples so that their age could be determined by radiocarbon dating. This potential was based on the presence of presumed cultural features at all of the sites (at site 42KA4655 the feature proved to be natural). Of course, the presence of features was also critical to the other two primary objectives. The features represented at the sites appeared quite diverse based on surface evi-

dence, and included obvious basin and slab-lined hearths, FCR scatters, and middens. As might be expected, testing revealed more diversity in hearths than was evident from the surface. Some of the features, principally those at the Archaic sites, appeared deflated and this was important for examining erosional impacts. In addition to the general objectives of the testing project, the tested sites had the potential to shed light on settlement practices and functional roles, especially for what seemed to be Formative and Post-Formative limited activity camps. We also hoped that testing might recover ceramics or other evidence that could inform about Formative cultural affiliation. A principal reason for including one small rockshelter in the site sample (42KA4794) was simply to salvage deposits being lost to dripline erosion and then to stabilize the site from further erosion. Fortunately this site also had the potential to provide considerable data about a probable Formative age limited activity camp.

The results of the testing project are reported below with the sites grouped by general temporal periods. These temporal periods were assigned based on survey information, but the processed radiocarbon dates have confirmed the tentative temporal assignments. Site and feature descriptions are given first along with a general accounting of recovered remains and samples. Detailed reports on the radiocarbon dating, analyses of faunal remains, flotation samples, stone artifacts, and perishable remains are included herein. General locations for the 13 sites are shown in Figure 5.1. The four principal Archaic sites are located near each other toward the north-central portion of Long Flat; one Archaic site that proved of little interest is located toward the west-central edge of Horse Flat. Two of the Formative sites are located near each other on the northern portion of Paradise Bench and the third is a small rockshelter located on Jack Riggs Bench. The Post-Formative sites occur in three different areas: two on Long Flat, one on Horse Flat, and two on Jack Riggs Bench.

ARCHAIC SITES

42KA4547

Survey Description

Site 42KA4547 (Figure 5.2) consists of a scatter of flaked stone artifacts and a few grinding tools associated with two charcoal stains (Features 1 and 3) and three FCR concentrations (Features 2, 4, and 5). The remains occur on the southern deflated edge of a sand dune ridge. The site probably originated as two activity areas, one on each side of the ridge crest. The north area contains Feature 1, a hearth, with a sparse scatter of flakes and a cobble chopper on a level clearing. The southern activity area contains one hearth (Feature 3) and three burned rock concentrations (mostly quartzite cobbles) associated with one fairly large artifact scatter. The FCR areas contain little to no intact charcoal or stained soil. The Feature 4 FCR scatter contains artifacts and fragments of a grinding slab; it might be a midden of sorts. The FCR scatters may be deflated roasting features or perhaps they were always merely surface scatters. A sparse artifact scatter that includes a mano occurs along a small drainage at the western edge of the site. The lithic assemblage of the site consists of several hundred flakes derived from a mixture of biface and cobble tool reduction, five cobble tools, one mano, and one fragmented grinding slab.

Test Units

Unit 1. Two 1 x 1 m test units were excavated at 42KA4547 (Figure 5.2). Unit 1 was placed directly over Feature 1, a probable basin hearth that was the principal feature of interest at this site (Figure 5.3). The unit was lightly scraped with a trowel to reveal the outline of the feature, which appeared as a circular dark charcoal stain. The sediment scraped from the unit was screened but no remains were recovered; the feature was then bisected and the fill removed from its southern half. A flotation sample and small charcoal sample were recovered, with the rest of the fill screened; no artifacts or bones were found and wood charcoal was the only carbonized plant remain seen.

Unit 2. The second 1 x 1 m unit was excavated within Feature 4, the largest of the FCR and artifact scatters. The unit was placed toward the upslope edge of this deflated-looking scatter, where the sediment appeared lightly charcoal stained (no charcoal pieces were evident here or at the other FCR scatters of this site). The unit was lightly scraped with a trowel and all sediment was screened. All FCR and artifacts occurred within the upper few loose centimeters of sediment, clearly revealing that the scatter was a lag deposit deflated from its original context. In the underlying sterile sand of this unit was a small rodent hole filled with lightly charcoal-stained sediment and containing a few small, eroded charcoal pieces. A sample of the charcoal was collected for potential radiocarbon dating.

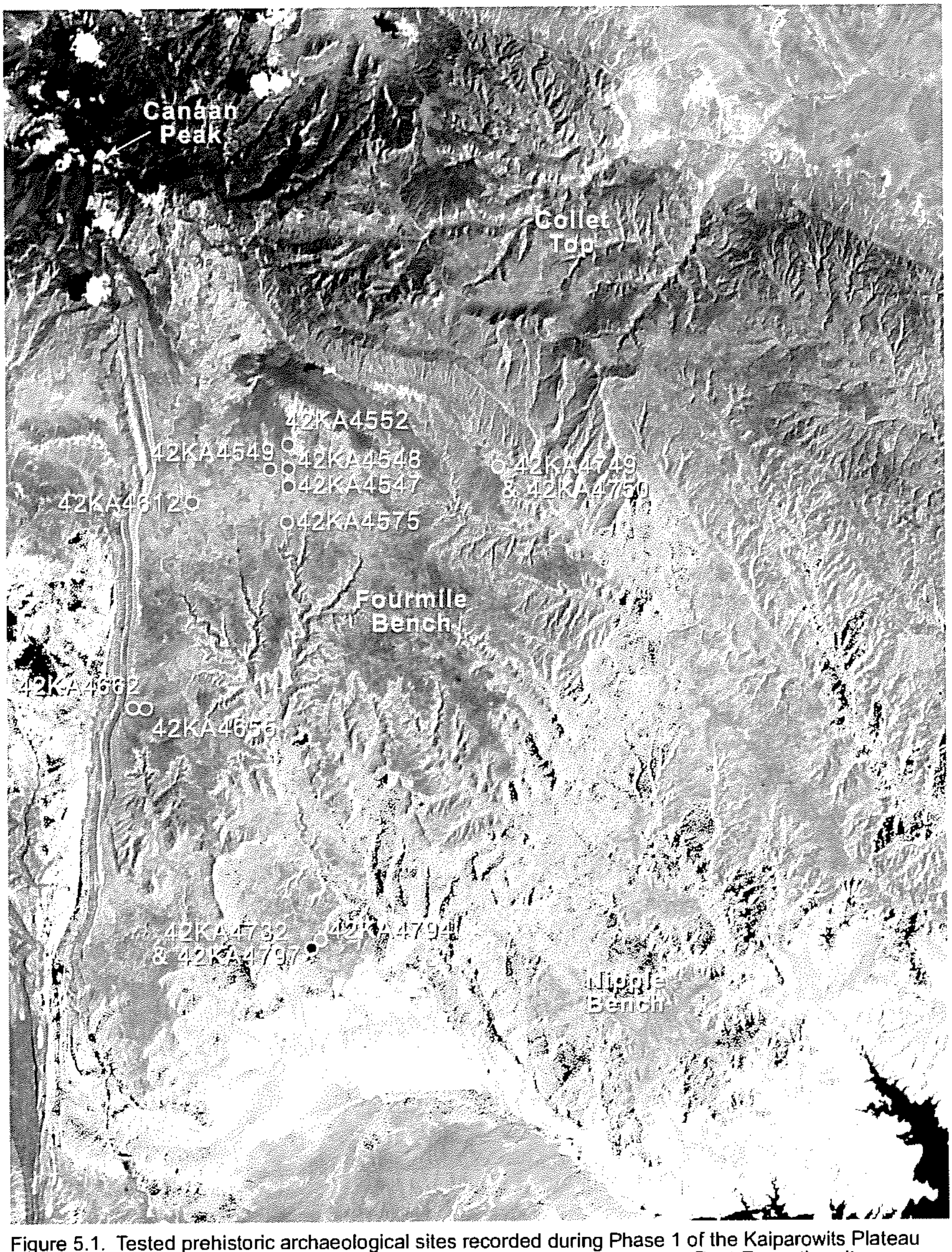


Figure 5.1. Tested prehistoric archaeological sites recorded during Phase 1 of the Kaiparowits Plateau Survey; red dots are Archaic sites, yellow are Formative sites, and green are Post-Formative sites.

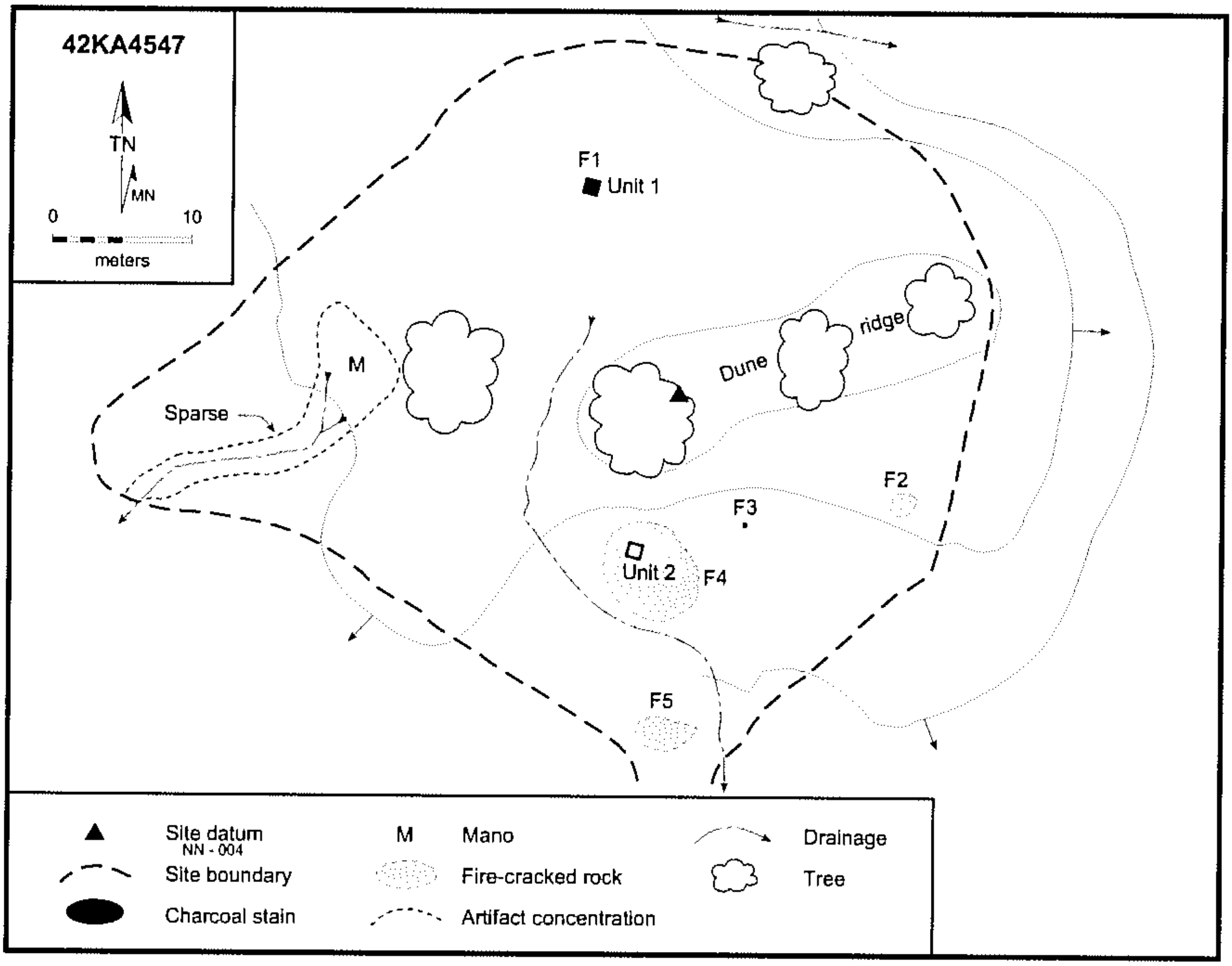


Figure 5.2. Survey sketch map of 42KA4547 showing the two test units.

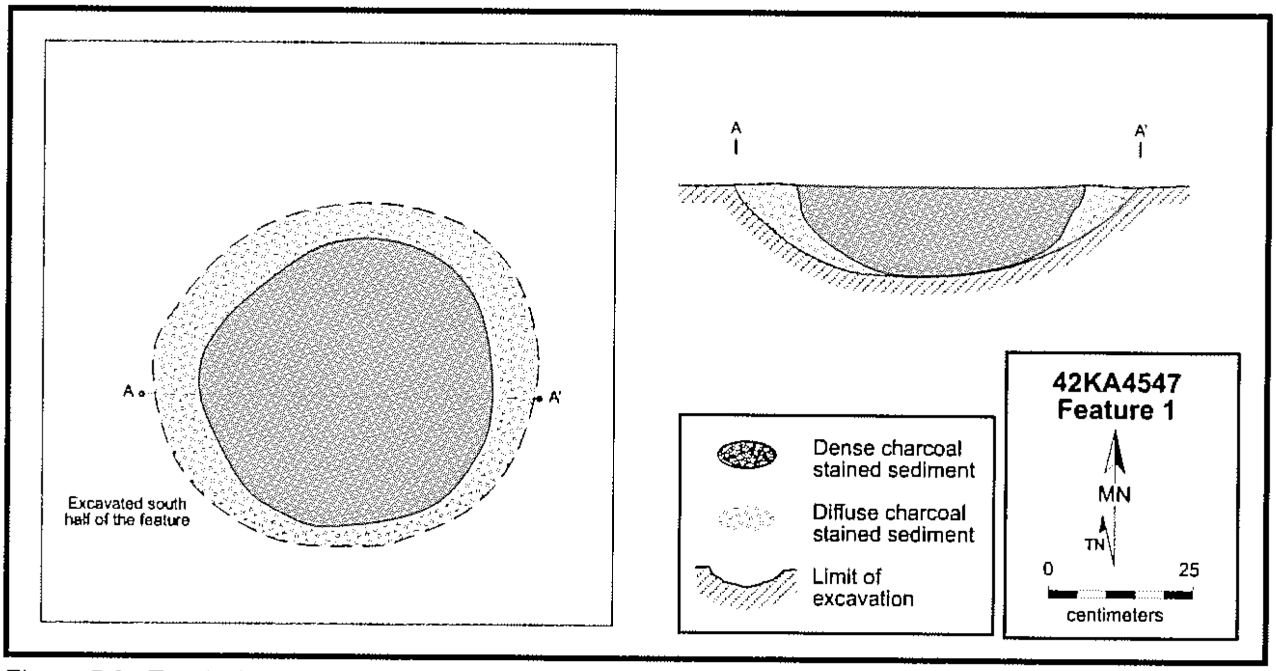


Figure 5.3. Test Unit 1 of 42KA4547 showing the plan and profile of Feature 1.

Features

Feature 1. This is a small, circular, unlined, basin-shaped hearth that measures 52 x 50 cm with a depth of 16 cm (Figures 5.3 and 5.4). These measurements do not include the bioturbated outer margins of the feature, only where the fill was dense black. The fill consisted of charcoal dust and charcoal-stained sand but few charcoal pieces. The charcoal pieces present within the fill were small and eroded, the result of post-depositional processes. This alone suggests that the hearth is perhaps a few thousand years old. The degraded condition of the charcoal stands in marked contrast to the charcoal found within the hearths of suspected Formative and Post-Formative age. No artifacts, bone, or plant remains other than charcoal were found in the fill during excavation. The fill lacked burned rock of any sort. A flotation sample was processed but it contained only a few small charcoal pieces. A radiocarbon date on charcoal from the fill is reported below.

Feature 4. This feature is a deflated and somewhat slope-washed scatter of FCR and stone artifacts. All of the FCR and artifacts occur within the upper few loose centimeters of sediment, clearly revealing that the scatter was a lag deposit of remains eroded from its original context. Because the remains were located on a modest slope, the scatter likely has lost not only its vertical provenience but some of its horizontal provenience with remains moved downslope to the south. Based on the single test unit it is difficult to know what the nature of the feature was prior to erosion—was it a rock-filled hearth or roasting feature surrounded by artifacts, or was it a midden-like deposit similar to that found at 42KA4552 (see below)? Of interest was the occurrence of a small rodent hole in the underlying sterile sand of this unit filled with lightly charcoal stained sediment that contained a few small, eroded charcoal pieces. Here and at similar probable Archaic age deflated sites, we suggest that cultural fill may have been intruded down from overlying features and deposits when they were intact prior to deflation. We have observed and documented in the adjacent Kayenta Anasazi region that rodent and bug holes below features of all ages commonly contain cultural fill.

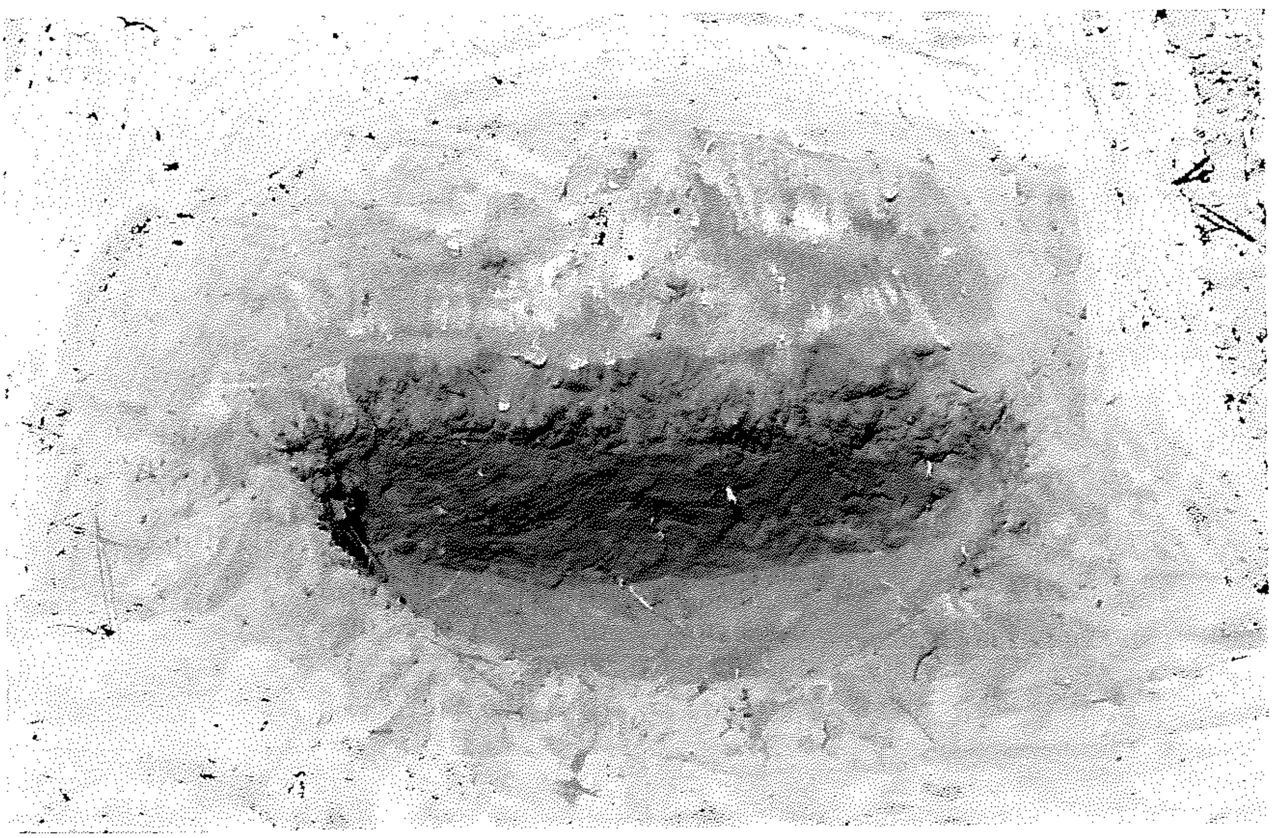


Figure 5.4. Feature 1 of 42KA4547 after exposing it in plan view and excavating the fill from its south half (looking north).

In this particular case we suggest that the rodent hole served to bring cultural fill down to a depth below the level of deflation and thereby preserve some charcoal for making age determinations.

Recovered Remains

The remains recovered from the limited test excavations at 42KA4547 include a flotation sample (from Feature 1), two radiocarbon samples (one from Feature 1 and one from Test Unit 2), and 15 flakes and one biface fragment (from Unit 2).

Dating

Small charcoal pieces from the fill of Feature 1 were submitted to Beta Analytic for AMS radiocarbon dating. Given the evident poor preservation of the wood charcoal in this feature we did not hold out much hope for recovering annual plant remains from the flotation sample sufficient for obtaining even an AMS date (this turned out to be the case). The charcoal returned a ^{13}C corrected radiocarbon age of 2200 ± 40 b.p. (Beta-144228, –21.2‰); it has a two-sigma calibrated date range of 380–165 B.C. This date supports the Archaic temporal assignment based on alternative dating criteria. The site is at the end of the late Archaic period, and considering that dead wood was probably burned, the hearth (if not the site overall) probable belongs to the Archaic-Formative transition.

42KA4548

Survey Description

Site 42KA4548 consists of a small concentrated scatter of fire-cracked rock and sparse flaked lithics situated on the western slope of a small sand-covered bluff edge overlooking a sage flat to the south (Figure 5.5). Four clusters of FCR were specifically identified as features; these are probably the remains of hearths or roasting pits. A single

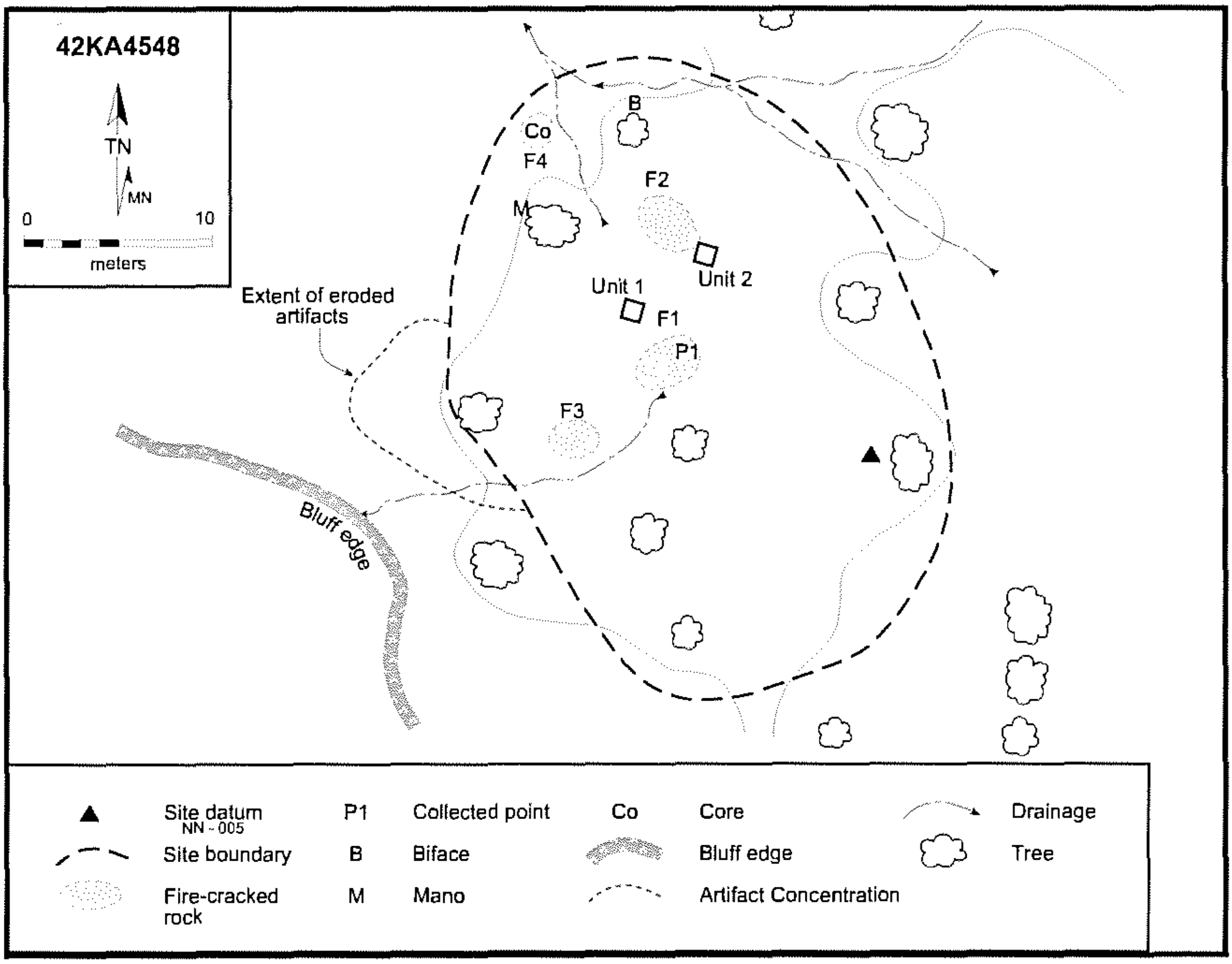


Figure 5.5. Survey sketch map of 42KA4548 showing the two test units.

badly eroded mano also indicates processing activities. It is possible that grinding slabs were once present but have since disintegrated (the local sandstone is highly friable). Flaked tools include both bifacially thinned tools and a cobble chopper. The debitage is mostly derived from late stage biface reduction and many of the flakes exhibit edge polish and rounding, evidence that they were removed during biface resharpening. This location provides an excellent study of this sort of site because it probably represents a single-use episode; it was likely not sequentially reused. The site is probably Archaic in age based on the dart-point base (Elko), lack of ceramics or arrow points, patina on flakes, and eroded condition of the mano. The site was probably a short-lived seasonal processing camp.

Test Units

Two 1 x 1 m units were excavated to test this site. Work began by excavating Unit 1 within the portion of the site that appeared best preserved, an area between Features 1 and 2. These features appeared to be merely two portions of a single FCR scatter, differentially exposed by erosion. A second unit was placed in the eroded-looking Feature 2.

Unit 1. A 1 x 1 m unit was placed in what appeared to be the best-preserved portion of the site where it seemed we would have the greatest chance of discovering intact deposits or a feature. The unit was located between Features 1 and 2, where the FCR was just barely exposed, protruding from a mantle of eolian sand. This area lacked charcoal staining or charcoal flecks. Excavation of this unit revealed that all remains were concentrated within the upper 8 cm of loose sediment; below this the sand was sterile except for slightly charcoal discolored sediment and several small charcoal pieces within rodent and insect holes. The unit confirmed our suspicion that Features 1 and 2 were merely exposures of the same FCR and artifact scatter. The unit also revealed that this scatter probably is deflated and therefore a lag deposit. The charcoal and charcoal-stained sediment of the rodent runs may well be derived from prehistoric hearths or deposits that were once present at the site. The rodent runs brought the cultural fill to a depth below that of deflation where the charcoal could be preserved.

Unit 2. A 1 x 1 m unit was placed toward the upslope edge of the deflated-looking FCR and artifact scatter designated as Feature 2. In this unit all cultural remains occurred within the upper few centimeters of loose eolian sand with no artifacts or FCR deeper than 5 cm. The entire cultural deposit here was eroded and rested close to the underlying friable bedrock. There was no charcoal-stained sediment or charcoal flecks in this unit or within underlying rodent holes.

Recovered Remains

Table 5.1 presents an inventory of all artifacts and nonartifactual samples recovered from the limited test excavations at 42KA4548. These include two radiocarbon samples (both from rodent holes in the bottom of Unit 1), 20 flakes and 1 grinding slab fragment from Unit 1, 1 flake from the rodent holes in the bottom of Unit 1, and 10 flakes and a retouched tool from Unit 2. The radiocarbon samples were not processed.

Table 5.1. Recovered artifacts and samples from 42KA 4548.

Prov No.	Bag No.	Specimen Type	Count	Unit	Feature[1]
1	1	Flaked stone	20	1	0
1	2	Slab metate fragment	1	1	0
2	1	Radiocarbon (charcoal)	1	1	rh
2	2	Flake	1	1	rh
3	1	Radiocarbon (charcoal)	1	1	rh
4	1	Flaked stone	11	2	2

[1]rh = rodent hole.

42KA4549

Survey Description

Site 42KA4549 is an extensive scatter of flaked stone artifacts and several grinding tools associated with three thermal features and a probable midden deposit (Figure 5.6). These remains occur on the high part of a low sand-covered ridge next to a moderate-sized drainage. The midden (Feature 1) is on the high point of the ridge where there is a good view in all directions. It consists of burned sandstone (very friable) and quartzite cobbles, as well as numerous lithic tools (mostly cobble choppers) and debitage. The debris scatter covers an area 17 x 14 m; separate features within this scatter are not clearly defined and the entire area is equally dense with remains. The three thermal features (Features 2–4) are similar to those at other sites in the vicinity, composed of burned and broken quartzite cobbles (FCR) associated with sparse flaking debris. Feature 1 exhibits charcoal-stained soil in several places as does the upslope portion of Feature 2. There is no evidence

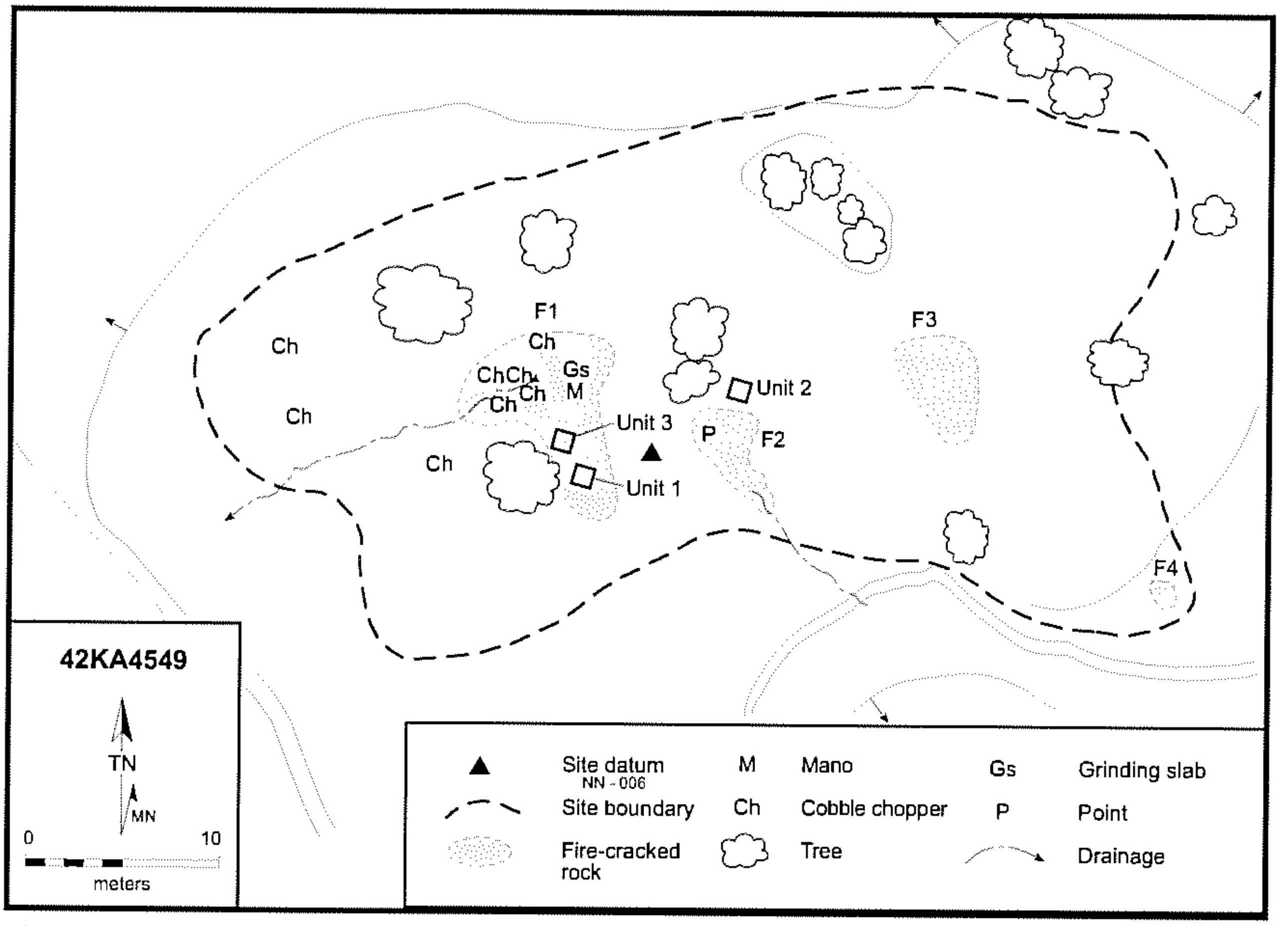


Figure 5.6. Survey sketch map of 42KA4549 showing the three test units.

of structures, but ephemeral surface structures may have been present at one time. The amount of burned sandstone suggests that some slab-lined features were once present, but no alignments could be defined. There are well over 500 flakes at the site from a mixture of biface and core reduction. Biface flakes are far more numerous and are mainly from late in the reduction sequence; many appear to be refurbishing flakes from knives and other tools. The core reduction flakes are from local cobbles of coarse rock, mainly quartzite, and were removed to prepare and refurbish cobble choppers and other heavy-duty cobble tools. A diversity of stone tools occurs on the site including dart point fragments, bifaces in various stages of reduction, drills, gravers, unretouched flakes, cobble choppers and pounders, manos, and unformalized grinding slabs. The high number of flakes, the diversity of tools, and the midden and FCR scatters suggest that this location served as some sort of temporary residential camp, perhaps with repeated use. An Archaic temporal affiliation is assumed based on the degree of patina on flakes, the degree of fragmentation and erosion to grinding tools, the carbonate buildup on cobble tools and flakes, and the similarity between the lithic assemblage at this site and those at other nearby sites with temporal diagnostics. It is worth noting that one of the manos has a morphology that suggests post-Archaic occupancy, sometime after the introduction of agriculture; some of the other artifacts may relate to a later use of the site.

Test Units

Three 1 x 1 m units were excavated to test this site. Two of these units were placed within the Feature 1 midden; a third unit was excavated toward the north (upslope) edge of an adjacent FCR scatter designated as Feature 2.

Units 1 and 3 (Feature 1). Unit 1 was placed over a scatter of sandstone slab fragments that we initially thought might have been an eroded slab-lined hearth. In hindsight this was a poor choice of placement because the slab portions were not

burned and closer inspection revealed them to be just a fragmented and exfoliated grinding slab. For this reason an additional 1 x 1 m unit was placed in Feature 1, in an area where charcoal-stained sediment was just starting to be exposed by foot disturbance of the loose surface sand. Unit 3 seemed to be in an area where the cultural remains were buried by eolian sand, thus we held out hope that an intact cultural layer or hearth would be discovered.

In Unit 1 all cultural remains occurred within the upper few centimeters of the loose surface sand with nothing occurring below 5 cm. There was no charcoal staining to the sediment nor any charcoal pieces; not even the rodent or bug holes of this unit revealed discolored sediment. The unit did yield a moderate amount of flaking debris.

In Unit 3 we found cultural remains within a loose matrix of lightly charcoal stained sand and silt covered by a few centimeters of sterile eolian sand. The layer yielding cultural remains was only a few centimeters thick and appeared to be a lag deposit like that found in Unit 1, but one that had been buried by recent eolian sand. The one favorable finding of Unit 3 was a moderately large rodent hole filled with lightly charcoal stained and flecked sediment containing flakes (designated as Feature 5). As with Unit 2 findings described below and other tested Archaic sites, the sediment in this rodent hole is assumed to be cultural in origin, intruded down from a once overlying intact cultural deposit, if not a hearth. We recovered flotation and ^{14}C samples from the rodent hole fill.

Unit 2 (Feature 2). Unit 2 was placed over a small FCR and burned sandstone slab concentration towards the northern edge of Feature 2. The unit was situated over a concentration of burned sandstone slab fragments that seemed likely to be the eroded and broken-up remains of a slab-lined hearth. Sediment occurring around the slab portions was slightly charcoal stained, although no charcoal pieces were present. Excavation did not reveal an intact feature or cultural deposit. As with Unit 1, the cultural remains were concentrated within the first few centimeters of loose sediment; screening of this sediment recovered a moderate amount of stone flaking debris. Deeper in the unit within the underlying sterile were bug and rodent holes filled with charcoal-stained sediment. A few small charcoal pieces were recovered from these holes for potential ^{14}C dating.

Recovered Remains

Table 5.2 presents an inventory of all artifacts and nonartifactual samples recovered from the limited test excavations at 42KA4549. These consisted of two radiocarbon samples (both from rodent holes in the bottoms of Units 2 and 3), a flotation sample (rodent hole in the bottom of Unit 3), 658 flakes, 8 flaked stone tools, 1 ground stone disk, fragments of two slab metates, 1 bone, and 1 snail shell (nonartifactual). Each unit contained a high incidence for debitage and flaked stone tools ranging from 95 to 307 items in what amounts to a single compressed level.

Table 5.2. Recovered artifacts and samples from 42KA 4549.

Prov No.	Bag No.	Specimen Type	Count	Unit	Feature[1]
1	1	Flaked stone[2]	262	1	1
1	2	Grinding slab fragments	3	1	1
1	3	Cobble pounder	1	1	1
2	1	Flaked stone	95	2	2
2	2	Radiocarbon (charcoal)	1	2	rh
2	3	Bone	1	2	2
3	1	Flaked stone	307	3	1
3	2	Projectile point	1	3	1
3	3	Grinding slab fragment	1	3	1
4	1	Flotation sample	1	3	rh
4	1	Radiocarbon (charcoal/ seeds?)	1	3	rh
4	3	Shell	1	3	rh

[1]rh = rodent hole.
[2]Includes a ground circular stone disk.

42KA4552

Survey Description

Site 42KA4552 is ans open flaked and ground scatter with a midden and four other features on a slope on the south side of a low clay ridge (Figure 5.7). The principal feature at the site is a midden deposit (Feature 1) covering a 10 x 12 m area. This deposit contains a moderate to heavy density scatter of flaked stone artifacts, abundant burned and heat fractured quartzite cobbles(FCR), several gringing tool fragments, charcoal-stained soil, and some burned stone. This feature may be an accumulation and blending together of several smaller thermal features similar to Features 2-5, or it may result from the purposeful dumping of refuse. Feature 2 is a 2 x 4 m scatter of burned quartzite cobbles and a few artifacts. Feature 3 may be a natural juniper burn that is associated with a few burned cobble fragments (there are several burned branches and a stump adjacent to

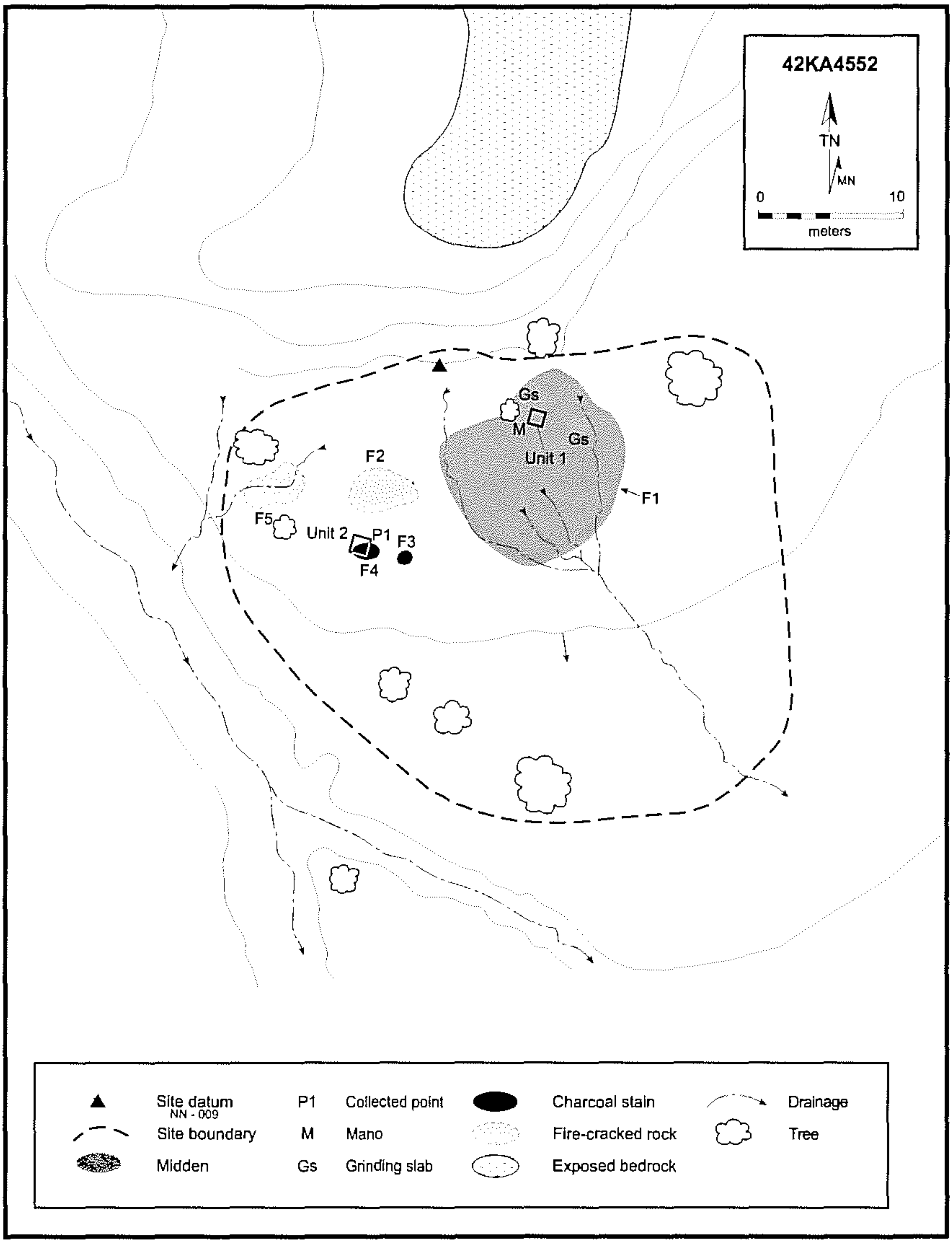


Figure 5.7. Survey sketch map of 42KA4552 showing the two test units.

the burning and the charcoal appears more intact). Feature 4 consists of two partially upright sandstone slabs that appear oxidized and a concentration of burned cobbles in a 1 m diameter area. Feature 5 may be a thermal feature that is just being exposed; it consists of several burned cobble fragments but no stained soil. There are several hundred flakes at the site, with well over half of these from local quartzite cobbles and other coarse materials (metasediment and various igneous rock). This cobble flaking debris results from the preparation and maintenance of cobble choppers and other heavy-duty cobble tools. The other component of the debitage assemblage is derived from biface reduction. Stone tools include dart-sized projectile points, bifaces in various stages of reduction, cobble choppers, a mano, and fragments of two grinding slabs. This site may have been used more than once, which would account for the amount of material in the midden area. Given the quantity and diversity of remains along with the midden accumulation, the site likely functioned as a residential camp for some portion of the year. The southern aspect of the site suggests use during the colder months. An Archaic temporal affiliation is inferred from the dart points and the eroded fragmented condition of grinding tools.

Test Units

Two 1 x 1 m units were excavated at this site (Figure 5.7). One of these was placed toward the central upslope side of the midden (Feature 1). The original testing plan called for two units within this feature, but a single unit proved sufficiently informative and yielded useful ^{14}C samples. The second unit was placed over Feature 4 to partially encompass the burned slabs. This unit was expanded to 1.2 x 1.2 m in size to obtain sufficient plan view exposure of this hearth.

Unit 1. This unit was excavated within the central upslope portion of the midden where abundant FCR and some flakes were exposed on the surface and the soil appeared moderately charcoal stained. The matrix for this unit in the upper 5 cm or so was loose silty sand with some clay; it screened easily. With depth the clay content increased and the sediment became increasingly difficult to screen. It eventually became exceedingly hard to excavate and screen, and many clay lumps that were impracticable to break apart were tossed into the backdirt pile. Ultimately we terminated our excavation at a maximum depth of 18 cm below the modern surface before encountering culturally sterile sediment. At this depth the sediment was still charcoal flecked, but artifacts and FCR were few in number so we were probably near the bottom of the cultural layer. Excavation had to stop before encountering sterile because we were out of time; nonetheless, we had accomplished the testing goals. Flotation and carbon samples were recovered from the unit along with stone artifacts and several animal bones.

Unit 2. This unit was placed over the concentration of burned cobbles and oxidized sandstone slabs identified as Feature 4. The unit was situated to define part of the feature in plan view. As it turned out, the unit had to be expanded an extra 20 cm to both the east and north, becoming a 1.2 x 1.2 m unit; this was necessary to obtain an adequate plan view. We excavated 5–8 cm of loose sediment to remove a thin cultural deposit (ca. 4 cm thick) and expose the underlying sterile clayey sand. The cultural deposit contained FCR and some flakes and was lightly charcoal stained; it was partially buried by eolian sand, especially in the east portion of the unit. Excavation of the unit to a 5–8 cm depth revealed a clear outline of Feature 4, a slab-lined hearth. We excavated the fill from what amounted to roughly the southwest quarter of the feature (the true size of this hearth remains unknown because of burial by eolian sand).

Features

Feature 1. Based on surface evidence, this feature was identified as a midden, and the nature of the deposit exposed by the test unit suggests that this designation is warranted. The test unit revealed two separate layers to the deposit: an upper layer of loose and easily screened sediment and a lower layer of hard clayey sediment that was difficult both to excavate and to screen. This is essentially an arbitrary separation in that it reflects post-depositional processes of deflation, erosion, and weathering and not true natural layers of accumulation. There was abundant charcoal throughout both levels, but more and larger pieces were present in the lower layer because it was less subject to wetting and drying and other destructive processes. The charcoal of the uppermost portion of the unit had been reduced to dust and small pieces, and no flecks were exposed on the surface of the midden, only charcoal-stained sediment. Abundant FCR and a moderate amount

of flaked stone artifacts occurred in both levels, but with a greater concentration in the loose upper level. This most likely results from surface erosion (slope wash and deflation) that reduced the thickness of the cultural deposit and left a greater concentration of remains in the upper loose sediment (artificial concentration). Burned animal bone occurred in low frequency throughout the deposit. Screening the sediment produced no carbonized plant remains other than wood charcoal. A flotation sample of the deposit was processed but it too produced only small charcoal pieces.

We have no doubt that Feature 1 is a true midden accumulation, but we believe that it was probably not just a location of secondary refuse disposal. Feature 1 was probably also an activity area where debris accumulated in abundance while conducting various cooking, processing, and production tasks. It seems likely that hearths are present somewhere within the midden, but we did not find any evidence for in situ burning in the excavated unit. Horizontal exposure within this deposit likely would reveal various hearths or roasting pits. Radiocarbon dating (reported below) demonstrates that Feature 1 is late Archaic in age. The degree of preservation of this feature relative to most features that we tested at other Archaic sites is likely a consequence of the clay matrix of Feature 1. The other Archaic sites we tested were within a sandy matrix, one readily deflated. It could also be that the similar features tested at the previous three Archaic sites are older than the late Archaic and thus subjected to more erosion.

Feature 4. This feature turned out to be a slab-lined hearth (Figure5.8) with most slabs poorly preserved due to the friable nature of the local sandstone, which was likely exacerbated by burning. The one upright slab exposed on the surface lined the southwest side of the feature. Other exposed slabs were badly weathered such that their upper portions had crumbled and fallen into the feature fill or outward onto the occupation surface. The hearth had a maximum depth in our excavation unit of 21 cm below the prehistoric occupation surface. The floor of the feature was slab lined (though badly fragmented) and the walls were lined with upright slabs that tipped outward to

Figure 5.8. Feature 4 of 42KA4552 as exposed in plan view within test unit 2 and after excavating the fill from half of the exposed portion (looking east).

varying degrees. The size of the feature remains unknown because of recent eolian sand and tree duff; the portion exposed in the test unit measures at least 1 m N-S and 50 cm E-W. The north-south dimension seems close to maximum. Feature fill consisted mainly of charcoal dust and charcoal; there were no burned rocks (excluding eroded burned upright slab fragments) and no artifacts or bone. The charcoal appears to be entirely fuel that was smothered and thus turned to charcoal. As a fuel layer, the flotation sample of this deposit might not yield plant remains relating to subsistence. A flotation sample of the deposit was processed but it contained only charcoal and a tiny fragment of a possible juniper seed. Because the hearth fill did not contain FCR, it seems likely that the moderate amount of FCR that occurred around the feature must derive from another source. Had the slab-lined hearth been used to heat stones for use in roasting or stone boiling it seems likely that we would have found at least a few small heat spalls within the fill. A large charcoal sample from the fill of this feature was dated by standard beta decay (reported below), indicating that this feature is more recent in age than the midden.

Recovered Remains

Table 5.3 presents an inventory of all artifacts and nonartifactual samples recovered from the limited test excavations at 42KA4552. From the midden (Feature 1) we recovered two radiocarbon samples, a flotation sample, 124 flakes, 5 flaked stone tools, and 16 bones. From the unit around the slab-lined hearth (Feature 4) we recovered 38 flakes and 3 flaked stone tools, and from the hearth proper we recovered one flotation and one radiocarbon sample.

Table 5.3. Recovered artifacts and samples from 42KA 4552.

Prov No.	Bag No.	Specimen Type	Count	Unit	Feature
1	1	Flaked stone	74	1	1
1	2	Bone	8	1	1
1	3	Radiocarbon (charcoal)	1	1	1
2	1	Flaked stone	55	1	1
2	2	Bone	8	1	1
2	3	Flotation sample	1	1	1
2	4	Radiocarbon (charcoal)	1	1	1
3	1	Flaked stone	39	2	0
3	2	Projectile point tip	1	2	0
3	3	Projectile point midsect.	1	2	0
3	4	Flotation sample	1	2	4
3	5	Radiocarbon (charcoal)	1	2	4

Dating

Carbon samples from both the midden (Feature 1) and the slab-lined hearth (Feature 4) were submitted to Beta Analytic for radiocarbon dating. Excavators recovered only wood charcoal from both of the features in the field. Before submitting these, the flotation samples were processed and given a close inspection for annual plant parts or other remains that would potentially not overestimate age. The midden sample contained small twigs (about 3 mm in diameter) that were selected for AMS dating rather than the wood charcoal. Nothing of utility was noted in the hearth sample, especially considering that we had sufficient charcoal for a beta-decay date (a cost consideration). The twigs from the midden returned a ^{13}C corrected AMS radiocarbon age of 3930 ± 30 b.p. (Beta-144229, –22.2‰) and the charcoal from the hearth returned a standard radiocarbon age of 1730 ± 50 b.p. (Beta-144230, assumed –25.0‰). The 3930 date has a two-sigma calibrated date range of 2480–2330 B.C., solidly within the late Archaic, even with an old wood discrepancy. Actual age overestimation with this sample should be minimal given the small diameter of the dated twigs. This date supports the Archaic temporal assignment based on alternative dating criteria. The radiocarbon assay for the slab-lined hearth came as more of a surprise because it has a two-sigma calibrated date range of 215–420 A.D, placing this feature within the Archaic-Formative transition. The date itself is not surprising, just the revelation that this small site has more than one component. This highlights the fact that even cohesive-looking sites that appear to be single component may well have complex use-histories that account for their creation. The bulk of the remains at this site likely date from the late Archaic because they occur in and around the Feature 1 midden; thus the interpretation of this site as a residential camp appears unchanged, at least for that component. The remains associated with the component dating to the Archaic-Formative transition are unknown, as is the function of the site during that interval.

42KA4655

Survey Description

This site consists of two loci of remains, apparently from distinct temporal intervals, located in and along a small incised drainage. Locus A consists of the flakes from a single biface reduction event using an orangish chert of unknown source. The flakes are from biface reduction, apparently

starting with a Stage 3 biface, which was thinned to Stage 4. Many large flakes are from classic biface thinning, but there are also alternate flakes. No cortex is present, but the flakes are covered with caliche on at least one face; this deposit is up to 1 mm thick, suggesting several thousand years of burial. Some flakes likely have eroded down the wash. The flakes occur in a small area about 1–2 m in diameter next to a small stain presumed to have been a hearth. Locus B consists of an exceedingly diffuse scatter of several flakes and two tools. The three observed flakes are a pressure flake of agatized wood and two percussion biface thinning flakes of the same material. The two tools include a thin and sharp arrow point tip and the base of a probable arrow point preform. These tools and the flakes are not patinated and the flaking looks quite "fresh" (recent). Therefore, Locus B is believed to be a Post-Formative Paiute scatter.

Testing

The plan for this site was to recover the exposed flakes and excavate what remained of the presumed hearth from the face of the arroyo cut. No excavation units per se were proposed and none were excavated. Upon relocating the flake scatter, it was evident that flash flooding since the summer of 1998 had washed away much of the debitage. We scraped up loose sediment in and around the remaining flakes and screened it to recover all debitage. Scraping of the arroyo cut profile failed to reveal the stratigraphic origin for the flakes, but certainly burial was not great, probably less than 10 cm. Excavation revealed that the supposed charcoal stain was a rodent hole filled with brown clay. No charcoal was observed while excavating this feature and none was recovered from the flotation sample of the clay fill. It is unfortunate that the feature was not cultural, because we had hoped to obtain a date that would help to determine whether carbonate deposition on chert flakes required centuries or millennia.

Recovered Remains

The only remains recovered from the limited work at 42KA4655 consisted of a flotation sample (PN1, Bag 1) and 86 flakes (PN2, Bag 1). The flotation sample was processed even though the sample seemed worthless (a clay-filled rodent hole). A scan of the light and heavy fractions proved beyond a doubt that the sample was not from a hearth; consequently both sample fractions were tossed out. The only remains still in the collections from this site are the 86 flakes.

FORMATIVE SITES

42KA4749

Survey Description

The site consists of a small concentrated scatter of flaked stone artifacts and fire-cracked rock along with two identifiable hearths (Figure 5.9). The principal concentration of fire-cracked rock occurs in an area that is darkly charcoal stained with charcoal pieces appearing on the surface; this was designated Feature 1. A light scatter of fire-cracked rock and charcoal-stained soil around Feature 1 might be part of a midden deposit associated with use of the hearth. A possible second hearth (Feature 2) is largely eroded by a wash. The few hundred flakes at the site are largely derived from biface reduction, from early stages of thinning through pressure finishing. There are also core reduction flakes, which are mainly of coarse cobble materials and related to the creation and resharpening of cobble choppers and other heavy-duty tools. Observed stone tools include a Rose Spring point base, other projectile point fragments, bifaces, a cobble chopper, a scraper, and a grinding slab fragment. This site appears to be some sort of seasonal encampment related to food processing and involving tool production and refurbishing. Based on the Rose Spring point, the site probably dates to the early Formative period, perhaps sometime between A.D. 500 and 900. The remains at this site are similar to those at nearby site 42KA4750, which had both a Rose Spring point and an Emery Gray sherd (see below). Both sites are probably related to limited Formative foraging activity on Paradise Bench.

Test Unit 1

A single 1 x 1 m unit was excavated to test this small site. The unit was placed over Feature 1, where we hoped to expose part of hearth. The plan called for testing Feature 2 as well, but time was limited and this feature seemed far less likely to provide useful samples than Feature 1.

Unit 1 was placed where we hoped that it would expose an edge to Feature 1. After removing about 10 cm of loose charcoal-stained sediment from the unit, the underlying sterile sand was exposed revealing a partial charcoal-filled outline of a hearth (Figure 5.10). This we designated as Feature 3 to differentiate it from the larger Feature 1 charcoal and FCR stain. The portion of the hearth exposed by the unit was excavated, revealing it to be a basin-shaped hearth. A few flakes were recovered from the feature fill but no bone; additional

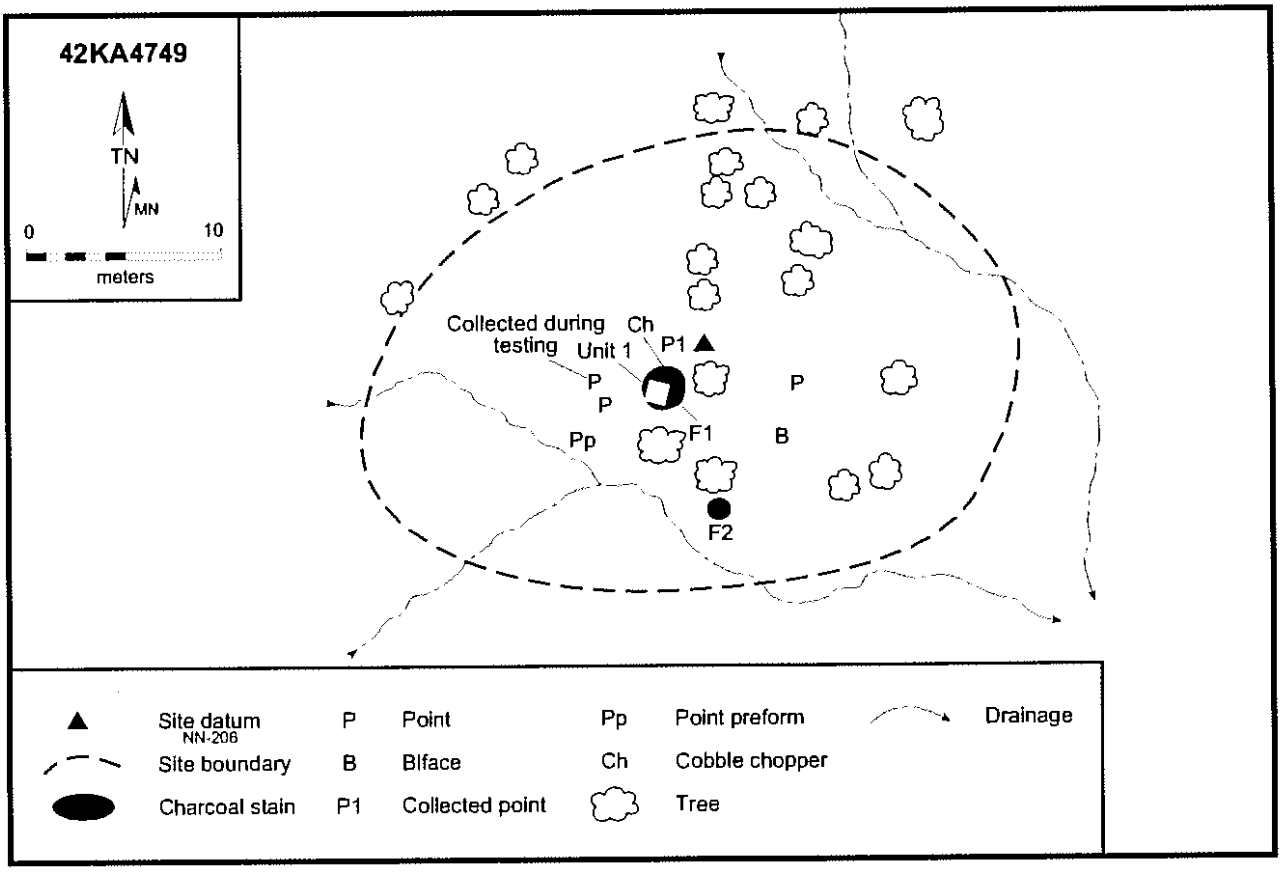


Figure 5.9. Survey sketch map of 42KA4749 showing the one test unit.

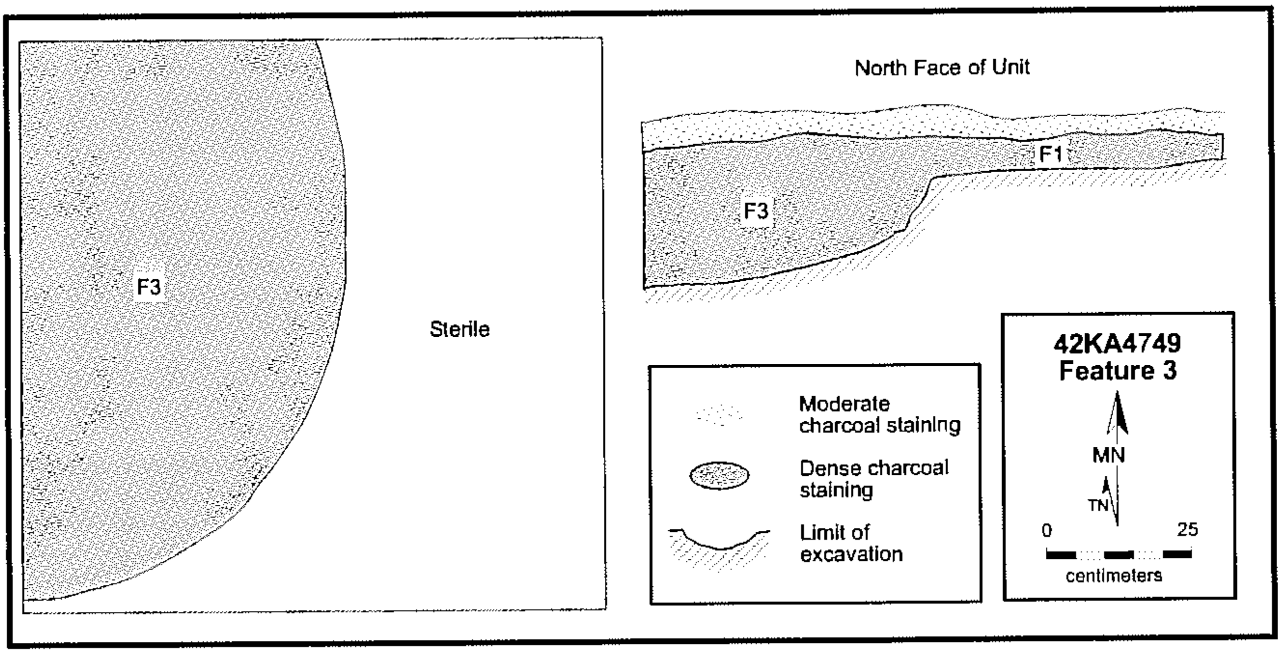


Figure 5.10. Test unit 1 of 42KA4749 showing the plan and profile of Feature 3.

flakes came from the cultural fill around the feature. A flotation and a ^{14}C sample were collected from the lower fill of the hearth.

Features

Feature 1. This number is retained to designate the general charcoal stain exposed on the surface of the site. The test unit excavated within this feature revealed a basin hearth that might be the origin for the entire Feature 1 stain, but because this stain appeared to have significantly larger dimensions than the basin, we assigned a new number to the basin hearth specifically. Little can be said about Feature 1 other than there was not a visible difference in section between the fill of the hearth and the surrounding Feature 1 charcoal stain.

Feature 3. This is a moderately large, unlined, basin-shaped hearth (Figures 5.10 and 5.11). The dimensions of this feature remain unknown because only the portion within the test unit was exposed in plan view and excavated. Within the test unit the feature measured 97 cm N-S by 55 cm E-W; it had a maximum depth of 18 cm below the occupation surface and 28 cm below the modern surface. The hearth was filled with dense charcoal dust and pieces, and contained some FCR. Most of the FCR was on the surface and within the upper 10 cm of feature fill. The lower feature fill contained little FCR but it had more charcoal and was darker in color from charcoal dust. Screening the feature fill recovered a few flakes but no bone. Additional flakes came from the cultural fill around the feature. A flotation and ^{14}C sample were collected from the lower fill of the hearth. It seems likely that the lower dark charcoal fill represents the fuel layer. Cobbles and other rock were probably placed on the hot coals to heat them for cooking purposes. Whether the heated stones were used in this hearth or in an adjacent pit is difficult to say from our limited exposure. Nonetheless, it seems likely that had stone been used in this pit then we should have found more rock in the hearth, in that there would have been no reason for the occupants to have cleared out the cooking stones from the basin. The lower charcoal layer appears to be entirely fuel that was smothered and thus turned to charcoal. As a fuel layer,

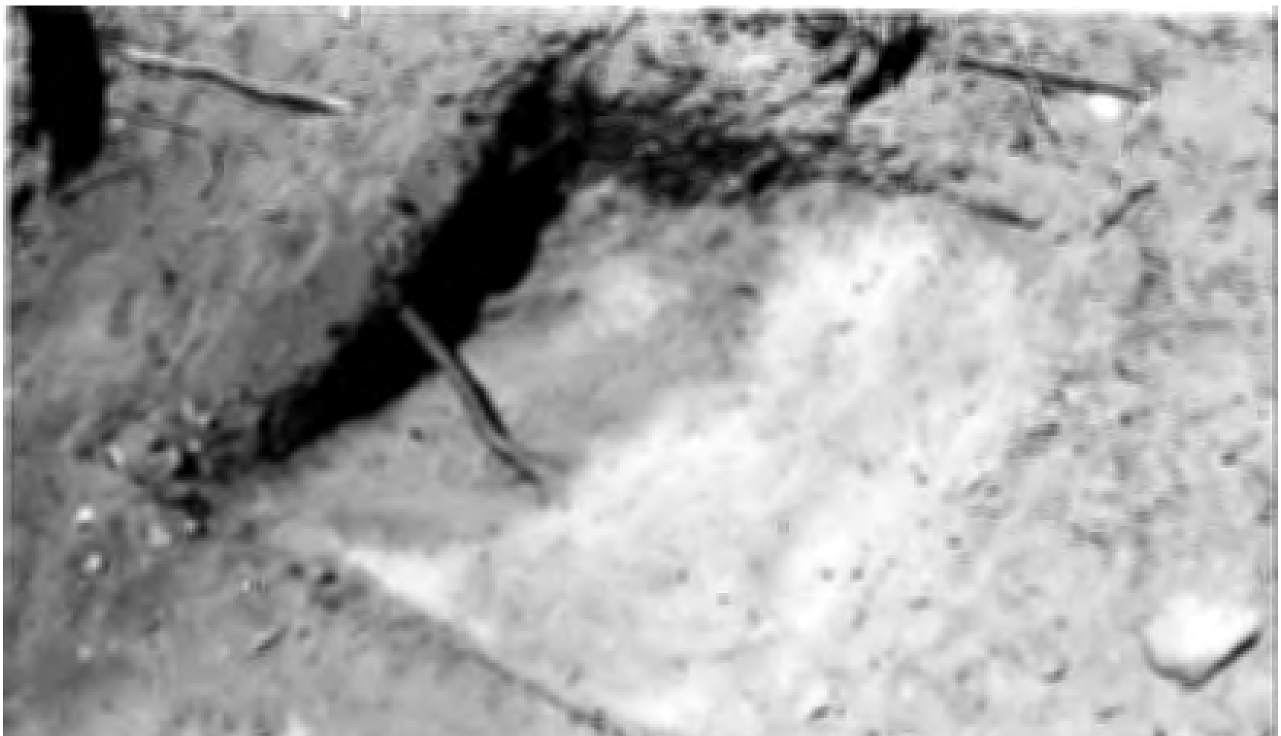


Figure 5.11. Feature 3 of 42KA4749 as exposed in plan view within test unit 1 and after excavating the fill from the exposed portion (looking northwest).

the flotation sample of this deposit might not yield plant remains relating to subsistence. A flotation sample of the deposit was processed but it contained only wood charcoal.

Recovered Remains

Table 5.4 presents an initial inventory of all artifacts and nonartifactual samples recovered from the limited test excavations at 42KA4749. From the unit around the basin hearth (Feature 1) we recovered 59 flakes, three pieces of bone, a flaked cobble tool, a radiocarbon sample of juniper seeds, and a flotation sample (the two samples might come from the upper hearth fill), whereas from the hearth proper we recovered 17 flakes and two flotation samples (only wood charcoal was observed in the hearth fill so no radiocarbon sample was collected). Also collected was a recycled obsidian projectile point (Elko Eared) found on the surface next to the hearth.

Table 5.4. Recovered artifacts and samples from 42KA 4749.

Prov No.	Bag No.	Specimen Type	Count	Unit	Feature
1	1	Flaked stone	59	1	1
1	2	Radiocarbon sample (juniper seeds)	1	1	3?
1	3	Bone	3	1	3?
1	5	Flaked cobble tool	1	1	1
2	1	Flotation sample	1	1	3
2	2	Flotation sample	1	1	3
2	3	Flaked stone	17	1	3
3	1	Projectile point	1	surface	1

Dating

During excavation of the test unit but before the basin hearth (Feature 3) had been specifically identified, we recovered some carbonized juniper seeds. It seemed probable that these seeds would not overestimate age as much as wood charcoal, thus they became a probable high priority sample for ^{14}C dating. Before submitting these, however, the hearth flotation samples were processed and given a scan for remains that might provide an equally good date. Because no such plant remains were found, the juniper seeds were submitted to Beta Analytic for AMS radiocarbon dating. The ^{13}C corrected radiocarbon age for the seeds is 1680 ± 40 b.p. (Beta-144226, –21.0‰), which has a two-sigma calibrated date range of A.D. 255–435. This date is within the Archaic-Formative transitional interval, and might be seen as further support for the use of bow and arrow technology before the arrival of pottery. It is worth mentioning that juniper seeds can overestimate age by 100 years or more; thus the site might still date to the early Formative.

42KA4750

Survey Description

This site is situated along the base of a low Wahweap Sandstone outcrop on the west side of a small canyon providing a warm sunny exposure (Figure 5.12). The outcrop provides a slight shelter and the level area at the base of this overhang was evidently the focus of activity. Artifacts, fire-cracked rock, and charcoal-stained soil are scattered down the moderately steep sandy slope in front of the shelter. There is one well-defined midden (Feature 1) with heavy charcoal staining and numerous lithic artifacts and fire-cracked rock (quartzite and igneous cobbles). One Emery Gray sherd and a Rose Spring Corner-notched point were collected from the site. Feature 2 is a linear scatter of FCR and light, patchy charcoal staining that occurs along a small rivulet and may have been exposed only recently by erosion. Along the outcrop, in the overhang area, there is light charcoal staining and a few artifacts; debris in Feature 1 was perhaps tossed downslope from this area. There are about 100 flakes on the surface, derived from a mixture of both biface thinning and core reduction. Most core reduction flakes are from coarse-grained cobbles (quartzite, igneous, and metasediment) and come from the preparation and refurbishing of heavy-duty stone tools (choppers and scraper planes). There are some chert core reduction flakes but most of the chert debitage is derived from biface reduction—mostly percussion thinning of late stage bifaces, but also some pressure flaking. Many of the thinning flakes are heat treated. Stone tools observed on the site include a Rose Spring point, two bifaces, a cobble chopper, and a probable metate fragment. The presence of a single Emery Gray sherd and a Rose Spring point may indicate Fremont use during the Formative period. The site possibly represents a repeatedly used, temporary residential camp related to foraging activities on Paradise Bench.

Test Units

Two 1 x 1 m units were excavated to test this site. Unit 1 was placed in the FCR and artifact scatter identified as Feature 1 and thought to be a midden deposit derived from use of the level area at the base of the overhang. The second test unit

was placed on the crest of the narrow level area where we expected to find intact features. This area appeared somewhat buried by modern sediment.

Unit 1. We placed Unit 1 over a dense concentration of FCR and artifacts within a matrix of charcoal-stained and flecked sediment. It seemed that this unit would provide a good sample of apparent midden accumulation, yielding both artifacts and nonartifactual remains and samples. As it turned out, although Unit 1 yielded a sample of artifacts, it also exposed roughly half of a hearth, designated as Feature 4, and perhaps a corner of another hearth (Figure 5.13). The depth of the cultural deposit within the unit was 5 to 10 cm, with slightly more depth in the hearth. The deposit had no vertical differentiation. The Feature 4 outline was evidenced by oxidation (reddening) of the underlying clayey sand and a dark charcoal-stained fill containing charcoal pieces and burned and reddened sandstone chunks. A flotation sample was collected from the lower fill of the feature (fuel layer) and another flotation sample was collected from the general cultural deposit around the feature. No high-quality materials for ^{14}C dating were found in the field (just wood charcoal). Artifacts from the unit consist of two small Emery Gray sherds, three points (one whole and two fragments), one biface, flakes, and one unusual ground stone artifact (ornament or atlatl weight?). A flotation sample from the midden deposit of the unit contained only wood charcoal.

Based on finding one hearth and perhaps another, it appears that Feature 1 is not so much secondary deposition as it is primary hearth contents somewhat eroded downslope. Certainly some of the remains originated from the level area upslope, but just as much evidently originated from activities on the slope proper. Much of the burned rock and charcoal found within Unit 1 was derived from Feature 4 and perhaps similar shallow hearths located on the slope.

Unit 2. Unit 2 was excavated on the level area at the foot of the overhang between the slope to the east and an erosional channel to the west at the base of the sandstone outcrop (Figure 5.14). The unit was placed where it seemed that we would find features. Excavation revealed a layer of sterile roof spall and sand up to 25 cm thick overlying a cultural deposit of variable thickness (ca. 10–25 cm) that rested upon sterile clayey sand mixed with rock (colluvium). The overlying sterile deposits that buried the cultural layer were deepest in the west and north part of the unit, thinning to the east and south. The cultural deposit was not obviously stratified, but there was a layer of darker charcoal staining that overlay a lighter stained deposit in the southwest portion of the unit (the former was designated as Feature 6 and the latter as Feature 5). The Feature 5 and 6 deposits filled a linear depression that ran north-south (parallel the sandstone outcrop) in the western third of the unit. This depression is where the cultural deposit obtained its maximum thickness. This linear depression might be a natural feature, specifically an erosional channel at the foot of the overhang, one just like the drainage channel that currently exists, but located further east of the outcrop. A possible cultural explanation for the feature would be a purposeful excavation cut in order to foot branches that were leaned up against the top of the overhang to create a small sheltered living space. It is impossible to say without greater horizontal exposure, though we favor a natural origin for the depression.

Two areas of the sterile clayey sand underlying the cultural deposit exhibited oxidation reddening from in situ burning. One of these was in the southeast corner of the unit; here the oxidized soil appeared to outline part of a circular depression filled with cultural deposit. This was designated as Feature 3. It might be a shallow basin hearth such as Feature 4 of Unit 1. If so, then the feature had to have been cleaned out after its last use because the fill of the depression was no different than the cultural deposit within the rest of the unit. The other area of oxidation occurred around the edge of a basin that contained the Feature 5 cultural deposit; this was at the southern end of the Feature 6 linear depression. As with Feature 3, the fill within the oxidized basin of Feature 5 did not represent in situ hearth fill, so whether or not Feature 5 actually represents a hearth is impossible to say based on our limited exposure.

Excavation of Unit 2 created more questions than it answered. It seems certain that the level area sampled by the unit was an activity area, but the nature of this use remains unknown. Was a temporary brush structure erected across the front of the overhang? Were the areas of in situ burning from hearths or from some other sort of fire? Perhaps burning of the brush structure? Are different episodes of use represented by the deposits? Answers to these and other questions must await further excavation.

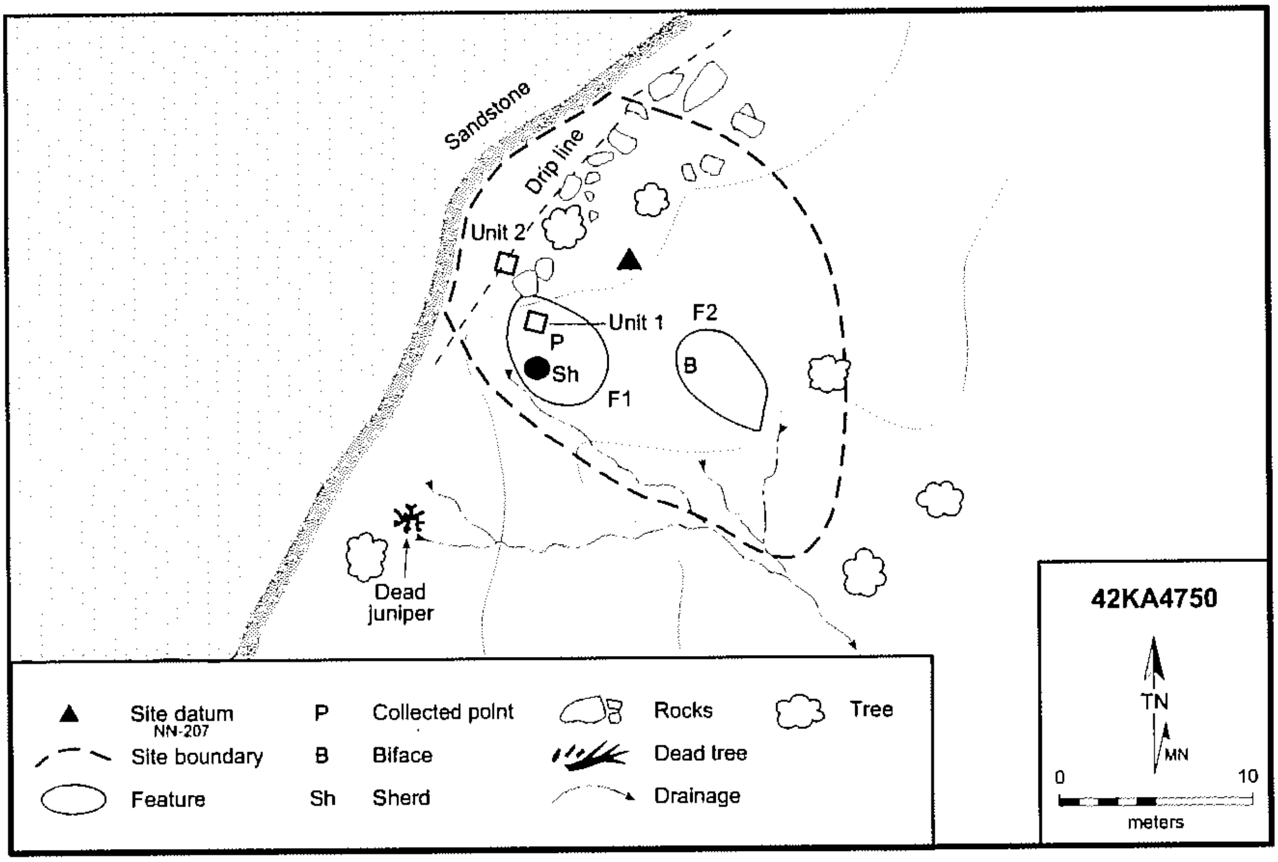


Figure 5.12. Survey sketch map of 42KA4750 showing the two test units.

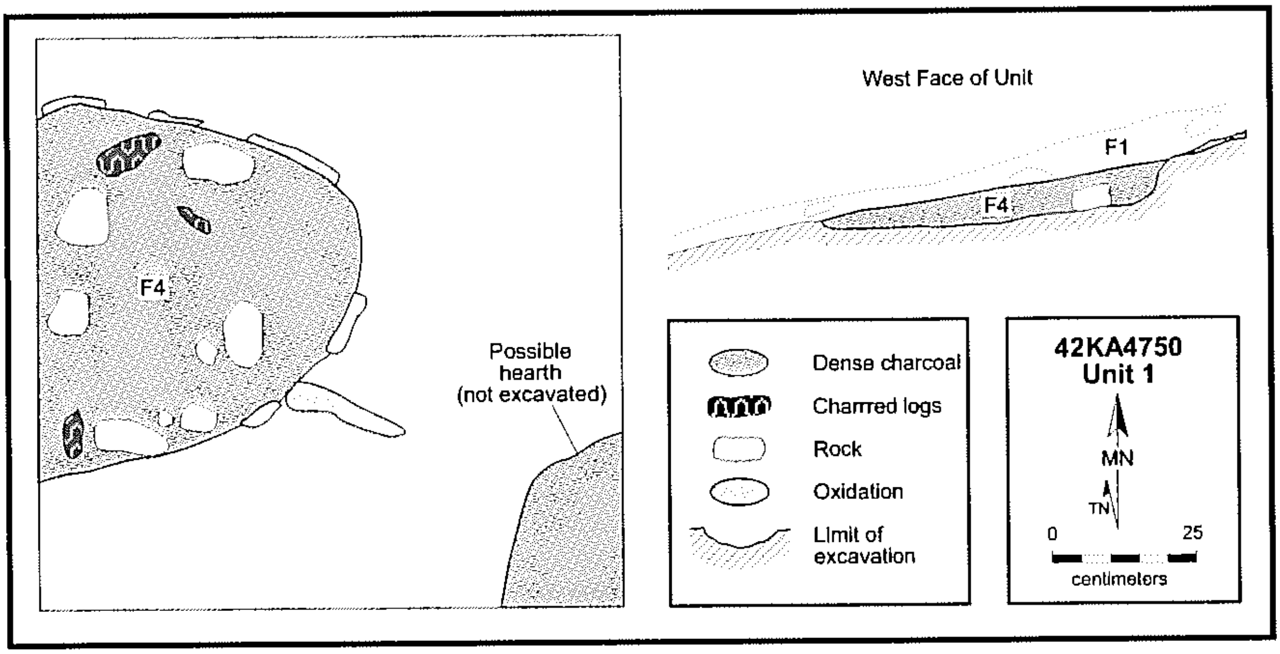


Figure 5.13. Test unit 1 of 42KA4750 showing the plan and profile of Feature 4.

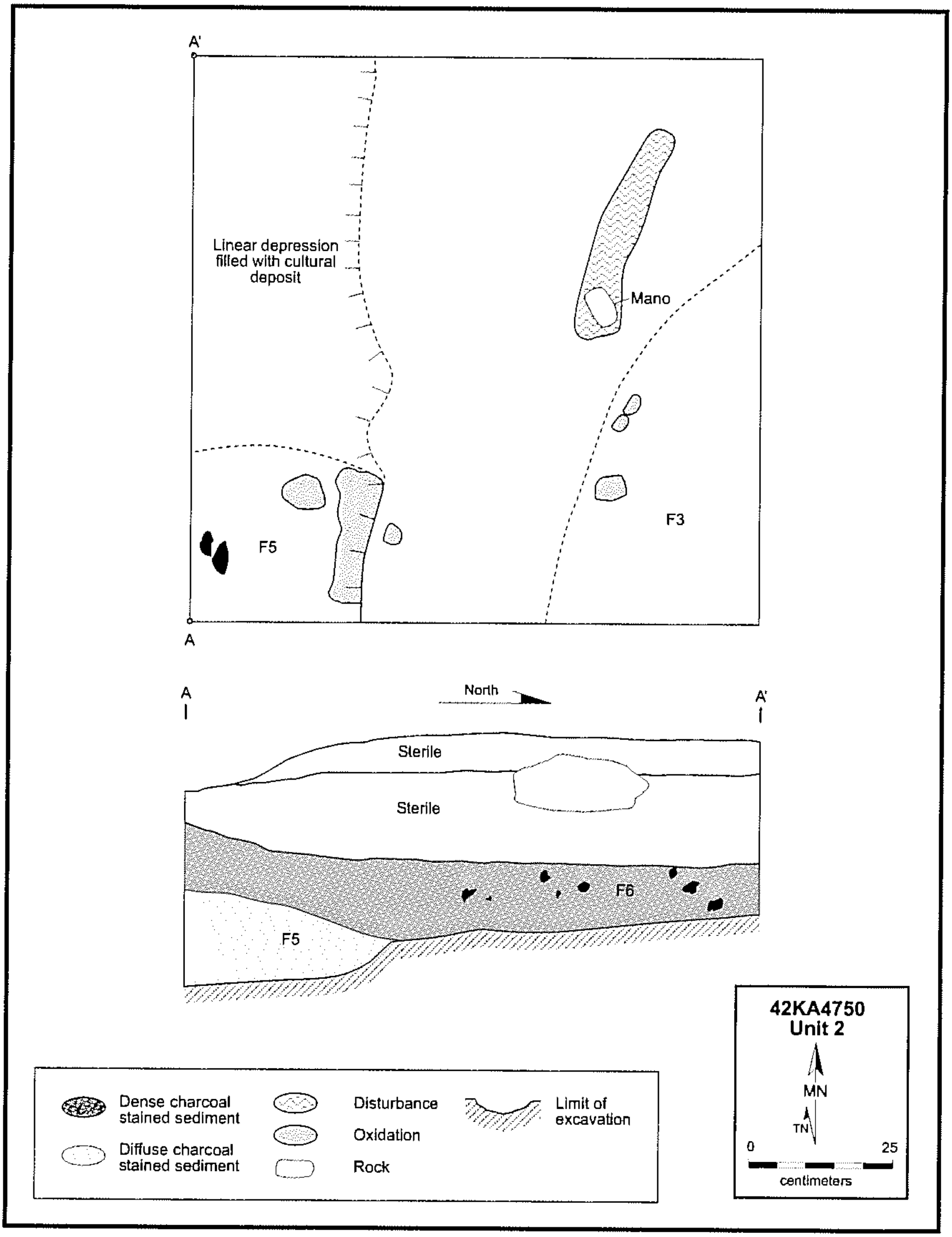


Figure 5.14. Test unit 2 of 42KA4750 showing the plan at the bottom of excavation and the profile of the west face.

Feature 4

Feature 4 is a shallow basin hearth built on a moderately steep slope (Figure 5.15, also 5.13). Probably about half of the hearth was exposed in the unit and excavated. Its oval outline was evidenced by oxidation (reddening) of the underlying clayey sand and dark charcoal-stained fill containing charcoal pieces and burned and reddened sandstone chunks. The feature measured 63 cm N-S and 56 cm E-W to the edge of the unit; it had a depth of 8 cm toward the upslope side. There were 21 burned sandstone chunks in the fill that ranged in size from 3 x 2 x 1 cm to 15 x 10 x 6 cm. Only burned sandstone occurred in the fill, despite the presence of fire-cracked alluvial cobbles (quartzite and metasediment) in the unit; the burned and spalled cobbles must have originated from a different hearth. Some of the charcoal in the hearth consisted of quarter sections of juniper and pinyon branches up to about 5 cm in diameter. As a fuel layer, the flotation sample of this deposit might not yield plant remains relating to subsistence; this sample was processed but not submitted to the analyst. Because only wood charcoal was found in the field and in our scan of the light and heavy fractions of the flotation sample, a radiocarbon sample from this feature was not submitted for analysis.

Recovered Remains

Table 5.5 presents an inventory of all artifacts and nonartifactual samples recovered from the limited test excavations at 42KA4750. From the unit around the basin hearth (Feature 4) we recovered 25 flakes, 4 flaked stone tools, 2 sherds, a shaped stone (atlatl weight?), and a flotation sample, whereas from the hearth we recovered a flotation sample (only wood charcoal was observed in the hearth fill so no radiocarbon sample was collected). The second test unit produced 2 flotation samples (Features 3 and 6), a radiocarbon sample (Feature 6), 22 flakes, a mano, 5 sherds, and 2 bones. We also collected an Emery Gray sherd from the surface next to Unit 1 (this sherd was described in the Phase 1 report based on a collected nip).

Figure 5.15. Feature 4 of 42KA4750 as exposed in plan view within test unit 1 and after excavating the fill from the exposed portion (looking west).

Table 5.5. Recovered artifacts and samples from 42KA 4750.

Prov No.	Bag No.	Specimen Type	Count	Unit	Fea-ture
1	1	Flaked stone	22	2	0
1	2	Mano	1	2	0
1	3	Sherds	2	2	0
1	4	Bones	2	2	0
2	1	Sherds	3	2	6
2	2	Radiocarbon sample (juniper seed)	1	2	6
2	3	Flaked stone	2	2	6
2	5	Flotation sample	1	2	6
3	1	Flotation sample	1	2	3
4	1	Flotation sample	1	1	4
5	1	Sherds	2	1	1
5	2	Flaked stone	28	1	1
5	3	Flotation sample	1	1	1
5	4	Shaped stone (atlatl weight?)	1	1	1
6	1	Sherd	1	surface	1

Dating

The best sample for radiocarbon dating was a juniper seed recovered in the field during excavation of the Feature 6 cultural deposit. The seed was submitted to Beta Analytic for AMS radiocarbon dating. The ^{13}C corrected radiocarbon age for the seed is 880 ± 40 b.p. (Beta-144227, –21.8‰). The calibrated two-sigma calendar date range for this assay is A.D. 1035–1250, which is in good agreement with the Anasazi pottery from the site but perhaps not the Emery Gray. It is likely that this site has at least two components, one represented by the late Formative ^{14}C date and Anasazi pottery and corresponding to McFadden's (2000) Fiftymile Mountain Phase, and an early Formative occupation represented by the Emery Gray pottery and corresponding to McFadden's (2000) Wide Hollow Phase.

ROSE SHELTER, 42KA4794

Survey Description

42KA4794 is a small rockshelter formed under a sandstone ledge at a pourover where one fork of a small canyon meets another fork (Figure 5.16). We named the site Rose Shelter after the thicket of wild rose bushes that were in bloom at the time of our test excavation. Most of the shelter is damp, crowded with wild rose bushes, and totally uninhabitable; only at its far north end is there a dry, level, protected living space and this is where all evidence of prehistoric activity occurs. This northern protected area faces east and would be pleasant on a winter morning or summer afternoon. This area is completely protected from precipitation, as the overhang is at least 6 m deep and out of the prevailing wind. Within the shelter is a small hearth (Feature 1) evidenced by an ash and charcoal concentration; dripline erosion had exposed the feature and caused slumpage of shelter deposits toward the south end of the living area. This erosion has also exposed a small 20 cm deep section of stratified deposits (laminated ash and sand containing artifacts, bone, and organics); the hearth is clearly toward the top of these layers. A small chunk (ca. 8 x 6 cm and 5 cm thick) of intact sediment slumped from the profile was carefully picked through, revealing a Rose Spring Corner-notched point base (with pitch still adhering) from a thin charcoal and ash layer. Other remains are sparse and all occur toward the south end of the living area; we observed a grinding slab fragment, a quartzite cobble chopper-pounder and a core flake of chalcedony evidently used for cutting. The one other surface artifact is a roof fall block with two sharpening grooves. More remains are doubtless buried in the preserved deposits of the shelter. The living area defined by the level, dry portion of the shelter is so small that just a few people could have used the site at one time. The small size also means that looters could remove all intact deposits in a day. Given the nature of the few remains exposed to view and the protection afforded by the overhang, it is likely that the site served as a temporary camp by small groups who wanted to get out of the elements during inclement weather. The site would not have made a good residential base because of access difficulties and space limitations. The Rose Spring point base indicates an early Formative occupancy, but other components may be present.

Test Units

We tested this small rockshelter with two 1 x 1 m units placed side-by-side (Figure 5.16). The units were oriented with the longest section of slump-exposed deposits, thus the units met the back wall of the shelter at approximately a 45 degree angle. Grid north was toward the shelter front, grid east toward the rosebush thicket, grid south toward the back of the shelter where no cultural deposits remained, and grid west toward the back of the shelter containing intact deposits. Unit 1 was the northernmost unit and overlapped the Feature 1 ash and charcoal concentration in order to sample it. Unit 2 abutted 1 on its south side and intersected the back wall of the shelter at its southwest corner. The deposits in most of Unit 2 were slumped and eroded; only the far north-

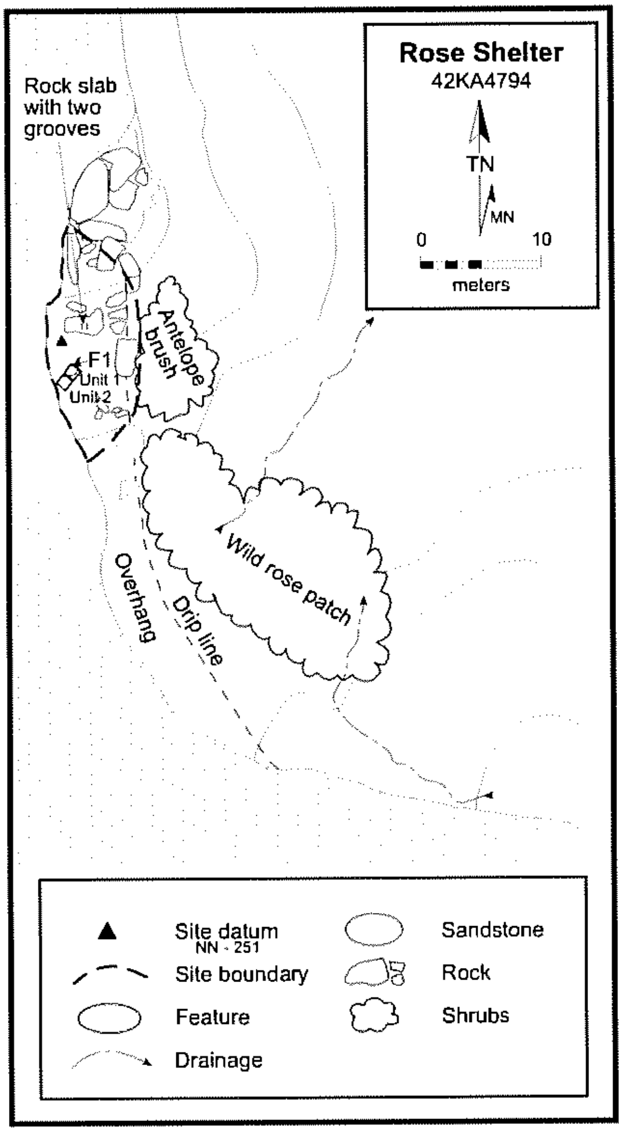


Figure 5.16. Survey sketch map of Rose Shelter (42KA4794) showing the two test units.

west corner of this unit contained intact layers. The deposits in about half of Unit 1 were slumped and eroded, and much of the intact portion of this unit was taken up by the Feature 1 hearth. In total we excavated less than 1 sq m of preserved cultural deposits that were less than 50 cm thick; most remains occurred within several fine layers that totaled less than 20 cm in maximum thickness.

After laying out the test units, the first task was removing the loose and slumped sediment to expose intact deposits and get a preliminary look at them before beginning stratigraphic excavation. The eroded deposits were carefully troweled and brushed to reveal the preserved layers; in this process we also cleaned out loose fill from all observed rodent or insect intrusions. This sediment was screened to save artifacts, but nonartifactual bone and plant remains were tossed. This process disclosed that only the northwest corner of Unit 2 was intact, with the rest lost to erosion and intensive rodent burrowing along the shelter wall in the southern portion of the unit. Unit 1 sampled a larger portion of intact deposits, with roughly half of the unit eroded but the western half well preserved. Excavation of the intact layers began in Unit 2, and after taking that unit into sterile, we excavated Unit 1. All excavation was by trowel and brush, with the thin layers removed and screened individually. All artifacts and bone were saved and various plant parts were judgmentally saved as well. Eight layers were identified in Unit 2, and these same layers also extended into Unit 1 (Figures 5.17 and 5.18). The upper cultural strata consisted of micro-thin compact sand and silt deposits variously stained by ash and charcoal and containing flakes, bone, fine organics, and charcoal pieces. These were separated by thin sterile sand layers that appeared to represent sediment that had washed into the shelter during intervals between occupation. The upper deposits were dry, but with depth the deposits became damp from ground moisture seeping through the back of the shelter. As a result, the organic content was lost, the sediment became looser, and the layers were thicker. Perhaps because the lower layers were softer there was more evidence of rodent activity. All cultural evidence (inclusions such as charcoal and artifacts) stopped at a depth of ca. 40 cm below the modern surface, but the principal cultural layers did not extend deeper than 15 cm below the modern surface. We excavated to a maximum depth of 95 cm below the modern surface in the northwest corner of Unit 1 but did not encounter any additional evidence of cultural activity.

There were four principal layers of cultural deposition (Layers 2–5), which all appear to result from Formative use of the shelter, and yielded abundant pressure flaking debris, a few arrow points, a sherd, and a moderate amount of animal bone, most of it burned. The two perishable artifacts recovered are a string fragment and a small portion of a reed arrow shaft, one portion of which is painted with red pigment. Feature 1 appears to represent a Formative age hearth associated with the uppermost layers of deposition.

The loose surface sediment of the shelter, which we designated as Layer 1, might be considered a separate layer corresponding to Post-Formative use of the site. An ash deposit desig-

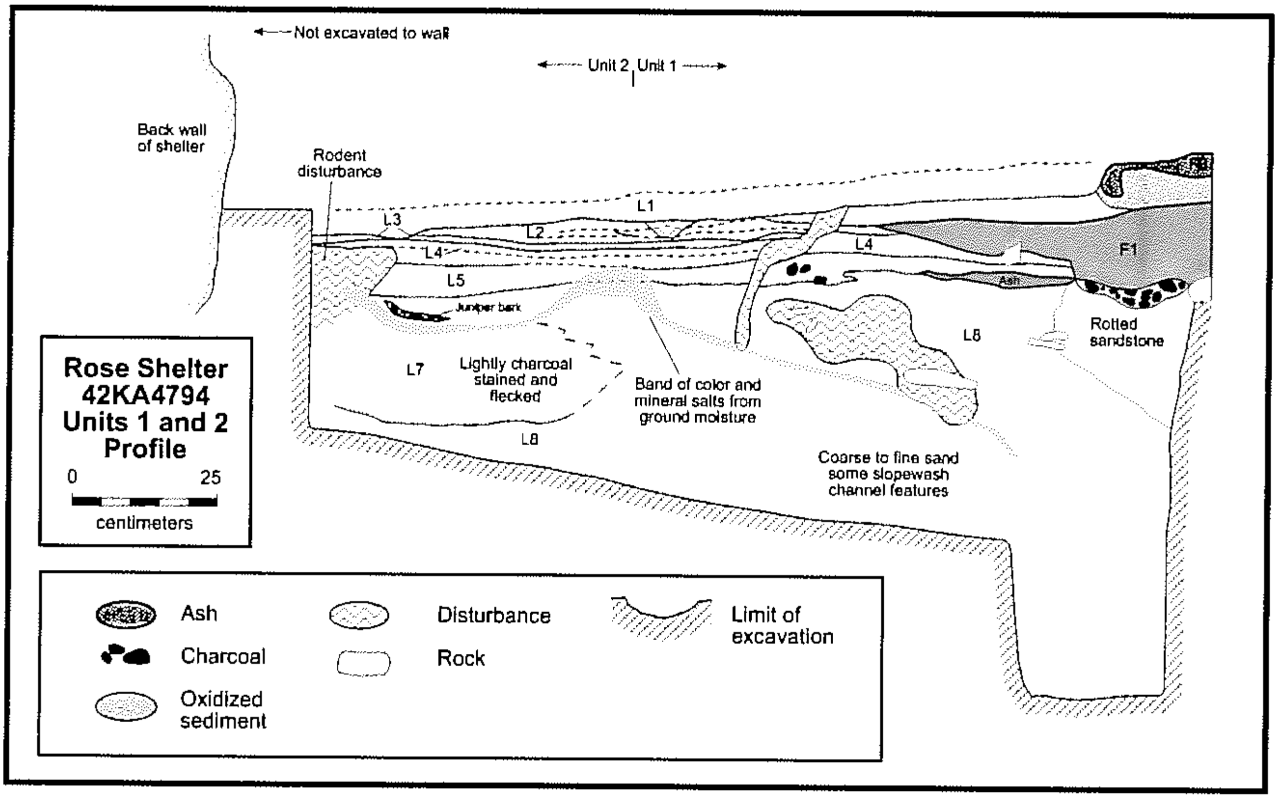


Figure 5.17. Stratigraphic section of deposits exposed in the grid west face of the test units at Rose Shelter.

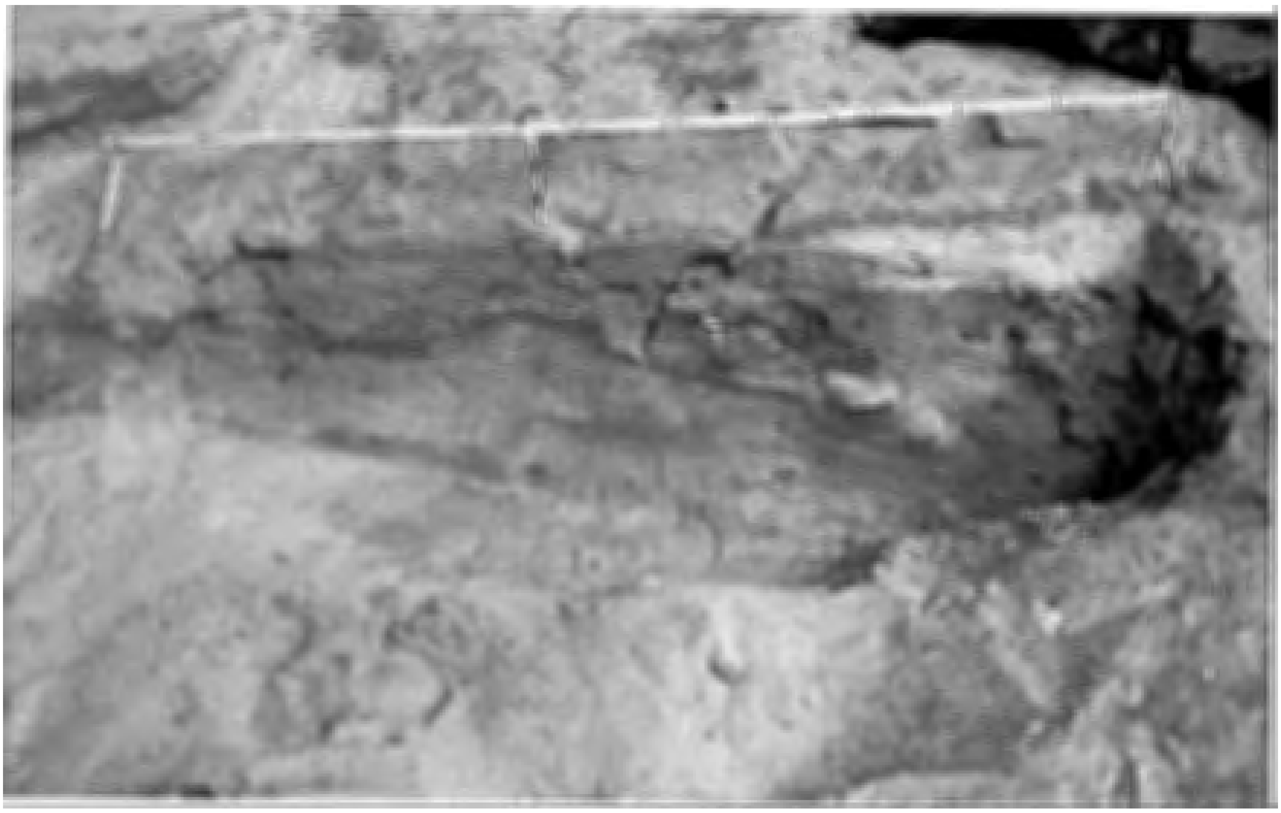


Figure 5.18. Deposits exposed in the grid west face of the test units at Rose Shelter; compare with Figure 5.17 above (looking northwest).

nated as Feature 3 and a whole grinding slab appear to form part of this upper layer. The ash deposit was seen in the far northwest corner of Unit 1 and the slab occurred just west of this unit. Layer 1 might thicken and become differentiated into several layers further west of the test units, as might any of the other identified layers.

The two deeper cultural layers (6 and 7) were only seen in Unit 2 close to the back wall of the shelter. These are also likely Formative in age and might actually represent rodent disturbed or redeposited remains; it is difficult to know based on our limited exposure. In any event, we obtained little from them so they are peripheral to the current discussion of the shelter. It seems possible that the shelter was poorly suited to cultural use until a massive roof spall event along the dripline, which helped to create a level area. This roof spall event is indicated by a layer of rotted sandstone in the north portion of Unit 1. The cultural layers abutted this sandstone and the Feature 1 hearth was built right on this deposit, oxidizing it; a 2–3 cm thick rind of the sandstone had turned purple from the heat of Feature 1.

Features

Feature 1. This is an unlined basin hearth that occurred in the northwest portion of Unit 1, part of which had slumped from dripline erosion. The total size of this feature remains unknown as does its shape, although it appears somewhat irregular, at least its upper ashy portion which extended for a considerable distance outside the central deep main basin. As shown in Figure 5.17, the lowest portion of Feature 1 consisted of a small basin (ca. 20 x 30 cm) filled with charcoal mixed with a little ash. This charcoal-filled basin was within a mass of decomposed coarse sandstone (roof spall), oxidized to a bright purplish color from the intense heat of the fire. Above this the hearth fill consisted of fine white ash with relatively sparse charcoal but including a moderate amount of burned bone and a diversity of plant remains (see flotation analysis results below). Also found within the ash was an Anasazi sherd. The ash spilled out in all directions from the central deep basin and pinched out at the top of Level 2. Given that most of the fuel of this feature was completely combusted and reduced to white ash, it is evident that the fire was never smothered for cooking or other reasons but always had full exposure to air until burning out. The amount of ash indicates either a sustained fire for many hours or sequential reuse of the hearth. If the latter happened it seems likely that we would have observed two charcoal-filled basins instead of one. Given the amount of calcined bone contained within the ash, it seem likely that the fire was used to cook game, which was then eaten with the bone being discarded into the fire. Plant remains from the flotation sample of the ash indicate plant processing as well.

Feature 2. Definition of this feature was greatly hindered by an especially heavy concentration of precipitated mineral salts, the result of ground moisture moving through the deposits. It appeared to be a small, steep-sided basin filled with some charcoal and an overlying layer of oxidized sediment. The bottom of this oval basin (ca. 25 x 22 cm) contained charcoal pieces, but there was no oxidation of the underlying sediment. It appears, therefore, that the coals were placed into the pit rather than a fire having been built within the pit. Overlying the coals was a 4 cm thick layer of oxidized soft sediment; the sediment had oxidized in place from being placed upon the coals, perhaps as a protective barrier for something being cooked. This feature originated at the contact of Layers 5 and 6 and is associated with the former.

Feature 3. Little is known of this feature and no samples or remains were recovered from it. This hearth was seen only in section at the far northwest edge of Unit 1, where it overlay the Feature 1 ash. It was separated from the Feature 1 ash by a layer of oxidized sediment, which suggests that Feature 3 is more recent in age, dating after accumulating sediment had buried Feature 1. Feature 3 appeared partially exposed on the modern surface of the shelter, lying below a veneer of sand easily disturbed by foot traffic. Further excavation is required to know the nature and extent of this feature; it might be associated with a grinding slab that also appears to lie just below the modern surface of the shelter.

Recovered Remains

The testing at Rose Shelter resulted in the largest collection of artifacts and samples, including perishable artifacts and nonartifactual remains (plants and animal hide). Table 5.6 presents an inventory of all artifacts and nonartifactual remains recovered from the two test units.

Dating

Only a single radiocarbon date has been processed for this site; what limited funds were available for ^{14}C dating had to be used for sites that would directly address the primary temporal

Table 5.6. Recovered artifacts and samples from Rose Shelter (42KA4794).

Prov. No.	Bag No.	Specimen Type	Count	Unit	Stratum	Feature
1	1	Flaked stone	97	1&2	slumped deposits	0
1	2	Groundstone	4	1&2	slumped deposits	0
1	3	Sherd	1	1&2	slumped deposits	0
2	1	Biface	1	2	2	0
2	2	Flaked stone	32	2	2	0
2	3	Bone	10	2	2	0
3	1	Flaked stone	19	2	lower mixed	0
3	2	Bone	7	2	lower mixed	0
3	3	Vegetation	1	2	lower mixed	0
3	4	Bone (rib)	1	2	lower mixed	0
4	1	Flaked stone	8	1	1	0
4	2	Jar lid (?)	1	2	1	0
4	3	Bone	24	1	1	0
5	1	Flaked stone	96	2	3	0
5	2	Bone	7	2	3	0
5	3	Vegetation	1	2	3	0
6	1	Flaked stone	2	2	4	0
6	2	Bone	1	2	4	0
7	1	Bone	7	2	5	0
8	1	Bone	4	2	6	0
8	2	Vegetation	1	2	6	0
9	1	Bone	4	2	6	2
10	1	Bone	3	2	7	0
11	1	Flaked stone	1	2	8 (rodent intrusive)	0
12	1	Flaked stone	53	1&2	rodent holes	0
12	2	Bone	45	1&2	rodent holes	0
12	3	Animal hide	2	1&2	rodent holes	0
13	1	Arrow shaft	1	1	2	0
13	2	Flaked stone	50	1	2	0
13	3	Bone	9	1	2	0
14	1	Flaked stone	128	1	top of 2	1
14	2	Bone	41	1	top of 2	1
14	3	Vegetation	4	1	top of 2	1
15	1	Flaked stone	103	1	3	0
15	2	Bone	1	1	3	0
16	1	Bone	6	1	4	0
16	2	Flaked stone	22	1	4	0
17	1	Flaked stone	94	1	top of 2	1
17	2	Bone	74	1	top of 2	1
17	3	Projectile points	2	1	top of 2	1
17	4	Vegetation	1	1	top of 2	1
17	5	Groundstone	1	1	top of 2	1
17	6	Sherd	1	1	top of 2	1
18	1	Flaked stone	15	1	4 (under Fea. 1)	0
18	2	Bone	18	1	4 (under Fea. 1)	0
19	1	String	1	1	5	0
19	2	Vegetation	1	1	5	0
19	3	Vegetation	1	1	5	0
19	4	Vegetation	1	1	5	0
19	5	Flaked stone	3	1	5	0
19	6	Projectile point	1	1	5	0
19	7	Bone	9	1	5	0
20	1	Flotation sample	1	1, N face	top of 2	1
21	1	Pollen sample	1	2, W face	6/7	0
21	2	Pollen sample	1	2, W face	2	0
21	3	Pollen sample	1	2, W face	3	0
21	4	Pollen sample	1	2, W face	4	0
21	5	Pollen sample	1	2, W face	5	0
21	6	Pollen sample	1	2, W face	7	0
21	7	Pollen sample	1	1, W face	8	0

objective of this project. An Anasazi sherd was recovered from the fill of Feature 1, suggesting that this hearth and perhaps Layer 2 dates to the Formative period. Rose Spring Corner-notched points from several layers also support a Formative temporal assignment. There was no evidence for Archaic use of the shelter. Several high-quality carbon samples are available for dating. The one dated sample consisted of part of an arrow shaft of common reed (*Phragmites communis*) from Stratum 2. The date on this artifact is 860 ± 40 b.p. (Beta-155679, –24.8‰), with a two-sigma calibrated date range of A.D. 1040–1260. This date indicates that the upper layer of the shelter including Feature 1 is late Formative, likely contemporaneous with the late Pueblo II–early PIII Anasazi occupation of Collet Top and Fiftymile Mountain.

POST-FORMATIVE SITES

42KA4575

Survey Description

The site is a small lithic scatter associated with a whole sandstone grinding slab and a hearth (Figure 5.19). The lithics are primarily interior flakes, some of which show use-wear. There is also an obsidian scraper, as well as two obsidian flakes. The hearth contains large pieces of charcoal. The relatively good condition of the metate indicates that it may be fairly recent. This, together with the charcoal and the presence of obsidian, leads to the possibility of a Paiute affiliation for the site; the site might be associated with pinyon harvesting.

Test Unit

We excavated a single 1 x 1 m unit placed directly over the charcoal stain identified as Feature 1 (Figure 5.20). A shallow scraping of the upper few centimeters of loose sediment from this unit revealed a clear plan view outline for what appeared to be approximately the eastern half of the hearth. It had an oval but somewhat amorphous outline. The fill from the south half of the exposed portion of the feature was excavated to reveal a shallow (ca. 8 cm) basin filled with charcoal pieces and dust with some burned sandstone and portions of several fire-cracked cobbles. No bone or other artifacts were found in the fill. We collected a flotation sample and two ^{14}C samples from the feature.

Feature

Feature 1 is a shallow basin hearth, roughly half of which was exposed in the test unit (Figure 5.21, also Figure 5.20). This feature measures 85 cm N-S and 58 cm E-W to the edge of the excavation unit. It had a shallow depth of just 8 cm below the occupation surface. We excavated the fill from the south half of the exposed portion of the hearth to reveal a layer of charcoal and little else, which represents the hearth fuel. Some of the charcoal chunks were 1.5 x 1.0 x 0.5 cm in size. At the bottom of the hearth were several juniper charcoal chunks with carbonized bark; a sample of the bark was collected as a radiocarbon sample. The bottom of the feature was oxidized to a reddish brown. Resting upon and somewhat intermixed with the charcoal were burned chunks of sandstone (ca. 20) and alluvial cobble spalls (ca. 30). The rocks seem to have been heated by placing them upon hot coals; this smothered the fire and left the dense charcoal layer in the hearth. Some sort of food was probably cooked by placing it on the heated rocks. No bone or other artifacts were found in the fill; a flotation sample of the fill contained only wood charcoal.

Recovered Remains

From the unit around the basin hearth (Feature 1) we recovered two flakes, and from the hearth we recovered a flotation sample and two radiocarbon samples (bark and wood charcoal). Twenty-nine pieces of FCR were collected for laboratory examination because some looked potentially artifactual; but all were subsequently tossed after cleaning and scrutiny showed no traces of use.

Dating

Dating a probable relatively recent site such as this with charcoal is highly problematic because of the old wood problem. Fortunately, in this case charred juniper bark was recovered from charcoal chunks at the bottom of the hearth. Dead branches with bark still attached are not likely to be anywhere near as old in the environment as branches without bark. Moreover, by dating the bark itself there is no cross-section effect (Smiley 1998:52–53). A small sample of the bark was submitted to Beta Analytic for AMS radiocarbon dating. The bark returned a ^{13}C corrected radiocarbon age of 400 ± 40 b.p. (Beta-144225, –21.9‰), which places the hearth within the Post-Formative period. The calibrated two-sigma calendar date range for this assay is A.D. 1430–1630.

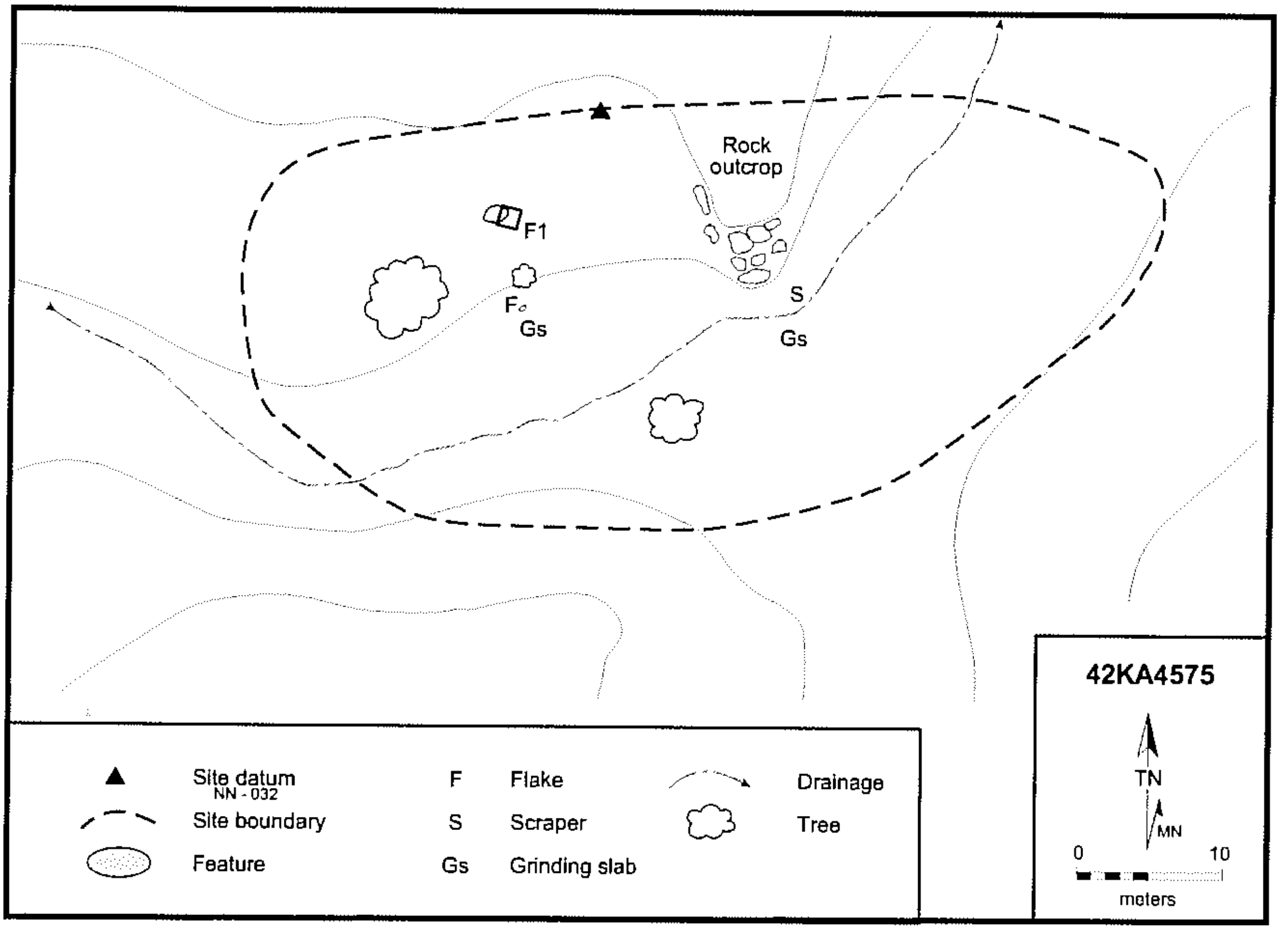


Figure 5.19. Survey sketch map of 42KA4575 showing the one test unit.

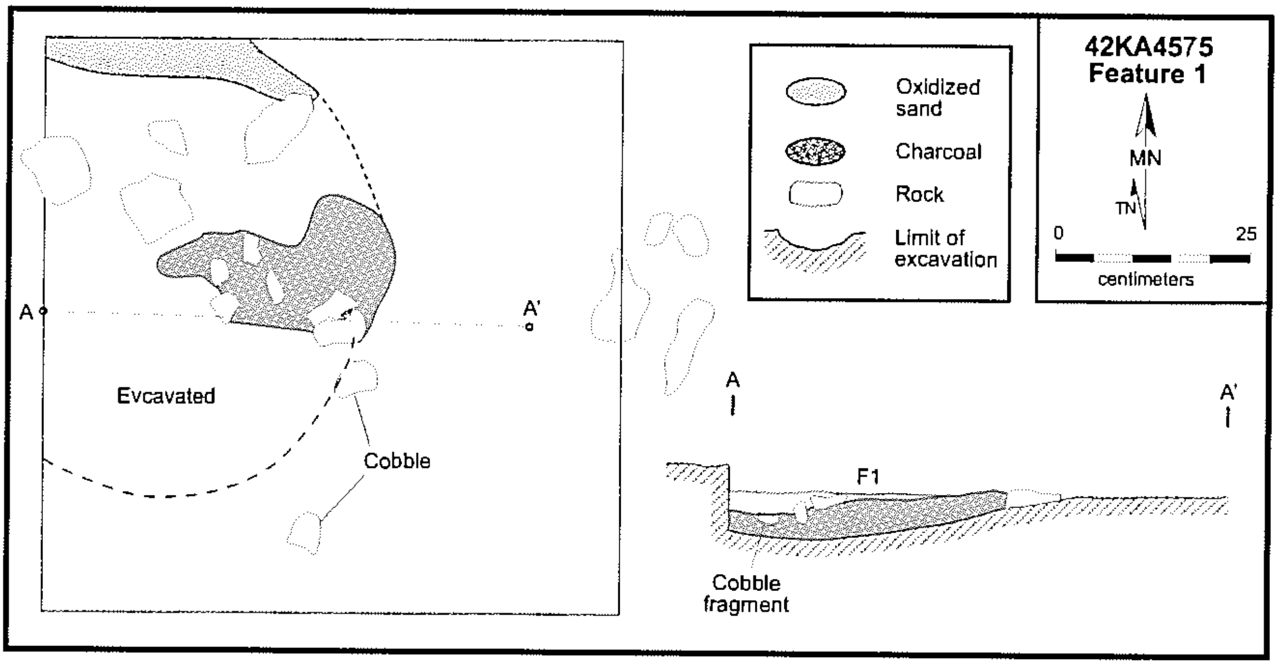


Figure 5.20. Test unit 1 of 42KA4575 showing the plan and profile of Feature 1.

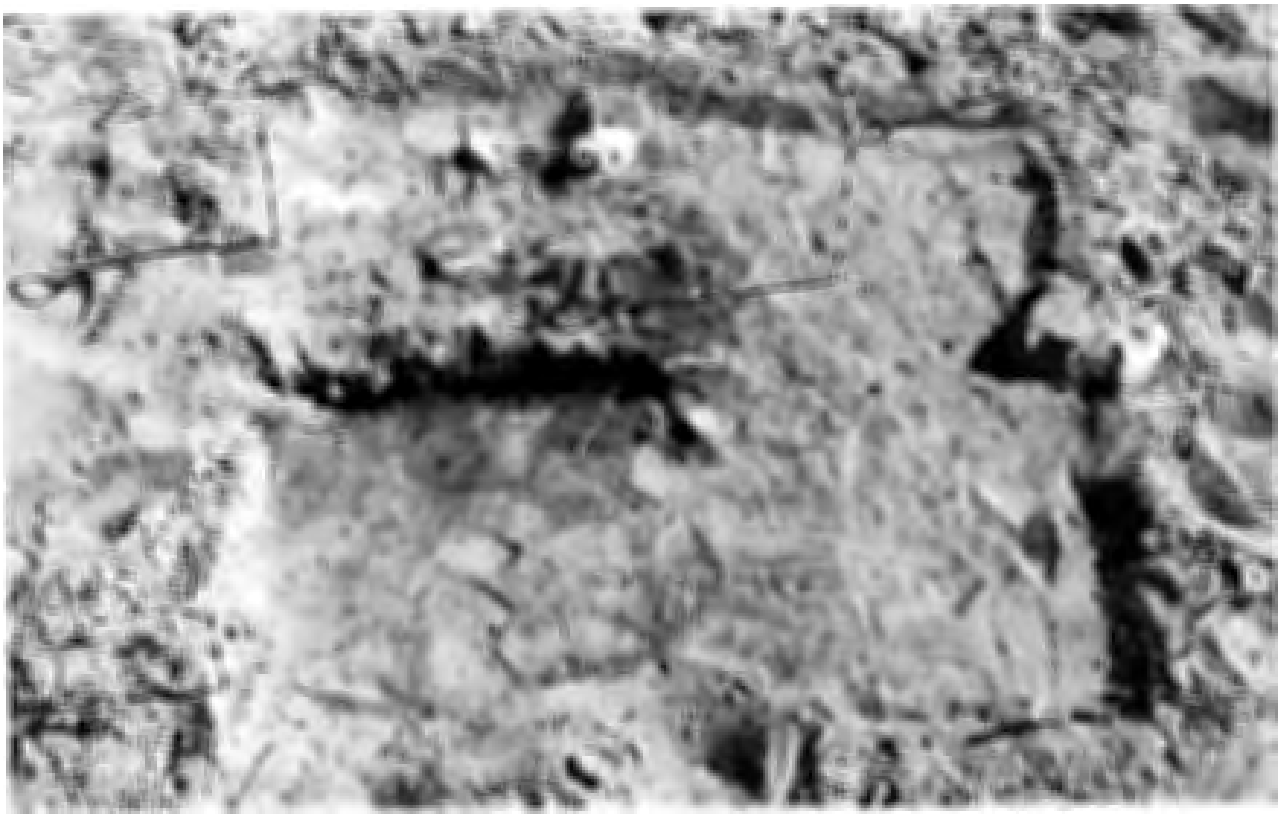


Figure 5.21. Feature 1 of 42KA4575 as exposed in plan view within test unit 1 and after excavating the fill from the south half of the exposed portion (looking north).

42KA4612

Survey Description

The site consists of a sparse lithic scatter and four hearths or fire-cracked rock scatters (Figure 5.22). Tools present include 4–6 fragments of grinding slabs (most of Kaiparowits sandstone but also one of Wahweap sandstone), a river cobble mano, and one arrow point tip made of Utah obsidian. Debitage is sparse, just 10–15 items consisting of chert and quartzite initial stage reduction flakes. Fire-cracked rock occurs here and there, primarily quartzite cobbles but also some igneous and metasediment cobbles. Although no diagnostic artifacts are present, the occurrence of grinding slabs with recognizable pecking and wear suggests a recent age, as does the arrow point tip of obsidian. The point tip looked "freshly" flaked, suggesting a probable Post-Formative age.

Test Unit

We excavated a single 1 x 1 m unit placed directly over the charcoal stain designated as Feature 1 (Figure 5.23). By removing a few centimeters of loose sediment, we obtained a clear outline of a somewhat circular charcoal-stained feature. Fill from the east half of the feature was excavated with a portion saved as a flotation sample (not analyzed). No plant remains that might be useful for ^{14}C dating were recovered in the field (something other than wood charcoal) and none were noted in the heavy and light fractions of the flotation sample. No artifacts or bone were found in or around the hearth.

Feature

Feature 1 is a small, shallow basin hearth entirely exposed in the test unit (Figure 5.24, also Figure 5.23). This feature measures 52 x 45 cm and has a maximum depth of 13 cm. We excavated the fill from the east half of the exposed portion of the hearth, revealing a 6–10 cm thick lower layer of dense charcoal pieces and dust (the fuel layer) and an upper 3–5 cm thick layer of oxidized (somewhat reddened) and charcoal-stained sediment. There were a few burned rocks and heat-spalled cobbles scattered around the hearth and one on the surface of the unexcavated half, but no burned stone was found within the fill of the excavated

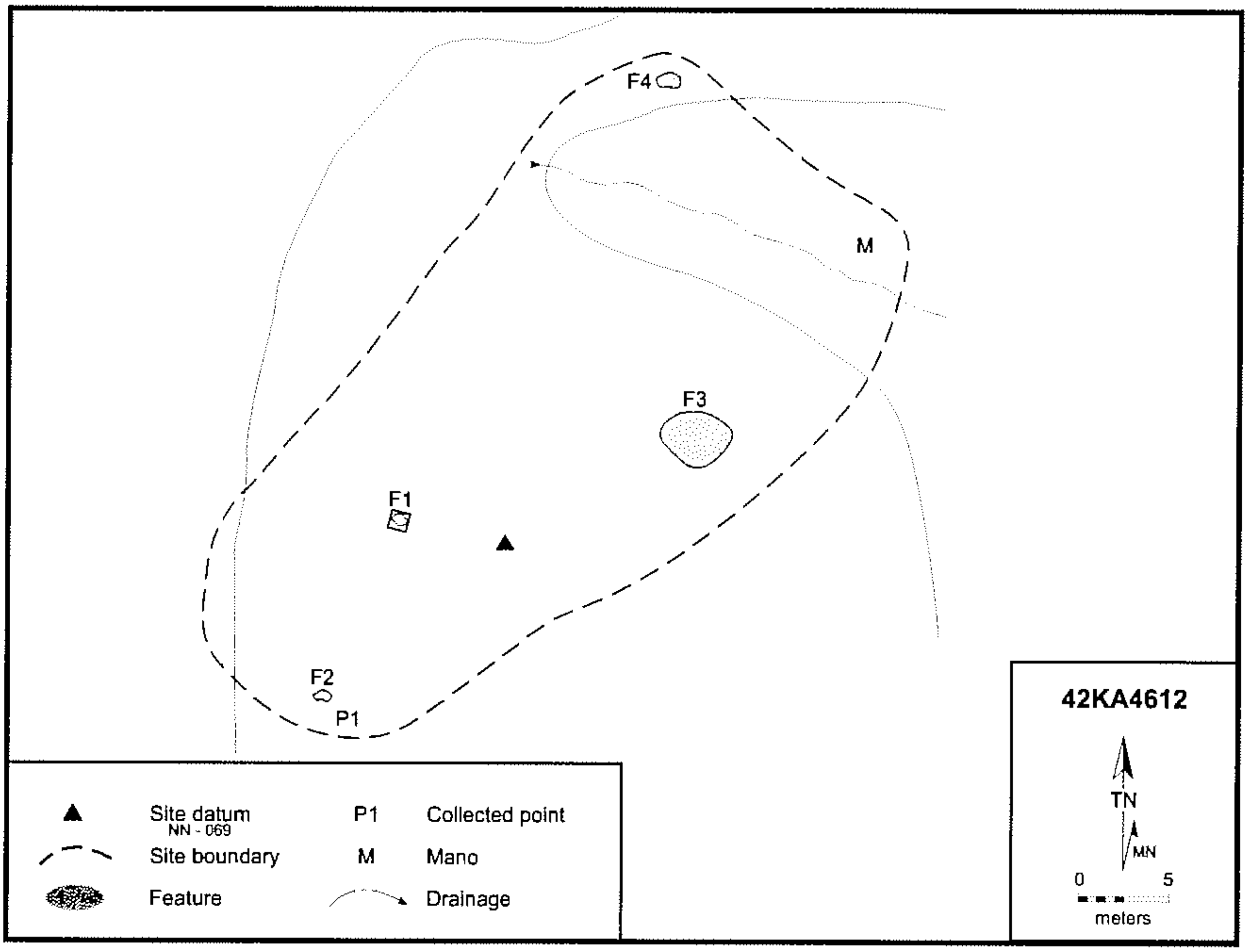


Figure 5.22. Survey sketch map of 42KA4612 showing the one test unit.

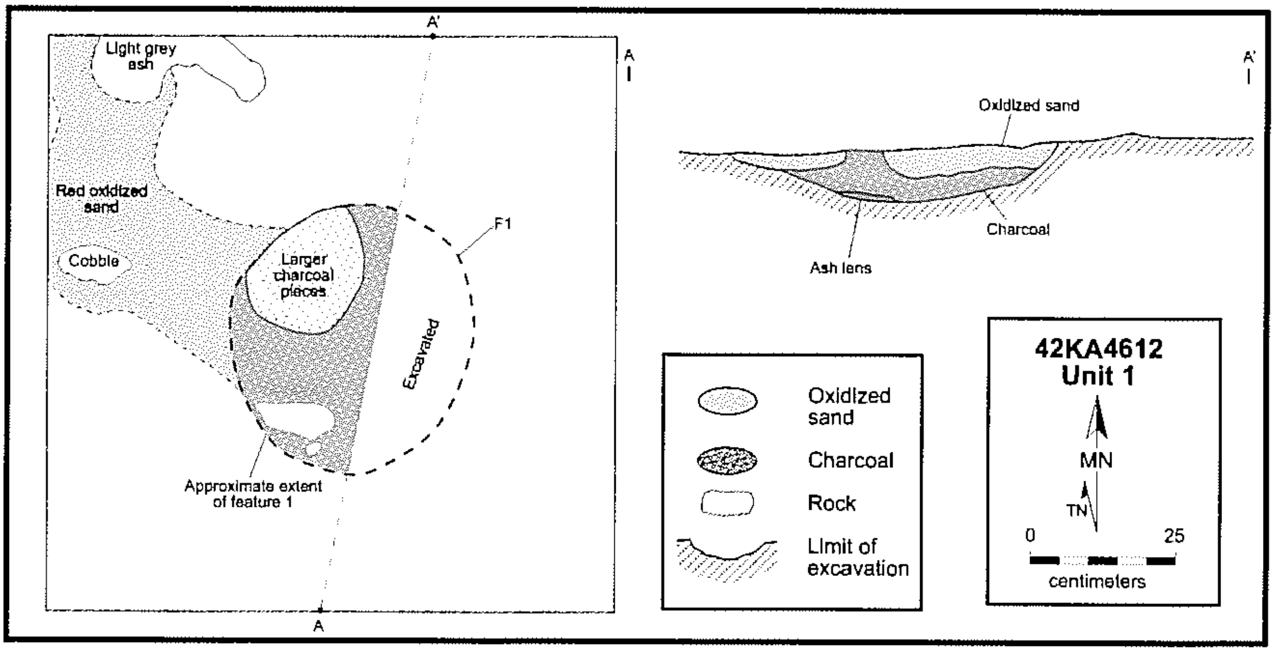


Figure 5.23. Test unit 1 of 42KA4612 showing the plan and profile of Feature 1.

Figure 5.24. Feature 1 of 42KA4612 as exposed in plan view within test unit 1 and after excavating the fill from the east half of the exposed portion (looking northwest).

half. Thus it would appear that the hearth was not used to heat stone for cooking purposes. The upper sediment layer was no doubt placed on the hot coals as a barrier between them and whatever was cooked or heated in the hearth. This feature could have been used to cook food, but it also could have worked to heat treat chert flakes (we have used similar small hearths for such a task). In this case there was no evidence around the hearth for the flaking of heat-treated chert such as we found at the site reported next (42KA4662). This is an interesting little feature that adds to the diversity of hearth "types" found on probable Post-Formative age sites of the Kaiparowits Plateau.

Recovered Remains

No artifacts were recovered from this site, just three samples: a flotation sample (PN1, Bag 1) and two radiocarbon samples (PN2, Bags 1 and 2).

42KA4662

Survey Description

The site is a small scatter of flaked stone artifacts and bone around two hearths that represents a briefly occupied camp, probably used by a hunting party (Figure 5.25). There are two hearths evidenced by charcoal pieces, charcoal-stained sediment, and burned sandstone fragments; burned and unburned bone occurs in and around these features. The bone is from animals that range in size from rabbit to deer. Tightly scattered around both hearths are lithic debitage and a few tools. The debitage is composed of simple core reduction flakes and small pressure flakes. The tip of an arrow point occurs near one of the hearths. The absence of grinding tools suggests use by a hunting party rather than a family group, and the site location (southeast exposure and closer to sage than trees) suggests a cold-season occupation.

Test Unit

We excavated two 1 x 1 m units placed directly over the charcoal stain and burned rock concentration identified as Feature 2 (Figure 5.26). We had planned to excavate just a single unit here, but the first one only clipped the edge of the feature so another was excavated. These side-by-side units revealed an exceedingly thin cultural deposit.

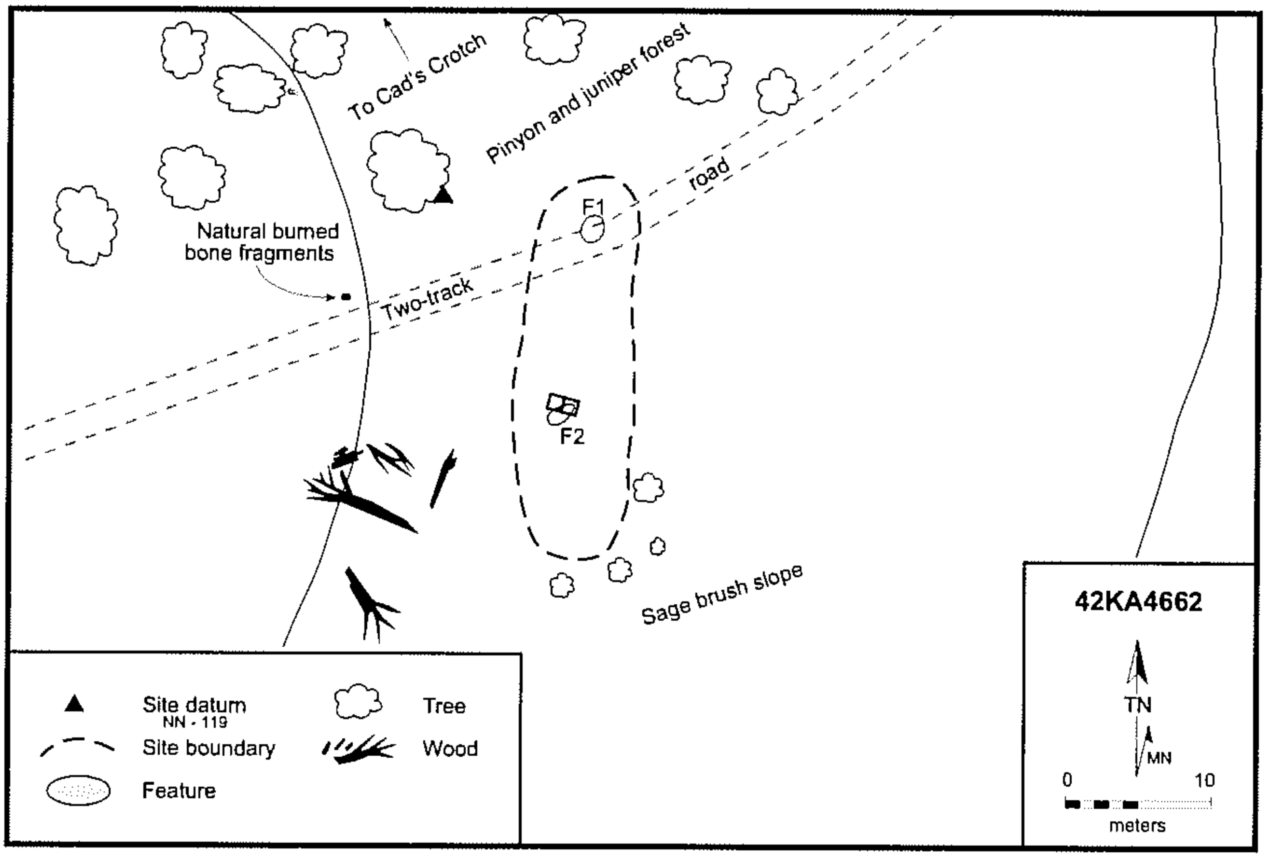


Figure 5.25. Survey sketch map of 42KA4662 showing the test units.

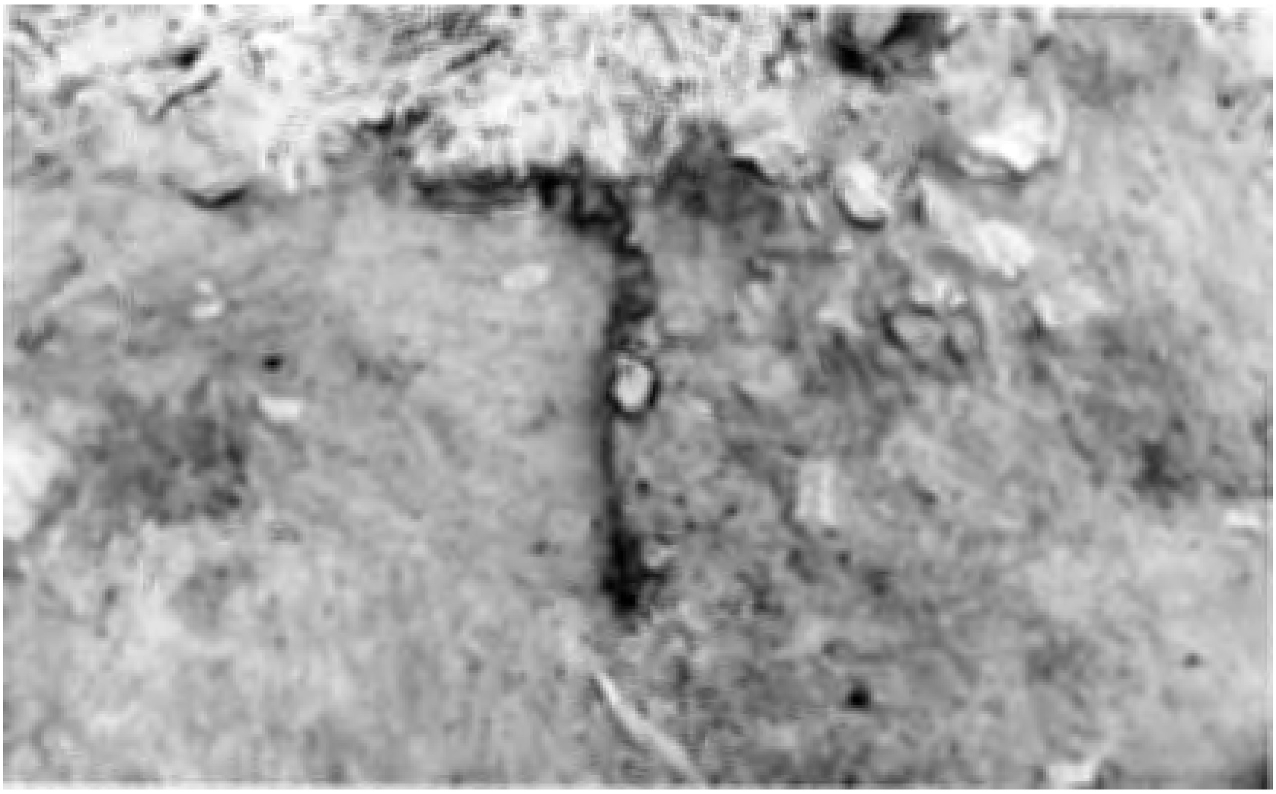


Figure 5.26. Feature 2 of 42KA4662 as exposed in plan view within test units 1 and 2 after excavating the fill from the eastern half of the northern exposed portion (looking south).

Materials were contained in just the first few centimeters of loose surface sediment. In contrast to the Archaic sites, this was not a matter of deflation but a lack of sediment accumulation since the remains were deposited. Only the thinnest veneer of eolian sand covered the artifacts, burned rock, and bone. Barely weathered, unburned bone occurred on and just below the surface; there was also burned bone. Flaking debris was moderately abundant, with most being pressure flakes. We discovered that the burned rock and charcoal rested directly upon the prehistoric occupation surface—in essence the feature has a topographic expression above the ground rather than below it. An identical feature occurs at another tested Post-Formative site (42KA4797). We found no plant remains useful for ^{14}C dating, just wood charcoal, but the unburned bone from the unit allowed for a collagen assay.

Feature 2

This hearth is evidenced by a surface scatter of burned rock, charcoal, and charcoal-stained sediment. Excavation revealed that the burned rock and charcoal rests directly upon the prehistoric occupation surface, so that the feature has a topographic expression above the ground rather than below it (Figure 5.26). There are two potential interpretations of the burned rock pile. First, the feature is a surface fire where fuel was burned right on the prehistoric surface without creating a pit, and then rocks were tossed upon the burning wood to heat them. Food, presumably meat because of the abundant animal bone, was then placed on the hot rocks and coals to cook. As an alternative to this, perhaps we excavated just the heating rock discard pile from a basin hearth located somewhere nearby. The rock pile is the surface visible feature that we focused on. Which of these scenarios is indeed true will require more horizontal exposure than was possible with our limited testing program. The surface fire scenario would seem to be supported by oxidation of the ground surface under the burned rock. Most likely only extinguished coals and cold rocks would have been tossed out in a discard pile, so that oxidation of the underlying sediment would not occur.

Recovered Remains

Table 5.7 presents an inventory of all artifacts and nonartifactual samples recovered from the limited test excavations at 42KA4662. From the two units around the hearth (Feature 2) we recovered 136 flakes, 3 flaked stone tools, and 113 bones, with most flakes and bones occuring in Unit 1 on the northwest side of the hearth. From the actual hearth fill proper we recovered a flake, five bones, and a radiocarbon sample (wood charcoal).

Table 5.7. Recovered artifacts and samples from 42KA 4662.

Prov No.	Bag No.	Specimen Type	Count	Unit	Feature
1	1	Flaked stone	112	1	0
1	2	Bone	102[1]	1	0
2	1	Flaked stone	27	2	0
2	2	Bone	7	2	0
3	1	Flake	1	2	2
3	2	Bone	5	2	2
3	3	Radiocarbon (charcoal)	1	2	2

[1]One bone submitted for ^{14}C dating and not reported in the faunal analysis.

Dating

We did not find any plant remains useful for ^{14}C dating, just wood charcoal. Dating such a probable recent site as this with wood charcoal is likely to misinform because of the old wood problem. Fortunately, in this case abundant unburned animal bone occurred around the hearth. An 11.4 g portion of an artiodactyl long bone was submitted to Beta Analytic for collagen extraction and AMS radiocarbon dating. The bone collagen returned a ^{13}C corrected radiocarbon age of 80 ± 40 b.p. (Beta-144224, –20.0‰), which places the hearth toward the end of the Post-Formative period. The entire calibrated two-sigma calendar date range for this assay is A.D. 1680–1955, but this consists of three separate range estimates: A.D. 1680–1745, 1805–1935, and 1945–1955. The latter of these is quite improbable based on the types of remains at the site—flaked stone artifacts and no historic artifacts. The oldest of the date ranges likewise does not seem realistic based on the moderately fresh condition of the bone despite shallow burial or even surface exposure. Indeed, at the time of excavation it was our hunch that Feature 2 must date to the late 1800s. Therefore, the middle date range is the one we find most believable given consideration of non-chronometric factors.

42KA4732

Survey Description

This site consists of two thermal features associated with two large metates, one projectile point base, and a sparse amount of flaked stone debitage (Figure 5.27). Both features appear intact and exhibit dark charcoal-stained sand mixed with abundant burned sandstone; small charcoal pieces occur on the surface or within both features. Feature 1 is about 2 m in diameter and Feature 2 is about 1 by 2 m. The two grinding slabs at the site are complete and are some of the best-preserved examples found at any sites during the Kaiparowits Plateau Survey. Diffusely scattered around the hearths and metates are roughly 20 flakes of mainly white chert, derived from pressure and percussion flaking of bifaces and unpatterned cores. It is possible that the flakes are not associated with the hearths and slabs because there is a diffuse debitage scatter across the dune sand in the general area. A recent age (Post-Formative) is suggested by the excellent preservation of the hearths, including surface charcoal, and two well-preserved grinding slabs. Based on the grinding slabs and thermal features it is likely that the site functioned as a short-term processing camp.

Test Units

We excavated a single 1 x 1 m unit placed directly over the charcoal stain and burned rock concentration designated as Feature 1 (Figure 5.28). By removing just a few centimeters of loose surface sediment, we obtained a clear outline of a circular hearth. It was bisected and the fill was removed from the south half revealing a moderately shallow basin filled with charcoal and some burned rock. Some burned animal bone was found in and around the hearth. We did not find any plant remains useful for ^{14}C dating during excavation, just wood charcoal, but the flotation sample contains annual plant parts that could provide a useful date.

Feature

Feature 1 turned out to be a moderately shallow basin hearth that measured 67 cm across the excavated width of the feature and about 75 cm N-S (Figure 5.29). The hearth had a depth of 15 cm below the occupation surface. It had a lower fill of dense charcoal pieces and dust (the fuel layer) and an upper layer of more lightly charcoal stained and flecked sediment. Between these two fill layers were burned sandstone pieces; some stone also occurred throughout the lower fill and on the occupation surface around the hearth. It seems evident that sandstone slabs had been placed on the hot coals of the basin to heat them. These also likely served as a protective barrier between the coals and what was cooked, but it also seems that some sediment was used as well. Whatever was being cooked would have been placed on the rock and sediment barrier. Some burned animal bone was found in and around the hearths, so animals were likely cooked. The presence of large grinding slabs indicates that food processing took place as well and the flotation sample from the hearth yielded various plant remains including ricegrass seeds and chaff. One use of the hearth might have been to generate coals for seed parching. Because no plant remains useful for ^{14}C dating were found in the field (just wood charcoal), this feature was not dated.

Recovered Remains

From around the hearth (Feature 1) within Unit 1 we recovered two pieces of bone and four metate fragments (burned rock); from the hearth fill we recovered two flotation samples (upper and lower fill) and a radiocarbon sample (wood charcoal). The metate fragments are perhaps from a single tool, but their find context indicates that they were merely functioning as cooking stone.

42KA4797

Survey Description

This site consists of an extensive scatter of cultural remains from several different time periods and probably from different seasonal or functional uses (Figure 5.30). Some of the remains, those of both Anasazi and Paiute, are clustered along the base of a low sandstone scarp with two small shelters (A and B) facing a drainage filled with sage. This drainage may have been farmable. Other remains are scattered on the sandy flat above (north of) the sandstone scarp. There are several discrete concentrations of remains with a generally diffuse scatter of materials in between. The eastern portion of the site, focused around rockshelter B, is designated the "Paiute Locus." This was the locus of interest for testing, specifically a probable hearth designated as Feature 3, and is the only one described here. At the Paiute Locus there are at least two probable hearths evidenced by surface charcoal and bone (Features

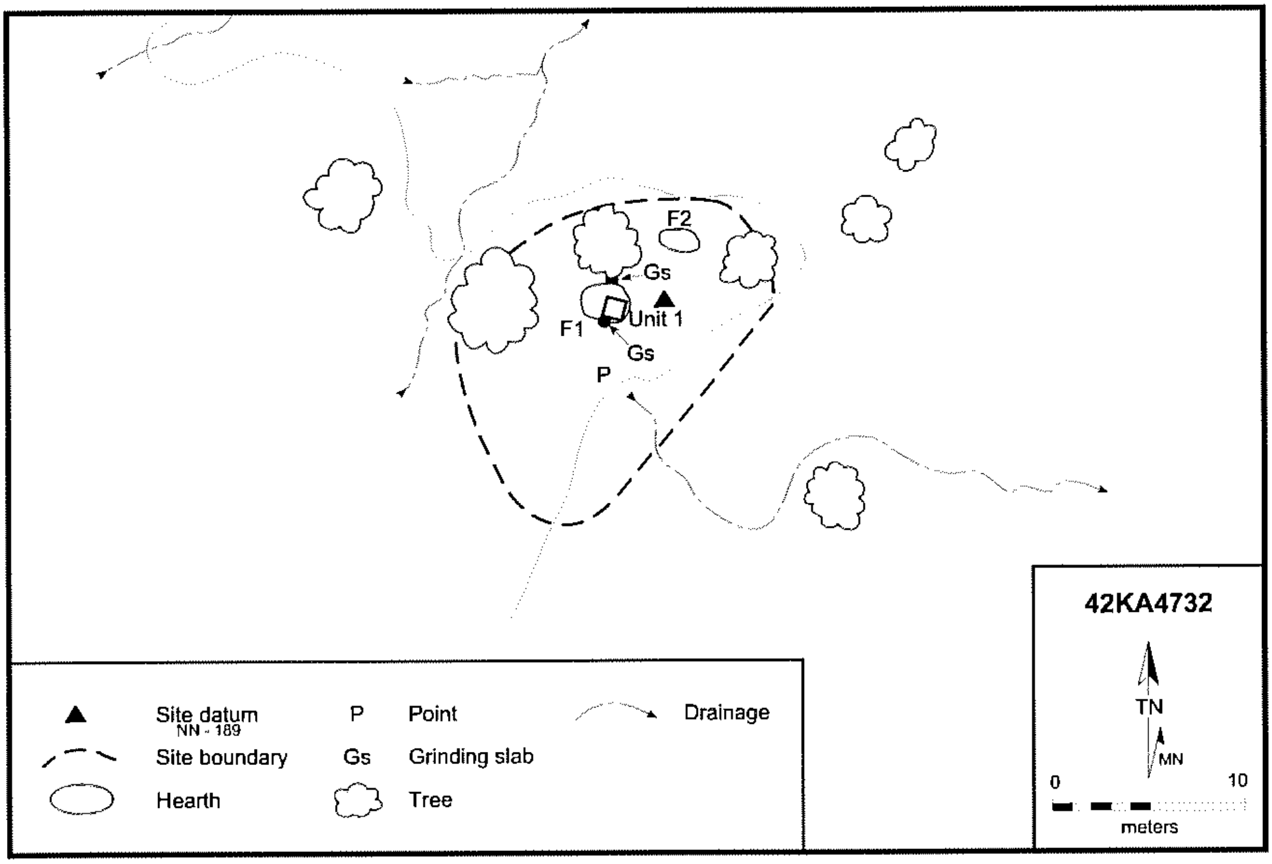


Figure 5.27. Survey sketch map of 42KA4732 showing the one test unit.

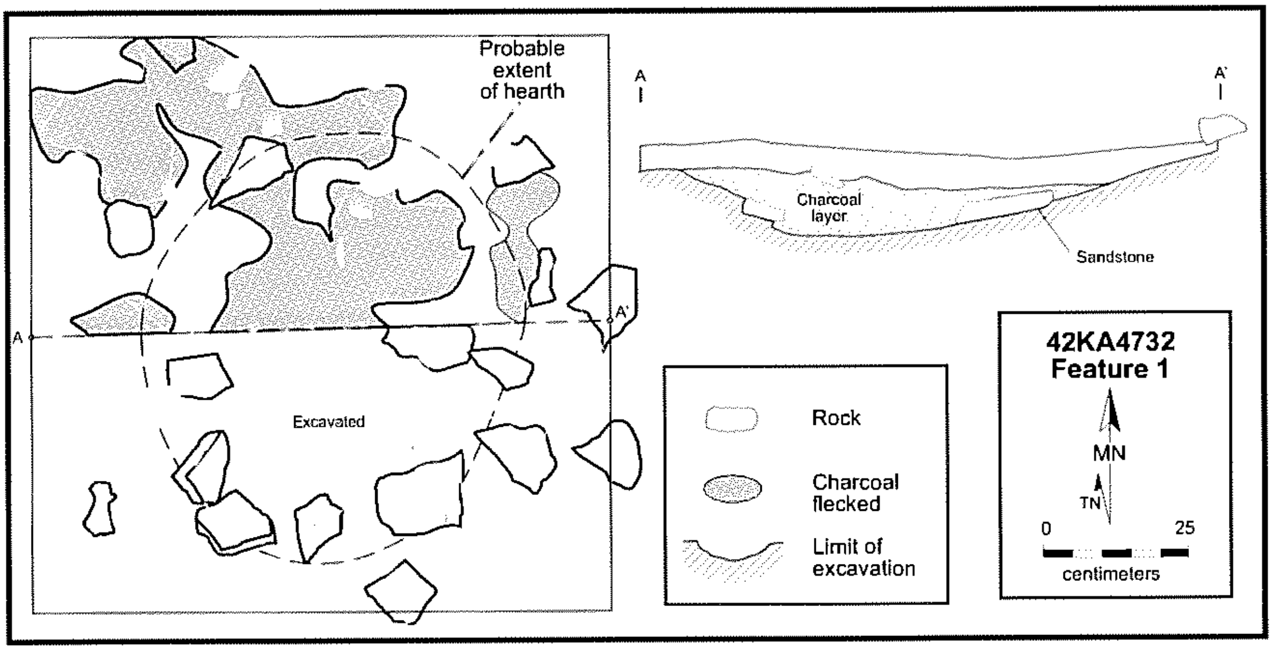


Figure 5.28. Test unit 1 of 42KA4732 showing the plan and profile of Feature 1.

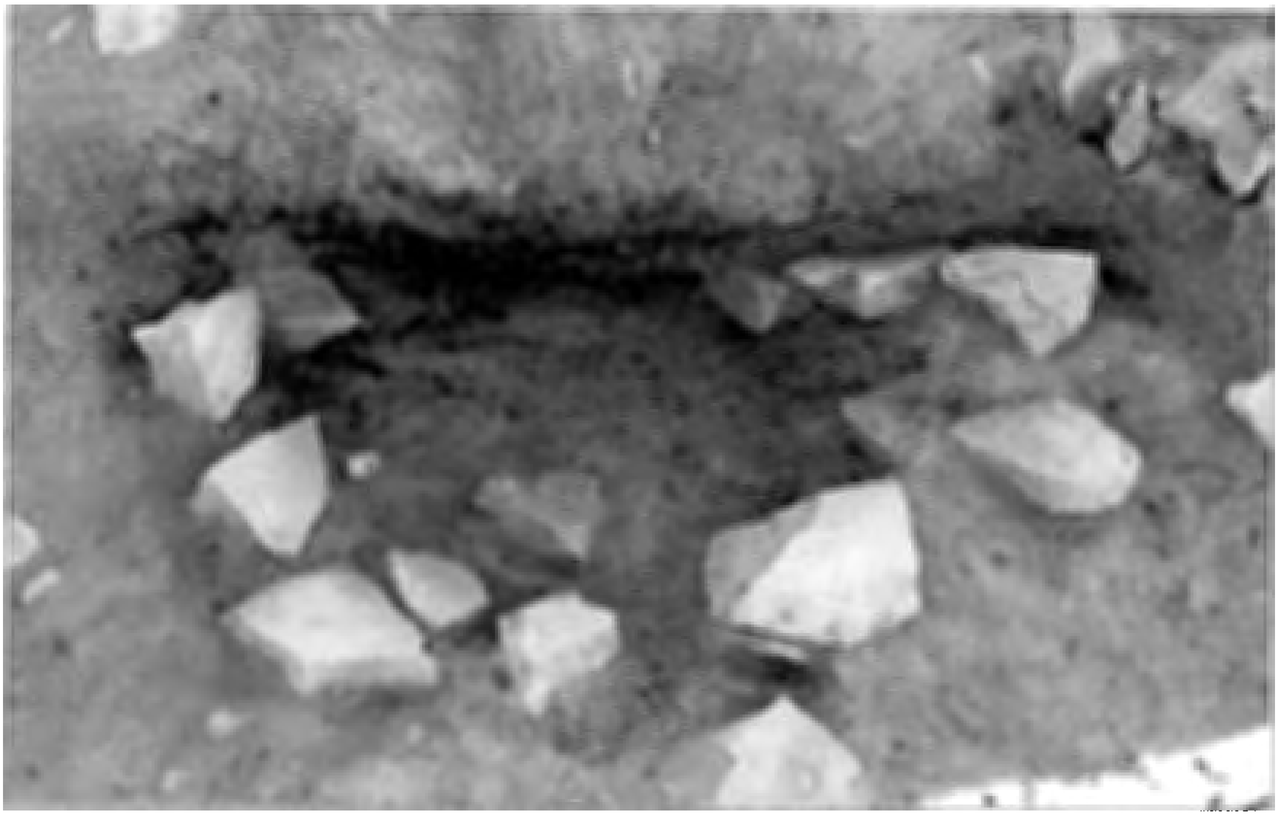


Figure 5.29. Feature 1 of 42KA4732 as exposed in plan view within test unit 1 and after excavating the fill from the south half of the exposed portion (looking north).

2 and 3) as well as a general scatter of burned rock and bone, and flaked and ground stone artifacts including Desert Side-notched points. The Post-Formative remains are mostly clustered close to a small shelter. Much of the debitage at this locus is of Paradise chert and consists of both simple core reduction flakes and pressure flakes. Based on the features and types of remains, it is probable that this locus was used as temporary residential camp.

Test Unit

We excavated a single 1 x 1 m unit placed directly over the charcoal stain and burned rock concentration identified as Feature 3. Removal of just a few centimeters of loose sediment containing cultural debris (burned bone and a few flakes) revealed a low pile of burned rock mixed with charcoal and charcoal-stained sediment resting upon sterile sand. The low pile was roughly circular but had amorphous edges and extended outside the test unit. The north half of this feature as exposed within the test unit was excavated. We did not find any plant remains useful for ^{14}C dating, only wood charcoal. Unfortunately, because the recovered bone is burned, a bone collagen ^{14}C date is not practical.

Feature 3

The test unit excavated directly over Feature 3 revealed a somewhat amorphous concentration of burned rock, charcoal, and charcoal-stained sediment that filled most of the unit and extended further east and south outside the limits of testing. The north half of this feature as exposed within the test unit was excavated, but no basin was found (Figure 5.31). Rather than a basin filled with charcoal and burned rock, the feature was revealed to be a low pile of burned sandstone and charcoal identical to that found at 42KA4662. The pile was somewhat oval but had amorphous edges and measured roughly 115 cm x 85 cm. Much of this was within the test unit, but greater horizontal exposure would be required to provide more accurate measurements. The maximum thickness of this pile was just 6 cm. As discussed for site 42KA4662, this feature is either a surface hearth or a discard pile from a basin hearth located somewhere nearby. The former seems probable, but the

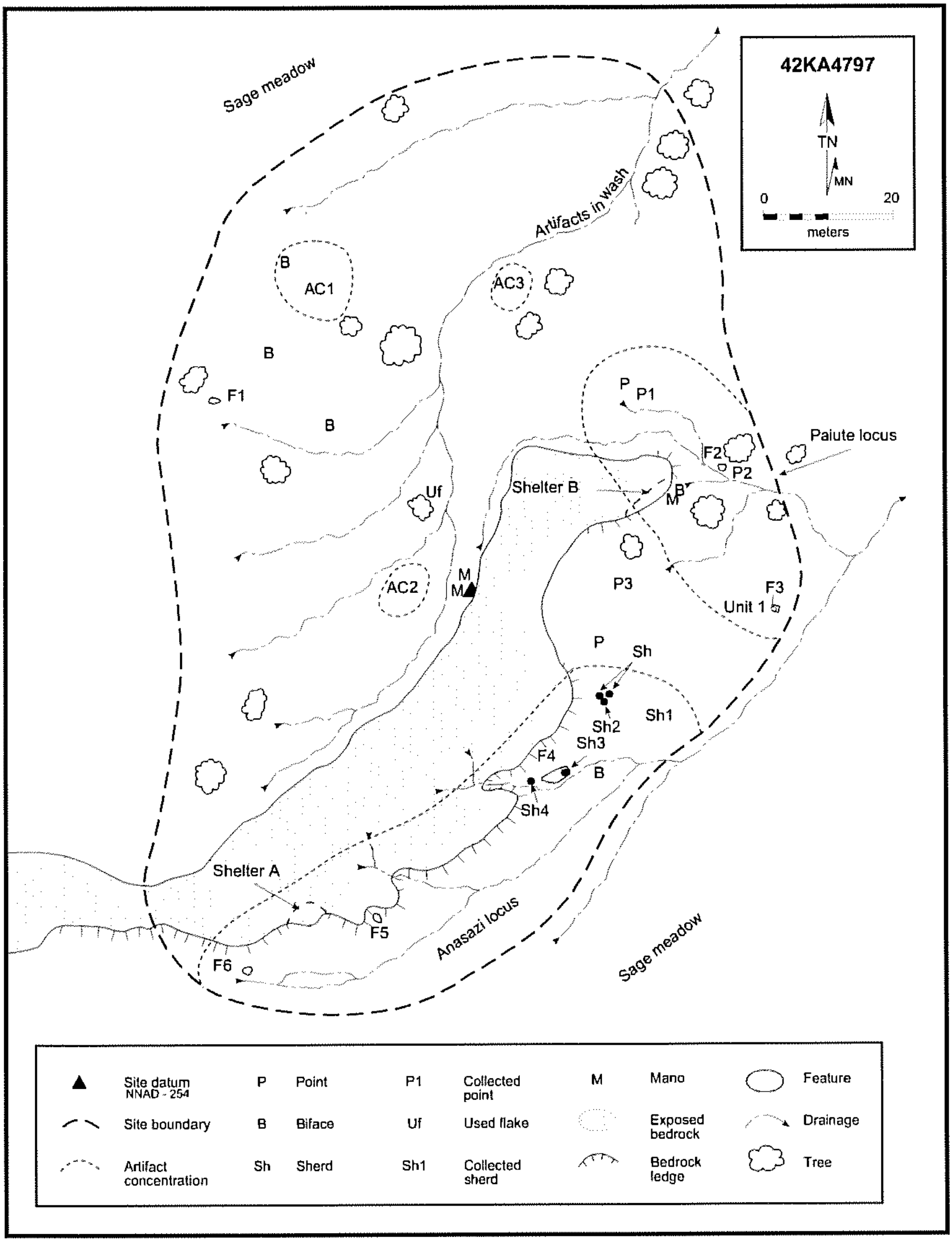


Figure 5.30. Survey sketch map of 42KA4797 showing the one test unit.

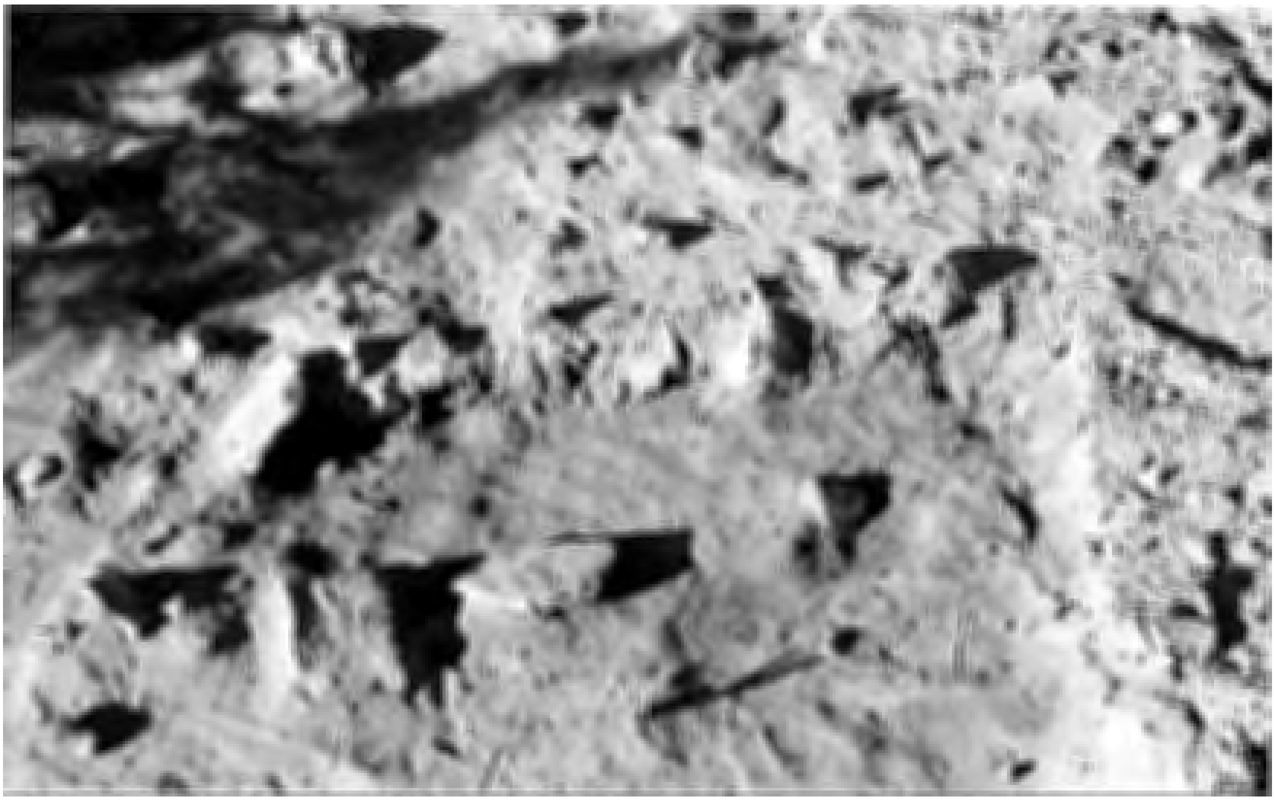


Figure 5.31. Feature 3 of 42KA4797 as exposed in plan view within test unit 1 and after excavating the fill from the exposed portion (looking south).

latter cannot be ruled out without greater horizontal exposure. Similar to the hearth at 42KA4662, there was burned and unburned mammal bone scattered in and around the hearth, so use of this feature in game processing seems probable. Unlike the other site, there were few associated artifacts. We did not find any plant remains useful for ^{14}C dating, only wood charcoal.

Recovered Remains

The limited remains recovered from test excavations at 42KA4797 consist of 11 pieces of bone from around the hearth (PN1, Bag 1) and flotation sample and radiocarbon samples (wood charcoal) from the hearth (PN2, Bags 1 and 3 respectively) along with nine pieces of bone (PN2, Bag 2).

SUMMARY OF RECOVERED REMAINS

The artifactual remains and nonartifactual samples recovered from the 13 tested sites are summarized in Table 5.8. All of the sites yielded some sort of sample, although the flotation sample from 42KA4655 was not from a cultural feature (the sample was processed to be certain that it lacked carbonized remains). Eleven of the 13 tested sites yielded artifacts; the two exceptions are both Post-Formative in age, and although artifacts occur on these sites none were found within the single 1 x 1 m test unit excavated at each to sample hearths. Flaked stone artifacts were the predominant class of recovered culturally modified remains, being found at 10 of the sites. Grinding tools were recovered from six of the sites with sherds from just two. The senior author conducted the analysis of all artifactual remains with Kimberly Spurr assisting with data manipulation for debitage and flaked stone tools. Presentation of the artifact analyses follows reports on the nonartifactual samples, starting with the results of radiocarbon dating and followed by the reports from specialists on nonartifactual faunal remains and flotation samples. All recovered faunal remains were analyzed (except for those found in flotation samples), but funding allowed examination of only eight flotation samples. The sediment for all flotation samples was processed at the NNAD laboratory so that only the light and heavy fractions would be curated. There was no funding for pollen analysis so none were processed;

Table 5.8. Summary of recovered remains from the 13 tested Kaiparowits Plateau sites.

	Artifacts				Samples					
Site No.	Flaked Stone	Grinding Tools	Sherds	Other	^{14}C	Bone	Float	Plant	Pollen	Other
42KA4547	x				x		x			
42KA4548	x	x			x					
42KA4549	x	x		x[1]	x	x				x[2]
42KA4552	x				x	x	x			
42KA4575	x				x		x			
42KA4612					x		x			
42KA4655	x						x[3]			
42KA4622	x				x	x				
42KA4732		x			x	x	x			
42KA4749	x	x			x	x	x			
42KA4750	x	x	x	x[4]	x	x	x			
42KA4794	x	x	x	x[5]	x	x	x	x	x	x[6]
42KA4797					x	x	x			

[1]Stone disk.
[2]Snail shell.
[3]Sample was non-cultural.
[4]Atlatl weight (?).
[5]Jar cover, cordage, arrow shaft.
[6]Hide/fur.

samples of this type were collected only from Rose Shelter (42KA4794), which had a stratigraphic sequence where pollen results might prove interesting. The few miscellaneous other nonartifactual remains are briefly characterized before the section on artifacts.

DATING

A central interest for the testing project was to examine the alternative dating methods used during Phase 1. The basic approach for achieving this was to test features at sites so as to recover carbon samples for radiocarbon dating. The radiocarbon samples would provide the chronometric dates against which we could evaluate which alternate criteria worked and which did not. Our hope was to provide better age estimates for the sites recorded during Phase 2 of the survey.

Nearly all of the 13 tested sites produced carbon samples of various quality. Most of the samples were wood charcoal, but several higher quality samples were also recovered, including juniper seeds, bark, and annual plant parts. There were many more samples than the budget would allow to be processed, so we had to decide which samples would be dated and which would be curated for potential dating at some later time. It was imperative that we sample sites from each of the three major temporal intervals represented in the testing program, but we also wanted to process the highest quality materials available. Because of concerns with old wood we were reluctant to date hearth wood charcoal. This was especially true for the most recent two periods (Formative and Post-Formative), where a date estimate that was 200 or more years too old might seriously affect site interpretation. As a result, we explicitly excluded the dating of wood charcoal samples from any sites potentially belonging to those periods. Of course, this restriction greatly reduced the number of samples available for dating, thus simplifying the decision process.

There were just two samples from Post-Formative sites that had any value: bark from the hearth at 42KA4575 and unburned bone from around the hearth at 42KA4662. (As it turned out, the macrobotanical analyst recovered annual plant remains from the tested hearth at 42KA4732 that could also provide an accurate age estimate.) Except for Rose Shelter, Formative period samples of any real value were equally few in number, with just one each from sites 42KA4749 and 4750. Both of these samples consisted of juniper seeds. Just one of several high-quality samples from Rose Shelter was processed at this time—part of a reed arrow shaft. Further dating seemed unwarranted because the shelter would not add greatly to our evaluation of alternative dating methods, which

all concern open sites. With just two Post-Formative samples and three Formative samples, all of which were small and thus required AMS dating, there were sufficient funds to process three Archaic samples, as long as one of these was a standard beta-decay date and thus less expensive. The selection of these was limited to samples from intact features of which there were only three: the basin hearth at 42KA4547 and the midden and slab-lined hearth at 42KA4552. Fortunately, the amount of charcoal recovered from the slab-lined hearth was sufficient for a standard date.

The eight selected samples were submitted to Beta Analytic for pretreatment, with those for AMS dating forwarded to one of their consortium labs for analysis and the one standard date processed in house. Table 5.9 presents the results for the samples in radiocarbon years b.p. along with information about context and the $^{13}C/^{12}C$ ratios. Note that the standard sample, which was on wood charcoal, has an assumed value of –25‰; the other six samples have measured values. The dates range in age from as recent as 80 years b.p. to as old as 3930 years b.p. Table 5.10 gives the calibrated results in calendar years for the eight dates using the information provided by Beta Analytic. We submitted all samples except for the arrow shaft portion to Beta Analytic in a single group, with the suspected youngest samples listed first and the oldest samples listed last. Thus, the first two dates were from sites thought to be Post-Formative, the next two from sites thought to be Formative, and the last three from sites thought to be Archaic; the arrow shaft was submitted later. As the calibrated results indicate, there is a moderately good correspondence between the approximate relative age of a site based on other evidence and the age estimate provided by the ^{14}C dates.

Lack of perfect correspondence is to be expected, thus we see that the slab-lined hearth at 42KA4552 is somewhat more recent than expected or at least earlier than the late Archaic date for the midden from this site. In this case the site evidently has two components (even though only one was

Table 5.9. Radiocarbon determinations for tested Kaiparowits Plateau sites.

Sample No.	Site	Context	Material Dated	^{14}C Age	$^{13}C/^{12}C$ Ratio
Beta-144224	42KA4662	Next to a hearth (F2) in a test unit	bone collagen	80 ± 40	–20.0‰
Beta-144225	42KA4575	From the bottom of a shallow basin hearth (F1)	bark	400 ± 40	–21.9‰
Beta-144226	42KA4749	Upper fill (F1) of basin hearth (F6) in test unit	juniper seeds	1680 ± 40	–21.0‰
Beta-144227	42KA4750	From buried cultural stratum (F6) in test unit	juniper seed	880 ± 40	–21.8‰
Beta-144228	42KA4547	From shallow basin hearth (F1)	charcoal	2200 ± 40	–21.2‰
Beta-144229	42KA4552	From lower fill of midden (F1)	twig	3930 ± 30	–22.2‰
Beta-144230	42KA4552	From slab-lined hearth (F4)	charcoal	1730 ± 50	(–25.0‰)
Beta-155679	42KA4794	Portion of a painted arrow shaft from Stratum 2	reed	860 ± 40	–24.8‰

Table 5.10. Calibration of radiocarbon age to calendar years for the dates of Table 5.9.

Sample No.	^{14}C Age	Intercept	One-Sigma Range	Two-Sigma Range
Beta-144224	80 ± 40	A.D. 1950	A.D. 1695–1725, 1815–1920, & 1950–1955	A.D. 1680–1745, 1805–1935, & 1945–1955
Beta-144225	400 ± 40	A.D. 1460	A.D. 1445–1500	A.D. 1430–1525 & 1560–1630
Beta-144226	1680 ± 40	A.D. 390	A.D. 340–415	A.D. 255–435
Beta-144227	880 ± 40	A.D. 1175	A.D. 1055–1085 & 1150–1210	A.D. 1035–1250
Beta-144228	2200 ± 40	B.C. 350, 310 & 210	B.C. 365–190	B.C. 380–165
Beta-144229	3930 ± 30	B.C. 2460	B.C. 2470–2430	B.C. 2480–2330
Beta-144230	1730 ± 50	A.D. 330	A.D. 245–390	A.D. 215–420
Beta-155679	860 ± 40	A.D. 1190	A.D. 1160–1230	A.D. 1040–1260

suspected based on surface evidence): one dating to the late Archaic and one to the Archaic-Formative transition. In less dramatic fashion, the juniper seeds found overlying or within the upper fill of the hearth at 42KA4749 are slightly preceramic. The latter is not out of line, given the finding of a Rose Spring Corner-notched point at the site and the lack of ceramics. The problem in this instance is that archaeologists currently lack a way of knowing whether an aceramic site with Rose Spring points in this portion of Utah is actually preceramic in age or simply a ceramic-age site without pottery. It is worth mentioning that comparative dating of juniper seeds and corn from single-component sites on the Rainbow Plateau has shown that juniper seeds can overestimate age by 100–200 years (see summary of dates in Geib and Spurr 2000). If true in this case, then the site does likely date to the early ceramic period.

FAUNAL BONE ANALYSIS

Andrea Miller

The Kaiparowits Plateau region offers a variety of faunal resources for human exploitation. Most sites included in the testing program represent temporary camps or processing areas, and faunal remains recovered from these sites provide information on economic systems of the occupants.

IDENTIFICATION AND QUANTIFICATION

Excavation methods used during the testing project are detailed in Chapter 1 and above; this section discusses only the faunal analysis. Several methodological studies of screening detail the advantages of using 1/8" and finer screen mesh for recovering small mammal and rodent bones (James 1997; Payne 1982; Schaffer and Sanchez 1993). James (1997) noted that substantial amounts of faunal materials were missed by 1/4" screens, creating a sample bias against small- and medium-sized animals. An earlier study using nested screens showed that large quantities of small mammal bones were lost with 1/4" and even 1/8" screens, whereas almost all bones were collected in 1/16" screens (Thomas 1969). Specifically, Thomas found that 95 percent of small rodent bones, 86 percent of chipmunk and squirrel bones, and 71 percent of cottontail and jackrabbit bones passed through 1/4" screens. During the Kaiparowits testing work, all excavated sediment not saved for flotation or for other analysis was screened through 1/8" mesh. Recovery rates should therefore be comparable among the sites, taking into consideration differential loss of bone due to weathering and decomposition on open versus sheltered sites and at sites of different ages.

Only mammal bones were recovered from the excavations. Durrant (1952) has provided information on the expected taxa of the region (Table 5.11). Identifications were made using comparative collections from Northern Arizona University's Faunal Laboratory and Northern Arizona University's Quaternary Studies Program. Limited comparative material for some taxa allowed assignments to only general categories in some cases. In addition, the fragmentary nature of the assemblage often necessitated a genus, family, or more general designation rather than consistent identifications to species.

General categories used in identification included "Rodent" for any animal fitting into designations of Peromyscus, Neotoma, or similarly sized mammals; "Small Mammal" for animals between the size of and including *Sylvilagus* and *Lepus*; "Artiodactyl" for metapodials, scapulae, or identifiable fragments of artiodactyl size; and "Large Mammal" for undiagnostic fragments such as ribs from animals larger than *Lepus* and equal to the size of a deer or mountain sheep. By using designations such as "Large Mammal" the species categories remain clean, containing only specimens that can be absolutely identified.

Distinctions between identifiable and non-identifiable bone were based on specific skeletal elements that allow consistent and reliable identification, such as epiphyses of long bones, distinctive cranial portions (facets, mandibles), teeth, carpals and tarsals, distal and proximal portions of metapodials, dorsal ribs portions, vertebrae, and scapulae and innominate portions. Articular facets and bodies provided the primary means of identifying these types of bones. The analysis of each bone distinguished side, bone portion (proximal, distal, shaft), and, if appropriate, whether the epiphysis was fused or unfused. This method provided an accurate though conservative count of identifiable bone, which maximizes the replicability of the bone counts.

Quantification of the faunal remains from the different sites was based on calculations of the NISP (number of identifiable specimens) rather than the MNI (minimum number of individuals) due to the small sample sizes. Advantages of the NISP method include the ability to calculate basic bone identifications in the field, as well as the additive nature of the values, allowing for com-

Table 5.11. Expected faunal taxa for the Kaiparowits Plateau region.

Hares and Rabbits	
	Lepus californicus
	Sylvilagus audubonii
Rock Squirrels	
	Citellus variegatus
	Citellus leucurus
Chipmunks	
	Eutamias quadrivittatus
Pocket Gophers	
	Thomomys bottae
Pocket Mice	
	Perognathus intermedius
Kangaroo Rats	
	Dipodomys ordii
Beaver	
	Castor canadensis
Cricetid Mice	
	Reithrodontomys megalotis (western harvest mouse)
	Peromyscus crinitus (canyon mouse)
	Peromyscus maniculatus (deer mouse)
	Peromyscus boylii (brush mouse)
	Peromyscus truei (piñon mouse)
	Onychomys leucogaster (northern grasshopper mouse)
Wood Rats	
	Neotoma lepida
	Neotoma cinerea
Microtine Rodents (meadow mice)	
	Microtus montanus
	Microtus longicaudus
Porcupine	
	Erethizon dorsatum
Coyote	
	Canis latrans
Foxes	
	Vulpes fulva (red fox)
	Urocyon cinereoargenteus (gray fox)
Ring-Tailed Cat	
	Bassariscus astutus
Weasels	
	Mustela frenata
Badger	
	Taxidae taxus
Skunks	
	Mephitis mephitis (striped skunk)
	Spilogale gracilis (spotted skunk)
Cats	
	Lynx rufus (bobcat)
	Felis concolor (mountain lion)
Mule Deer	
	Odocoileus hemionus
Mountain Sheep	
	Ovis canadensis

parisons between collections and new remains (Klein and Cruz-Uribe 1984).

TAPHONOMY

Taphonomy refers to processes that affect an assemblage of bones or artifacts after deposition, causing the recovered assemblage to differ from the deposited assemblage (Klein and Cruz-Uribe 1984:8). Several taphonomic considerations directly apply to the interpretation of faunal remains, at both open sites and protected locales such as Rose Shelter.

Packrats and Carnivores

Packrats (*Neotoma* sp.) represent a non-cultural agent at work in and near rockshelters, causing bone damage and displacement. Effects on the faunal assemblage may be quite significant; Lyman (1994:193) cited studies documenting average horizontal and vertical movement of bones of 1–2 m. In addition, Lyman (1994) noted that even assemblages with little evidence of rodent chewing have been moved by packrats. Evidence for packrat presence and possible effects on bone distribution and condition include packrat remains, nests at the site, and gnawing marks. Carnivores can also distort a faunal bone assemblage through damage and displacement. In some ways, the impact of carnivore damage is more difficult to assess, as entire bones can be destroyed or removed from a site. Identifiable damage to bone by carnivores consists of punctures and striations or furrows caused by gnawing; in some cases these marks appear similar to the cut marks produced by humans (Fisher 1995).

Burning

Lyman (1994) and Grayson (1988) have discussed the problematic interpretation of burned bone. Grayson (1988) noted that burned bone does not necessarily mean cultural use of the bone, but may indicate in situ natural burning, especially in the case of rockshelters and caves. Lyman (1994: 384), however, noted that most bones are burned between an organism's death and burial but that a situation combining rich organic deposits and dry conditions is a good candidate for some natural burning. Rose Shelter (42KA4794) presents an excellent example of this situation, although the tested portion of the shelter exhibited no evidence of natural fire.

Several attributes may assist in determining the condition of a bone when it was burned. For

Table 5.12. Faunal remains from tested Kaiparowits Plateau sites.

Taxon	Frequency	Burned
42KA4549 (Archaic)		
Unidentifiable	1	0
42KA4552 (Archaic)		
Lepus	1	1
Unidentifiable	15	13
42KA4749 (Formative)		
Small mammal	2	2
Sylvilagus	1	1
42KA4750 (Formative)		
Small mammal	2	0
42KA4794 (Formative)		
Artiodactyl	3	1
Large mammal	15	15
Rodent	14	0
Small mammal	7	4
Sylvilagus	4	0
Unidentifiable	217	164
42KA4662 (Post-Formative)		
Artiodactyl	2	0
Odocoileus	2	0
Sylvilagus	1	1
Unidentifiable	108	106
42KA4732 (Post-Formative)		
Rodent	1	1
Sylvilagus	1	1
42KA4797 (Post-Formative)		
Artiodactyl	3	2
Unidentifiable	17	7

instance, burning dry bone results in surficial cracking, no longitudinal splitting, and no warping. A bone burned while it is fleshed often shows serrated, transverse fractures throughout the entire bone, as well as diagonal cracking and warping. A burned green bone will exhibit serrated fractures near epiphyses, parallel-sided fractures throughout the bone, and less-pronounced warping than a fleshed bone (Lyman 1994). These characteristics do not necessarily appear on every bone, but they represent distinctive attributes when present.

A study by Buikstra and Swegle (1989) suggested that only defleshed bone appears uniformly smoked. Gifford-Gonzalez (1989) concurred, showing that bone burned all-over results from burning after defleshing, whereas burning only on the articular surfaces of bones signals burning with flesh still attached. Lyman (1994) speculated that culturally produced burning typically affects only green bone, with or without flesh; there is little reason for people to burn dry bone, which has no nutritional value for humans. Lyman (1994) also noted that natural conditions regularly carbonize bone, but rarely produce calcined bones. If a bone is broken before it is burned, the bone will show burning on the fracture surface as well as on the interior cavity; in contrast, a bone exposed to fire (as during roasting) and then broken will not exhibit a burned interior cavity (Lyman 1994). Although these experimental results offer guides for analysis, not all burned bone recovered from archaeological sites is easily interpreted.

ANALYSIS RESULTS BY TIME PERIOD AND BY SITE

Results of the faunal analysis for the Kaiparowits testing program are summarized by site in Table 5. 12. This section presents a brief discussion of the faunal remains recovered from each investigated site; discussions and interpretations are offered below.

Archaic

42KA4549. Bone recovered from this Archaic site originated from Unit 2, excavated next to burned sandstone slabs within an eroded scatter of fire-cracked rock and artifacts (Feature 2). The slabs might be the remains of an eroded hearth. The one unidentifiable fragment of bone from Unit 2 is not burned and so may be intrusive.

42KA4552. Site 42KA4552 is an Archaic camp with a midden deposit (Feature 1) that contains fire-cracked rock, lithic artifacts, and a low frequency of bone. A test unit in the upslope portion of the midden recovered 13 unidentifiable burned fragments, two unidentifiable unburned fragments, and one burned *Lepus californicus* humerus. Charcoal from the midden produced a radiocarbon age that is within the late Archaic period. A tested slab-lined hearth (Feature 4) at this site did not yield any bone.

Formative

42KA4749. This Archaic-Formative transitional site contained fire-cracked rock, one hearth, a possible midden, and a variety of debitage and stone tools. The test unit excavated within Feature 1 recovered two burned small mammal long bone fragments and one burned *Sylvilagus audubonii* second phalange.

42KA4750. This Archaic-Formitive site consisted of a small shelter with a midden deposit of fire-cracked rock, charcoal-stained soil, various stone artifacts, and sherds. The charcoal-stained cultural deposit excavted in Unit 2, placed in front of the shallow shelter, produced only two unburned small mammal long bone fragments.

Unit 1, excavated on the midden-covered slope below the shelter, did not produce any bone.

Rose Shelter (42KA4794). Rose Shelter, used principally during the Formative period, contained a hearth (Feature 1) and 20 cm of stratified cultural deposits. This rockshelter is believed to have functioned as a temporary hunting camp, protecting a small number of people during poor weather. This site yielded the largest number of recovered bones at a single site, including 164 burned unidentifiable bone fragments. Thirty-six of these exhibit cut marks. Although 57 of these bones are probably attributable to rabbits, hares, deer, or mountain sheep, they were too fragmentary for certain identification and, for the sake of consistency, were placed into the unidentifiable category.

The shelter also yielded 53 unburned unidentifiable fragments, as well as 3 artiodactyl bones (1 cut rib, 1 burned third phalange, 1 tooth), 14 burned large mammal rib bones, and 1 burned large mammal long bone. Rose Shelter also contained four unburned *Sylvilagus audubonii* bones (one mandible, two calcaneum fragments, and one tibia), as well as seven small mammal bones (three burned ribs, one burned metatarsal, one tooth, one vertebra, one unidentifiable fragment), and 14 unburned rodent bones, which are probably intrusive.

Post-Formative

42KA4662. This Post-Formative site contained two hearths, lithic debitage, and faunal bone; it possibly functioned as a hunting camp. Excavation of two 1 x 1 m units next to one of the hearths recovered a large number of unidentifiable burned bones (106) that probably represent rabbits, hares, and deer, but could not be confidently placed into a specific category. Other bones included two unidentifiable unburned fragments, one burned *Sylvilagus audubonii* scapula, two unburned artiodactyl femur fragments, and two unburned *Odocoileus hemionus* tooth fragments. One partial artiodactyl femur was submitted for radiocarbon dating prior to the analysis; this bone is not included in the database or tables.

42KA4732. A tested hearth (Feature 1) at this Post-Formative site yielded one burned *Sylvilagus audubonii* humerus and one burned rodent mandible.

42KA4797. This Post-Formative site included a hearth (Feature 3) surrounded by a scatter of bone and flaked stone artifacts. Recovered bone included 7 burned unidentifiable bone fragments (large mammals probably accounted for 6 bone fragments), 10 unburned unidentifiable fragments, 1 fractured unburned artiodactyl metapodial fragment, and 2 burned artiodactyl vertebral fragments.

DISCUSSION OF FAUNAL REMAINS

Animal Groups Represented

The Kaiparowits test excavations recovered 15 artiodactyl remains (*Odocoileus hemionus* or *Ovis canadensis*), 10 large mammal bones that are probably from artiodactyls, 8 lagomorph fragments (*Lepus californicus* or *Sylvilagus audubonii*), and 11 small mammal remains that are probably from rabbit or hares. These bones, combined with the 160 unidentifiable fragments that most likely represent small or large mammals, suggest that occupants of the area relied heavily on hunting to procure protein. In fact, as suggested in the Phase 1 survey report (Geib, Huffman and Spurr 1999), many of these sites probably functioned as temporary hunting or processing camps. Fifteen rodent bones were recovered from the tested sites. These do not necessarily represent a protein source that was specifically sought, but rodents were probably consumed if they were available and easily procured (e.g., Cushing 1920; Spier 1928; Miller 2000).

Artiodactyl Index

The artiodactyl index presents the ratio of large game (deer and mountain sheep) to small game (rabbits and hares). The index specifically addresses the dietary importance of artiodactyls compared to lagomorphs (Szuter and Bayham 1989). Calculation of the artiodactyl index is based on a formula from Szuter and Bayham (1989), as follows:

> Artiodactyl Index = number of artiodactyls / number of artiodactyls + total number of lagomorphs.

Szuter (1991: 250) argued that smaller and less agricultural populations will expend more effort to procure wild resources, such as scheduling hunting parties that travel longer distances. The goal of such forays would be to procure large game that could feed multiple people for a period of time. If this model is valid, the artiodactyl index should increase for smaller, more mobile, and less agricultural populations. Likewise, the artiodactyl index should decrease with larger, more sedentary, and more agricultural populations. Szuter (1991) suggested that populations committed to

agriculture will be less able to undertake extended hunting excursions and will have access to increased numbers of small game animals attracted to fields.

Artiodactyl indices were calculated for tested sites within temporal categories to compare procurement strategies through time. Given the nature of the sites, which are mainly hunting camps or short-term residential camps used once or sequentially, the range of recovered fauna is not expected to be large. Remains at most sites probably represent meals derived from one or a few animals. In addition, the range of local animals that could represent small or large mammals is relatively limited. For these reasons, calculation of the artiodactyl index assumes that remains in the Large Mammal category belong to artiodactyls, and those in the Small Mammal category are lagomorphs. This approach was adopted due to the small sample sizes and an understanding that the index attempts to identify the major source of protein in prehistoric diets in the general sense of large or small animals, rather than the exact species that were consumed.

The lack of identifiable artiodactyl bones from Archaic sites prevents index calculations for two sites. For the Formative sites, the artiodactyl index is 18/34 or 0.53, and the Post-Formative sites have a value of 7/9 or 0.78. These relatively high scores for the artiodactyl index indicate that, based on the recovered and identifiable bones from the tested Kaiparowits sites, occupants of the area procured artiodactyls regularly and were relatively more reliant on large game than smaller animals. There is a significant increase in the index from the Formative to the Post-Formative period, perhaps suggesting that artiodactyls were chosen more frequently than smaller animals during the later period. This interpretation is tenuous, however, due to the large number of recovered unidentifiable fragments of bone that could be from either small or large mammals. Fragmentary long bones are particularly problematic in that they may represent small bones from large animals or large bones from small animals, thus bridging the categories of both artiodactyls and lagomorphs.

Different processing activities could also produce an artificial difference reflected by the artiodactyl index. For instance, processing techniques such as grinding or mashing could skew the index to an unknown degree. It is conceivable that such processing techniques would be more common for small game, and taken to an extreme, such processing would be more likely to erase traces of bones from smaller animals than from larger animals. On the other hand, crushing an artiodactyl bone produces more fragments than crushing a rabbit bone, so the sheer number of bones may not be an accurate indicator of the types of animals most often processed. The index is therefore most valid with large samples, and the small number of recovered faunal material from the testing project poses an additional problem in solid interpretations. Finally, the artiodactyl index was initially proposed to assess environmental changes caused by occupants of an area, as reflected by animal populations and availability. Given the temporary nature and hunting function of most of these sites, the artiodactyl index provides only a suggestion as to the behavior and activities of occupants at these particular sites. Environmental changes would not be reflected with such small samples.

Cut Marks and Tool Identification

Three of the tested sites yielding bone were Post-Formative camps, presumably representing Paiute use of the region. Excavation at 42KA4662 produced bone that appeared extremely fresh, raising the possibility that the occupation was quite recent. A radiocarbon assay on one of the fresh-looking bones from this site has three possible calibrated dates ranges, the most probable being A.D. 1805 to 1935 (calibrated two-sigma range). Most of the debitage at the site resulted from pressure flaking to produce arrow points. A lack of evidence for stone cutting implements in the artifact assemblage prompted consideration that the site occupants might be using metal tools, particularly knives, while still producing characteristic Desert Side-notched points.

Metal tools usually create "almost hairline" sized cut marks, often leaving an "overlapping small 'shelf' of bone in place" (Binford 1981:105). Metal tools generally produce longer cut marks than stone tools, which often require less continuous, shorter strokes. Stone tool marks generally occur in groups of short, parallel marks with a "more open cross section" and a "more ragged appearance" (Binford 1981:105). Processing of animals, however, involves a range of activities, including skinning, dismemberment, filleting, and marrow consumption. These various tasks require a range of cutting motions, all of which must be considered when evaluating cut marks on bone (Binford 1981:106). It is difficult to assign a single or small group of cut marks to a specific tool or task.

Cut marks on bones from site 42KA4662 appear to have been created by stone tools, primarily due to the short, deep marks that run parallel to each other. This does not directly support or contest the radiocarbon dating of bone from the site. It does suggest that if the date is correct, stone technology was still in use through the nineteenth century, and possibly into the early twentieth century, for traditional tools. Cut marks on bones from site 42KA4794, a Formative rockshelter, are too faint to designate the type of tool that produced them. Assuming that the bone was deposited during the main occupation of the shelter, the tools would necessarily be made from stone.

Assemblage Condition and Comparisons

Overall, unidentifiable fragments comprised most of the faunal bone assemblage (373 of 432 bones, or 86%), largely due to high rates of fragmentation and burning. A large portion of these unidentifiable bones (160) probably represent small or large mammals such as rabbits, hares, or deer. They could not be confidently assigned to a species category, however, and were classified as unidentifiable for consistency.

Two scenarios help to explain the large percentage of unidentifiable bones in the assemblage. First, the high incidence of burning (74% of the total assemblage, including unidentifiable fragments) reduced many bone fragments to mere splinters and erased most bone morphology that would have aided in identification. The high frequency of burned bone, especially calcined or blackened bone, suggests that these bones were burned after deposition or in a thermal feature as trash, rather than during cooking.

Only a few excavation projects have been undertaken within or directly adjacent to the area covered by the Kaiparowits Plateau Survey, and data on faunal remains from the sites are of variable quality. Excavations conducted for the Glen Canyon Project involved minimal use of screens, especially 1/8" mesh, and the number of recovered faunal bones is predictably low. From excavations within the Escalante River basin, Gunnerson (1959b) reported a small number of bones from a variety of animals including deer, sheep, jackrabbits, and cottontails; from excavations on Fiftymile Mountain, Fowler and Aikens (1963) recovered a small number of bones, most of them unidentifiable, but with a significant number of artiodactyl remains.

More recent excavations produced similar results. Small sites in the Circle Cliffs area produced few faunal remains, but most screening involved 1/4" mesh. Remains were mainly unidentifiable small fragments that were not burned, and the analysis results showed little emphasis on hunting (Tipps 1992). Excavations at two prehistoric Southern Paiute sites near Kanab (Firor 1994) also recovered few bones, the majority burned and unidentifiable. Excavators there used 1/8" screen and most identified bones were attributed to animals of rabbit or hare size. The small number of recovered specimens and the taxonomic classes of animal remains from these excavations mirror those of the Kaiparowits testing project.

Ethnographic evidence (Tyler 1975; Miller 2000) shows that many bones from rabbits and hares were ground or broken into small pieces, and were sometimes consumed with the meat. Bone fragments from these activities would be small and unidentifiable at best, if they remained recoverable at all. Similarly, boiling bone to release flesh and grease, as well as marrow extraction, also increases fragmentation (Lyman 1994). Kelly's (1964) ethnographic account of the Southern Paiute recorded the use of a variety of animals, including deer, mountain sheep, antelope, rodents, rabbits, and birds. Processing techniques for these animals included boiling and roasting.

FAUNAL ANALYSIS CONCLUSIONS

Although it is impossible to establish a solid numerical threshold of bones to differentiate a more permanent habitation from a temporary camp, generally analysts assume that larger numbers of bones indicate longer stays at a site, larger groups of people, better preservation environments, or different functions of sites. Because the preservation environment is constant for the sites in the Kaiparowits area (with the exception of Rose Shelter), the number of recovered bones can be compared by site and temporal affiliation to identify any changing patterns in occupation of the area over time (Table 5.13). No clear patterns

Table 5.13. Site function and temporal affiliation of tested Kaiparowits Plateau sites.

Site	Function	Total Bones	Temporal Affiliation
42KA4549	Residential camp	1	Archaic
42KA4552	Residential camp	16	Archaic
42KA4749	Residential camp	3	Formative
42KA4750	Residential camp	2	Formative
42KA4794	Hunting camp	260	Formative
42KA4662	Hunting camp	113	Post-Formative
42KA4732	Processing camp	2	Post-Formative
42KA4797	Residential camp	20	Post-Formative

stand out, either by site function or by time period. Protection from physical erosion at Rose Shelter (42KA4794) partially explains the large number of bone at that site.

Ubiquity is another method for investigating the importance of different animal groups in the prehistoric economy. One assumption tied to ubiquity is that the more often a species appears across a sample of sites, the more important that animal was as a procured resource. Small mammals, artiodactyls, cottontails, and rodents have the highest ubiquity rates (Table 5.14), but all sites except Rose Shelter and 42KA4662 contain only one or two animal categories. This pattern supports the conclusion that these sites were temporary and their locations were probably not areas of long-term, high-volume animal processing or discard. As noted above, most sites probably represent processing and consumption of one or a few animals.

The large portion of burned bone from the tested sites (74% overall) indicates that cooking and burning of animal refuse was an important part of processing animals. Due to the frequency of burning, many bone fragments may have been destroyed. The majority of burned bone was blackened or calcined, indicating exposure to extreme heat. Bone burned beyond the stage of sooting or charring usually occurs during burning of trash in a pit or after being tossed into a hearth. Therefore, the importance of animal procurement may be significantly understated from loss of bone by burning. To optimize the amount of meat and nutritional value of procured animals, processing techniques such as grinding and mashing, in addition to cooking or boiling, would have produced maximum yield per animal and procurement effort. These activities would greatly decrease the number of recoverable and identifiable bones.

The Kaiparowits Plateau contains many temporary and residential camps that represent occupation from the Archaic through Post-Formative periods. Overall, the faunal elements recovered from testing support general survey assessments of site function and forager use of the Kaiparowits Plateau. The area provides a diverse population of animals available for procurement of important animal protein. In addition, occupants used various processing techniques designed to maximize nutritional yield from small to large animals. Although occupants of the Kaiparowits Plateau hunted and captured a variety of animals, their reliance was most heavily on cottontails, jackrabbits, and artiodactyls such as deer and mountain sheep.

PALEOETHNOBOTANY

Lisa W. Huckell

The investigation of 13 small, limited-use sites on the Kaiparowits Plateau provided the opportunity to study a common but poorly understood site type. Although subsistence was not included in the four research objectives of the study, the presence of hearths or midden deposits at the sites offered the opportunity to assess macrofossil preservation and productivity of these feature classes and to obtain basic data on plants used for food and fuel during three time periods: Archaic (ca. 8000–0 B.C.), Formative (ca. A.D. 0–1300), and Post-Formative (ca. A.D. 1300–1900). Eight flotation samples from seven sites representing these three periods were submitted for analysis.

METHODS

The flotation soil samples were processed using an IDOT style water processing system (see Pearsall 1989:Figures 216–219). A 30-gallon trash can is filled to within 15 cm of the top with water. The IDOT bucket, composed of 0.05 mm mesh, is placed in the tank on two slats so that it is partially immersed. One to two liters of soil matrix is poured into the bucket, which is slowly agitated

Table 5.14. Presence and ubiquity of faunal remains from tested Kaiparowits Plateau sites.

	Archaic		Formative			Post-Formative			
	4549	4552	4749	4750	4794	4662	4732	4797	Ubiquity
Large mammal					Yes				1/8
Artiodactyl					Yes	Yes		Yes	3/8
Odocoilius						Yes			1/8
Small mammal			Yes	Yes	Yes				3/8
Sylvilagus			Yes		Yes	Yes	Yes		4/8
Lepus		Yes							1/8
Rodent					Yes		Yes		2/8
Unidentifiable	Yes	Yes			Yes	Yes		Yes	5/8

with a side-to-side rocking motion. As the soil disaggregates, buoyant materials are released, after which they are retrieved from the water surface by means of a 0.25 mm mesh hand sieve. This component, the light fraction, is tapped out onto a chiffon square. The procedure is repeated until the sample has been processed. A fish tank siphon is then used to recover less buoyant plant material from below the water surface, which is added to the light fraction chiffon square. The remaining component, the heavy fraction, is agitated until freed of fine sediments after which it is poured out of the bucket onto a fresh chiffon square. Any residue lingering in the bucket is added to the square using a hose. Both squares are tied shut and hung up to dry. After drying, each fraction is placed in a polyethylene bag along with labels bearing provenience and sample information recorded at the beginning of sample processing.

Both the light and heavy fractions were submitted for analysis. Samples ranged in volume from 2.5 to 4.0 liters. The light fractions were put through a graduated series of geological sieves which divided them into six size classes: (1) greater than 4.0 mm, (2) between 2.0 and 4.0 mm, (3) between 1.0 and 2.0 mm, (4) between 0.5 and 1.0 mm, (5) between 0.5 and 0.25 mm, and (6) less than 0.25 mm. This strategy enhances the ease and reliability of microscopic sorting and identification, and is useful when subsampling is necessary. The heavy fractions were not put through the sieve series.

All light fraction size classes were examined for plant remains. Heavy fractions were carefully examined by scanning in small increments. Identifiable specimens were removed and placed in protective plastic vials that were stored in ziploc polyethylene bags. Sorting was carried out using a binocular stereozoom microscope with a magnification range of 10x to 110x. Carbonization was the main criterion used to distinguish recent contaminants from plant parts with the highest probability of affiliation with the prehistoric occupation (Minnis 1981). Uncarbonized plant parts were also identified and counted as a means of evaluating the nature and degree of disturbance present in sampled loci. Additional evidence of disturbance was obtained from nonbotanical items such as microvertebrate bones, fecal pellets, mollusks, and insect parts. Quantity estimates were calculated and assigned an appropriate value using an ordinal scale: A = 1–10, B = 11–50, C = 51–100, D = 101–500, and E = >500.

Wood charcoal was also analyzed. Ideally, a sample of 20 fragments was analyzed from each float, although some samples lacked a sufficient number of suitable specimens. Fragments were judgmentally selected, with 10 taken from the 4.0 mm screen and 10 taken from the 2.0 mm screen when possible. Fragments had to be of sufficient size to display a complete growth ring or unequivocal diagnostic features and to permit effective handling, which usually involved snapping the specimen transversely to expose a fresh cross-section and, where needed, radial and tangential views.

Identifications were made using modern specimens in the author's comparative collection. The taxonomy employed in the following discussion is taken primarily from McDougall (1973) with some updating from Lehr (1978). Note, however, that for the sake of consistency with the rest of this report, ricegrass is designated as *Stipa* following Welsh et al. (1987) rather than *Oryzopsis*. A list of the plant taxa identified at the sites is presented in Table 5.15.

RESULTS

Results of the analysis were disappointing, as just two of the eight samples produced assemblages composed of multiple macrofossil taxa. Two other samples yielded 1–2 tiny possible juniper seed fragments, and the remaining four contained no carbonized botanical materials apart from wood charcoal. Seven taxa were identified, all of which are wild plant species that are locally available in the project area. The inventory of plant taxa recovered is presented in Table 5.16. Some taxa are preceded by "cf." (compares with), a qualifier that indicates that the identification is probable but not absolutely secure due to either insufficient criteria for a positive identification or the presence of additional related taxa that could not be viewed and evaluated for exclusion from consideration. Because it signifies a lower level of identification confidence, it is a part of that taxon's name and must be included with it whenever it is used.

Evidence for disturbance was found in all samples (Table 5.16), with insect parts, fecal pellets, and microvertebrate bones particularly common. Uncarbonized seeds and plant parts were also frequently encountered, with 13 taxa identified. Despite the ethnographically documented economic significance of most uncarbonized plants, nothing more will be done with them—they are common components of the local

Table 5.15. Plant taxa recovered from tested Kaiparowits Plateau sites.

Taxon	Common Name	Plant Part
Gymnospermae		
Cupressaceae	Cypress family	
Juniperus sp.	Juniper	Fruit[2], seed[1,2], branchlet[1,2], wood[1]
Pinaceae	Pine family	
Pinus sp.	Pine	Nutshell[2], microstrobilus[2], needle[2], wood[1]
Pinus edulis Engelm.	Piñon pine	Nut[2], needle[2]
Angiospermae		
Monocotyledonae		
Gramineae	Grass family	
Stipa hymenoides (R. & S.) Ricker	Indian ricegrass	Floret[1,2], lemma·palea[1,2]
Sporobolus sp.	Dropseed	Caryopsis[1]
Dicotyledonae		
Anacardiaceae	Sumac family	
cf. *Rhus trilobata* Nutt.	Squawbush, sumac	Wood[2]
Cactaceae	Cactus family	Areole[1,2], spine[1,2]
Echinocereus sp.	Hedgehog cactus	Seed[1,2]
Platyopuntia sp.	Prickly pear cactus	Seed[2]
Sclerocactus sp.	Fishhook cactus	Seed[1,2]
Chenopodiaceae/Amaranthaceae	Cheno-Am	Seed[1],
Chenopodiaceae	Goosefoot family	
Chenopodium sp.	Goosefoot	Seed[2]
Compositae	Sunflower family	
Chrysothamnus sp.	Rabbitbrush	Wood[1]
Cruciferae	Mustard family	
Descurainia sp.	Tansy mustard	Seed[2]
Euphorbiaceae	Spurge family	
Euphorbia sp.	Spurge	Seed[2]
Leguminosae	Bean family	Seed[2]
Ulmaceae	Elm family	
Celtis reticulata Torr.	Netleaf hackberry	Endocarp[1,2]

[1]Carbonized.
[2]Uncarbonized.

flora that could easily have been introduced into cultural contexts through bioturbation and other natural processes.

Examination of the heavy fraction revealed that few plant remains had escaped the flotation process. Very little charcoal was present, and the only carbonized macrofossils consisted of two hackberry drupe or stone fragments and an unidentified dicot stem midsection. This component proved to be a significant source of additional information on dense, less buoyant inclusions such as flakes, burned and unburned bones and teeth, and termite fecal pellets. Representative samples of each of these were set aside, with a selection emphasis on diagnostic elements and coverage of the range of features observed. Gross estimates of the number of items in the heavy fraction were made and added to Table 5.16 when heavy fraction data were all that was available for a category.

Plant Taxa

Juniper (Juniperus). Juniper was definitely recovered from two sites and probably found at two more (Table 5.16). Recovered parts include small seed fragments, branchlet fragments, and small scale-like leaflets. The most abundant and diverse remains came from 42KA4794, Rose Shelter, and a hearth in one of the Post-Formative sites (42KA4732). The seed remains are too fragmentary to permit a species identification, as are the branchlet segments.

Junipers have provided people with several useful products. The dense aromatic wood has been used as fuel and durable construction wood. The female cones or "berries" of all species are edible although they can be dry to fleshy and range between flavorless, resinous, bitter, and sweet. The fruits can be eaten raw, roasted or boiled, used as a seasoning for stews and soups, and used to make a beverage and medicinal tea. The strong resinous flavor of the berries provides gin with its distinctive taste. The fruits were often ground into a meal that was made into cakes and could also be dried and stored for winter use. Available in the late summer into winter, they were often useful during times of food shortage, as

Table 5.16. Plant remains recovered from tested Kaiparowits Plateau sites.

	Archaic			Formative			Post-Formative	
	42KA4547 F1: Hearth 3.5 liter	42KA4552 F1:Midden 3.0 liter	42KA4552 F4:Hearth 3.5 liter	42KA4749 F3: Hearth 4.0 liter	42KA4750 F1: Midden 2.5 liter	42KA4794 F1: Hearth 3.0 liter	42KA4575 F1: Hearth 3.0 liter	42KA4732 F1: Hearth 3.0 liter
CARBONIZED								
Cactaceae areole						15/5		
spine						1/0		
Cheno-Am								5/1
Echinocereus								6(15)/2(11)
Sporobolus						3/0		
Juniperus seed								0/27
branchlet						0/13		0/6(25)
leaflet						3/0		
cf. *Juniperus* seed			0/1	0/2				
Stipa floret								19/3(30)
lemma/palea								5/15(42)
caryopsis								6/1
Sclerocactus						5/1		
Celtis endocarp						0/2*		
Unknowns						0/1*		0/6(15)
Total	0	0	1	2	0	27/22	0	41(50)/ 61(152)
UNCARBONIZED								
Cactaceae areola					A	B		
spine						B		
Celtis						A		
Chenopodium				A			A	
Descurainia								C
Echinocereus					A			A
Euphorbia				A				
Gramineae					B			
Juniperus seed			A	A	B		A	A
fruit					A			
branchlet					B	B	B	
microstrobilus						A		
Leguminosae							A	
cf. Leguminosae pod					A			
Stipa floret						A		
lemma/palea						B		
Pinus nutshell				A				
Pinus microstrobilus					A			
Pinus edulis needle					D	A		
nut +shell frags					B	A		
Platyopuntia				A				
Sclerocactus					A	B		
Unknown				B	B		A	
DISTURBANCE								
Snails		A	A		A	A		A
Bones		A		A	A*	D	A*	A
Bones, burned		C*	A*	B*	A*	D		A
Tooth, burned		A				A*		
Insect parts	D	B	D	D	D	A	E	E
Insect parts, burned						A		
Fecal pellets	D		E		E	A	E	E
Fecal pellets, burned						B*		D
Termite fecal pellets				E		D		
Termite fp, burned	E	B	B	A		E	A	
OTHER								
Flaked stone		B*	A*	3	A*	13		A*

Plant entries are seeds/disseminules unless otherwise indicated.
X/X = specimens > half complete / < half.
X(X) = actual number counted (estimated total in sample).
A= 1–10, B = 11–50, C = 51–100, D = 101–500, E = > 500.
*Found only in heavy fraction.

they can linger on the trees for some months. A medicinal tea was also prepared from the leaves, compresses for bruises were made from heated branchlets, and gum from *J. monosperma* has been used to fill dental cavities (Beaglehole 1937; Curtin 1965; Robbins, Harrington and Freire-Marreco 1916; Stevenson 1915). The durable seeds are often recovered from the archaeological record (Lentz 1984).

Dropseed (Sporobolus). Three caryopses were recovered from the hearth in Rose Shelter. The small grains are obovate in shape with an elliptical cross-section. The largest specimen is 0.9 mm long, 0.6 mm wide, and 0.4 mm thick. Several species of dropseed are found on the Colorado Plateau (McDougall 1973). They grow in a variety of habitats including open sandy areas, mesas, dry bluffs, meadows and valleys, and in disturbed soils. Dropseeds are warm season grasses, producing large numbers of tiny seeds in the summer and fall. Despite their size, the seeds can be gathered in large quantities and have served as staples for several Southwestern societies. The seeds are also frequently recovered from archaeological sites throughout the Southwest (Brand 1994; Doebley 1984; Gasser and Kwiatkowski 1991). The grains are commonly prepared by parching followed by grinding into meal.

Ricegrass (Stipa). Ricegrass was found in the hearth at 42KA4732. The remains consisted of florets, caryopses or "seeds," and lemmas and paleas, the two bracts that enclose grass grains and form the chaff that is usually removed prior to consumption. The spindle-shaped florets consist of the caryopsis enclosed by the lemma and palea. The largest intact specimen is 4.2 mm long, 1.9 mm wide, and 1.8 mm wide. The largest of the globose caryopses has a length of 2.3 mm, a width of 1.4 mm, and a thickness of 1.3 mm.

Ricegrass is commonly found on open sandy plains and hills and in juniper woodlands at elevations of 1067 m to 2256 m (3500 to 7400 feet), often in extensive stands (McDougall 1973). A cool season grass, the plump grains ripen in the late spring and early summer, although a smaller crop may appear in late summer in response to exceptional precipitation. Both the ethnographic and archaeological records indicate a long history of exploitation of ricegrass (Brand 1994:Tables 1, 2, and 3; Jones 1938). The large starchy grains are easily freed from the bracts or chaff, and could be collected in large quantities with a seed beater and collection basket. The florets were commonly parched with hot coals prior to winnowing, and then ground into meal.

Cheno Am (Chenopodiaceae/ Amaranthaceae). Five Cheno Ams and a fragment of a sixth specimen were retrieved from the hearth at 42KA 4732. All have expanded from heat exposure and lost the diagnostic testa, leaving the perisperm encircled by the embryo. The largest intact specimen is 1.8 by 1.6 by 0.8 mm. Cheno Am is a term applied to members of the Chenopodiaceae and Amaranthaceae families in which morphologically similar seeds are produced that can be difficult to distinguish, particularly after carbonization has occurred. Because many of these species share habitat preferences, phenological cycles, economic uses, and seasonal behaviors in addition to their seed similarities, they are often grouped under the convenient composite term "Cheno Am."

Species of several genera of each family have been utilized, with *Chenopodium* and *Amaranthus* among the most widely exploited. Many members of these genera are weedy annuals that favor disturbed habitats such as field margins, roadsides, and stream floodplains and can be found from sea level to 3048 m (10,000 feet). The plants provide two important foods: herbage from late winter through summer, and prodigious quantities of tiny seeds in the summer and fall. The plants could be picked whole or harvested repeatedly for tender young leaves during the maturation period for a double crop (Castetter and Underhill 1935: 14–15; Curtin 1984:70; Meals for Millions/Freedom from Hunger Foundation 1985). The ethnographic record indicates extensive use of the seeds, and that they often made a significant contribution to the diet (Castetter 1935; Castetter and Bell 1942; Ebeling 1986; Felger and Moser 1985; Gasser and Kwiatkowski 1991; Whiting 1966). Preparation usually involved parching the seeds prior to grinding them into meal. Carbonized Cheno Am seeds are the most commonly recovered plant macrofossils from archaeological sites throughout the Southwest, often constituting the only evidence for plant use at a site (Brand 1994; Gasser 1982a; Gasser and Kwiatkowski 1991). Although this may be attributed in part to their tiny size, which facilitates losses during cooking, their overall high ubiquity nonetheless reflects their widely perceived value as a food source.

Cacti (Cactaceae). Areoles, the small area in which a spine cluster is produced, and loose spines were found in the Rose Shelter hearth fill.

Comparative material for these structures is currently unavailable, precluding a more specific identification. The recovery of fishhook seeds from the same sample suggests that the spines may be from this cactus.

Hedgehog (Echinocereus). Several seeds and seed fragments were recovered from the hearth at 42KA4732. The seeds are globose with a large round hilum or seed attachment scar at one end. The body is covered with low rounded papillae interspersed with punctations. The largest specimen is 1.6 mm long, 1.3 mm wide, and 1.2 mm thick.

These short, cylindrical cacti are found on floodplain and bajada soils, where they produce fruits in early summer (Kearney and Peebles 1960: 570–572). They may be found on the Colorado Plateau at elevations up to 2743 m (9000 feet; McDougall 1973:320–321). The red fruits are edible, with the spines of several species easily removed by brushing (Curtin 1984:57). The seeds are edible as well, and are often eaten together with the fruit when it is eaten raw. The fruits can also be baked or dried and used later as a sweetener (Jones 1931; Whiting 1966:85). The seeds are common inclusions in the archaeobotanical record, particularly among the Hohokam (Gasser and Kwiatkowski 1991).

Fishhook Cactus (Sclerocactus). Five carbonized seeds and an additional fragment of this genus were found in the Rose Shelter hearth. The seeds are irregularly obovate, with the large hilum located along one side above the narrow seed base where it resembles a bite taken out of the margin (Benson 1982:746). The body of the seed is covered with abundant small papillae. All of the specimens are damaged, having lost much of the testa. Minimum dimensions for the largest specimen include a length of 2.0 mm, a width of 2.9 mm, and a thickness of 1.6 mm.

The small stems characteristic of this genus are globose to cylindrical in shape. The plants are most commonly found in the Four Corners region where they favor open rocky or gravelly soils (Benson 1982). Small red fruits are produced during the summer. Ethnographic and archaeobotanical data for this cactus are lacking. Based on known qualities of other similar cacti, the fruits and seeds should be edible. It is also possible that the small succulent stems could be roasted and eaten as well.

Hackberry (Celtis). Two burned endocarp fragments were recovered from the heavy fraction from the Rose Shelter hearth sample. Although small in size, the distinctive thick wall, inferred large size, and distinctive surface sculpture of a coarse raised reticulum confirm their identity as netleaf hackberry.

Found as a tree or shrub along drainages, hackberry is characterized by distinctive warty bark and the production of small orange globular drupes or fruits containing a large endocarp or stone surrounded by a thin sweet mesocarp layer. The fruits are edible raw and were also ground prior to consumption (Castetter 1935; Elmore 1944). The stone provides an unobjectionable crunch and may be a valuable source of dietary calcium (Ebeling 1986:476). The durable stones are problematic macrobotanical remains in Southwestern sites, as they are commonly found but are rarely burned, making their linkage with cultural activity uncertain. The fruits are also eaten by a variety of animals, who often introduce them into archaeological contexts.

Wood

Wood charcoal from seven of the samples was examined. A maximum of 20 fragments was selected for identification (Table 5.17). Predictably, the dominant taxon is juniper, an excellent fuel

Table 5.17. Wood charcoal from tested Kaiparowits Plateau sites.

	Juniperus	*Chrysothamnus*	cf. *Rhus*	cf. *Pinus*	Total
42KA4547 PN 1.1 F1: Hearth					NA
42KA4552 PN 2.3 F1: Hearth	14				14
42KA4552 PN 3.4 F4: Midden	15			1	16
42KA4749 PN 2.1 F3: Hearth	19		1		20
42KA4750 PN 5.3 F1: Midden	16		1	3	20
42KA4794 PN 20.1 F1: Hearth	19	1			20
42KA4575 PN 2.1 F1: Hearth	20				20
42KA4732 PN 2.3 F1: Hearth	19	1			20
Total	122	2	2	4	130
Percent	93.9	1.5	1.5	3.1	100.0

wood that is readily available in the open pinyon-juniper woodland that is the dominant biotic community of the region. It accounts for 94 percent of the 130 analyzed fragments. The remaining taxa comprise 5 percent of the assemblage; the eight fragments of rabbitbrush, cf. sumac, and cf. pine probably represent inadvertent inclusions gathered up when the wood was collected. Pinyon pine and the two shrubby taxa would be common elements of the region's flora.

SITES

Seven sites were investigated for plant remains. Two are assigned to the Archaic period, three to the Formative period, and two to the Post-Formative period. These brief site descriptions are taken from the more detailed information provided earlier.

Archaic

42KA4547. The site consists of a scatter of flaked and ground stone artifacts associated with three fire-cracked rock (FCR) concentrations and two charcoal stains, one of which was found to be a shallow, unlined, basin-shaped hearth (Feature 1). A flotation sample was taken from the lower hearth fill, which was observed in the field to contain charcoal-stained sand and a few scattered eroded tiny charcoal fragments. Apart from a few very small charcoal pieces, no other plant remains were recovered from the sample.

42KA4552. This site consists of a midden (Feature 1), four small thermal features, and a flaked and ground stone artifact scatter. Flotation samples were taken from the midden and Feature 4, a slab-lined hearth that was overlain with FCR and sandstone slab fragments. The midden sample produced small charcoal fragments only. Feature 4 also yielded charcoal along with a very small fragment of what is probably a juniper seed.

Formative

42KA4749. The site consists of a small scatter of flaked stone artifacts and FCR along with two hearths, one of which had experienced extensive erosion. A flotation sample taken from lower deposits within an intact hearth, Feature 3, contained nothing but wood charcoal. However, excavators recovered juniper seeds from the upper hearth fill; these were submitted for radiocarbon dating.

42KA4750. The site is a slight shelter formed by a sandstone outcrop. Flaked and ground stone artifacts, a sherd, and FCR were present within the overhang zone and down the slope below the occupation area. The material on the slope formed a well-developed midden (Feature 1), from which a flotation sample was taken. Although it contained an extensive array of modern plant taxa, carbonized remains were restricted to wood charcoal only.

Rose Shelter (42KA4794). This small rockshelter is formed by a sandstone ledge, under which a limited area of dry living space is present at the far north end where intact deposits and a small hearth (Feature 1) were found. Abundant flaked stone artifacts were recovered from the deposits along with a few grinding tool fragments, a sherd, and two perishable artifacts. A flotation sample taken from the hearth fill produced one of the two best records from the project, with five taxa identified. Included are cactus areoles and spines, dropseed grains, juniper branchlets and leaflets, fishhook cactus seeds, hackberry stone fragments, and an unknown stem, with the latter two recovered from the heavy fraction. It is possible that the juniper vegetative material was used as tinder, after which hackberry and fishhook fruits were baked. The cactus stem could also have been roasted in the hearth coals, which would account for the loose areoles and spines. Ten unidentified seeds were also recovered. One resembles the teardrop-shaped seeds found in some species of primrose (*Oenothera* sp.). Another is similar to the durable fruits found in some genera in the Nyctaginaceae or four o'clock family.

In addition to the dense hackberry fragments and the unknown stem, the heavy fraction also contained a surprisingly large quantity of debitage and animal bone. The flakes appear to represent several distinct siliceous raw materials, and may reflect tool retouching activities carried out next to the fire. The faunal material included both burned and unburned bones and teeth, with relatively large and dense burned shaft fragments.

Post-Formative

42KA4575. The site consists of a basin-shaped hearth (Feature 1), a grinding slab, and a small lithic scatter. Carbonized plant remains from a sample of hearth fill yielded abundant juniper charcoal only.

42KA4732. This site consists of two hearths, a pair of metates, and a small quantity of flaked stone artifacts. Feature 1, the larger of the hearths, was basin-shaped and contained burned sandstone fragments, charcoal-stained sand, and well-preserved abundant charcoal.

The hearth's recentage is undoubtedly a factor in the recovery of well-preserved burned taxa from the fill (Table 5.16). Included are juniper branchlets and seed fragments; ricegrass florets, lemmas and paleas, and caryopses; hedgehog seeds; and Cheno Ams. Although the juniper branchlets may be tinder or incidental inclusions introduced with juniper fuelwood, the remaining plant parts are typical of what remains following the parching of seeds prior to storage or grinding into meal. Heat also expedites freeing the chaff from the ricegrass grains; these same parts are often found in prehistoric thermal contexts where processing probably took place.

The heavy fraction yield from this feature also contained flakes and small vertebrate bones and teeth that were both burned and unburned, although in much smaller quantities than those recovered from Rose Shelter.

DISCUSSION AND CONCLUSIONS

Preservation of plant remains at the tested sites was highly variable, with the record generally poor. The best samples came from a protected shelter environment and a recent open site. Older open sites offered the least information, a logical result of the lengthier period of exposure to processes promoting decay and deterioration. In the case of the hearths, the possibility that the firepit may have been used for a purpose other than plant food preparation must also be considered in evaluating the paucity of remains. The features are generally small and would require frequent cleanings to remove charcoal accumulations. The fire-cracked rock found at some sites suggests that multiple cleanout episodes may have taken place during the short use-life of the feature. The hearth's final use may have involved roasting small animals, or simply providing light and warmth.

Although the data yielded are modest, they provide a small body of subsistence data on which additional research can build. Readily available wild resources were exploited, with fishhook cactus an unusual discovery. Seasonality cannot be evaluated except to say that 42KA4732 was in all likelihood occupied in the late spring–early summer based on the ricegrass remains obtained. A much larger sample of productive flotation samples will be needed to begin to identify the range of plants exploited, patterns in resource use, and trends in the seasonality of the occupations.

The investigated sites appear to reflect brief transitory occupations by small groups, the members of which exploited local wild resources for edible plants and fuelwood. Hearths at the sites were clearly focal points for a range of domestic activities that included parching and cooking plant foods, roasting small animals, and refurbishing stone tools.

PERISHABLE NON-ARTIFACTUAL REMAINS

The semi-dry deposits of Rose Shelter (42KA 4794) yielded a few non-carbonized plant remains during excavation and sediment screening. The main interest in collecting these mostly annual or short-lived plant remains was to provide for accurate dating of the cultural deposits. Most of these remains do not necessarily have a cultural origin (materials purposefully brought to the site by humans for some purpose), but they likely closely correspond in time to the cultural materials deposited in the shelter. Table 5.18 lists the plant remains that excavators recovered in the field from Rose Shelter. Identifications are not highly specific.

Also recovered from Rose Shelter were two pieces of animal hide, perhaps from a ground squirrel that died there of natural causes. One of the items is a tail and the other an ear or muzzle portion with stiff whiskers. Occurring as they did together in a rodent hole, these remains likely have nothing to do with hunting.

The one other animal remain recovered during the testing project is a small snail shell from the Archaic site 42KA4549. This item was found within a rodent hole filled with charcoal-stained soil in Unit 3 at the site. The significance of this find is unknown.

Table 5.18. Non-artifactual plant remains recovered in the field from Rose Shelter.

PN	Bag No.	Description
3	3	decayed joint fir stems (uncounted); ca. 1.2 g but includes sand and precipitated salts
5	3	2 juniper seeds
5	3	14 stems of grass and joint fir
5	3	2 large hollow stems with several rings of growth
8	2	2 pieces of bark
14	3	4 hollow stem fragments of an annual plant, with fibrous bark
19	2	1 flattened monocot stem (*Typha*?)
19	3	1 poorly preserved yucca leaf
19	4	1 flattened monocot stem (*Typha*?)

FLAKED STONE ARTIFACTS

Debitage

Methods

Flaked stone production debris accounts for the vast majority of the artifacts recovered by the testing project. Indeed, a few of the sites yielded an abundance of debitage, with more than 200 flakes in a I x I m unit. The flaking debris was analyzed on an item-by-item basis using a series of attributes that are presented in Table 5.19. Each flake was examined under a binocular dissecting-type microscope to look for use-wear traces and inspect flake features. Flakes with use-wear were coded on the debitage form and then set aside for subsequent analysis as tools (see below). The recorded information was entered into a database with summary data and statistics for each site generated using SYSTAT.

Technological category is the principal attribute for making inferences about reduction behavior; this variable is an assessment of the reduction stage or objective represented by a flake. The accuracy of such a variable is enhanced by the degree to which the analyst has direct experience in flaked stone tool production. The more one experiments with different reduction sequences and objectives the greater is one's ability at recognizing the characteristic technological attributes of flakes. Of course, no assumption is made that flakes can be correctly categorized 100 percent of the time. The objective of this sort of analysis is to look for trends in the data, and as such a certain sample size (number of flakes) is required to make firm conclusions about reduction activity at a particular site. Some of the sites that we tested have sufficiently large flake assemblages whereas others do not.

Other variables that perhaps deserve some mention before presenting the findings include evidence of thermal alteration and type of rejuvenation. As we discuss in the next chapter, heat treatment of siliceous stone was widely practiced on the Kaiparowits Plateau throughout all time periods. The principal piece of evidence for this practice is differential luster on a single flake—either a contrast in luster among flake scars on the dorsal surface or a contrast in luster between the dorsal and ventral surfaces (see examples in Chapter 6). When one has experience with given material types it is possible to use other types of evidence to argue for heat treatment. For example, some materials are never lustrous in their raw state, thus any flake of such material that is highly lustrous likely came from a heat-treated core or tool (excluding of course gloss patina or post-depositional polishing of some sort). An example of this (described in Chapter 6) is Boulder jasper, which in its natural state has a fracture surface that is dull and minutely rough-textured. This material becomes highly lustrous and waxy to the touch with heat treatment, even at low temperature. Therefore, any flake of this material that is coded as having a high luster (variable state 1 in Table 5.19) must be heat treated. The same does not apply to agatized wood. Natural pieces of this material can be quite lustrous; some however have dull fracture surfaces. For this material, differential luster (variable state 2 in Table 5.19) is required to be certain that heat treatment was done. Burning (variable state 5 in Table 5.19) generally precludes accurate assessment of heat treatment (it also does not permit assessment of patina), but some burned flakes exhibited such obvious differential luster that positive identifaction of heat treatment was possible.

Type of rejuvenation refers to evidence for the flake having been detached from a used tool of some type. Frison (1968) called attention to certain flakes of this sort, but many others are common on the Kaiparowits Plateau, such as those detached for resharpening heavy-duty cobble choppers, scraper-planes, and pounders The use-wear traces that allow identification of flakes having been detached from used tools usually occur on the platform, though not exclusively. In some cases wear traces might occur along the margin of a flake that removes the edge of a tool such as a scraper or larger form like and adze (Crabtree's [1972:95] tranchet blow; also "orange peel" flakes [Chafer 1976]). Wear might also occur on the distal end of an overshot flake. Some of the larger flakes from the testing project, especially those from early stage biface thinning, exhibit rounding and polish of the platform margin that seem related to use. Nonetheless, the platform angles of these flakes are not acute, such that designating the flakes as comming from knives or cutting tools (variable state 1 in Table 5.19) seems far from certain. Early stage bifaces might have been used for a variety of tasks that have nothing to do with fine, precision cutting. These examples were coded as variable state 7 so that their occurance could be registered without having to force them into a known slot. Variable state 8 was a further means for keeping the known catagories of rejuvenation flakes "clean."

Table 5.19. Attributes analyzed for the debitage recovered from tested Kaiparowits Plateau sites.

Raw Material Type - RM

1	Chert - NFS
2	Paradise chert
3	Paradise chalcedony
4	Canaan Peak cobble chert (tan, yellow, pink, red)
5	Chinle agatized wood
6	Other petrified wood
7	Kaibab chert
8	Glen Canyon chert
9	Other chalcedony
10	Local fossiliferous chert
11	Boulder jasper
12	Mudstone/siltstone
13	Honaker Trail
14	Owl Rock chert
20	Obsidian
21	Rhyolite
22	Metasediment
30	Quartzite
31	Pudding stone (local alluvial cobble)
40	Coarse igneous
99	Indeterminate

Cortex Amount – CORT (dorsal surface only, not the platform)

0	None
1	< 25%
2	25–50%
3	>50%
9	Indeterminate

Thermal Alteration - TAlt

0	Absent
1	Possibly heat treated (overall high luster)
2	Heat treated (differential luster)
3	Heat treated (heat affected fracture)
4	Heat treated (differential coloration)
5	Burned (crazed, potlids, etc.) so can't evaluate (burning also precludes accurate patina evaluation)
9	Indeterminate

Technological Category - TECHNO

00	None (shatter)
01	Undiagnostic flake fragments (no platform)
02	Unpatterned core flake
03	Bipolar core flake
04	Edge preparation flake
05	Alternate flake (also square edge removal)
06	Biface thinning flake, early stage
07	Biface thinning flake, late stage
08	Uniface percussion flake
09	Pressure flake, biface
10	Pressure flake, uniface
11	Pressure flake, notching
12	Tool spall—proj. point tip/tang
13	Tool spall—biface margin
14	Tool spall—scraper
16	Tool spall—pounder
20	Potlid
21	Eraillure flake
30	Other—specify
40	Heat Spalled cobble fragment
99	Indeterminate (Unidentifiable Category)

Weight - WT (Actual weight to nearest 10th of a gram [4 columns]; if it doesn't register on the scale, assigned 0.1)

Type of Rejuvenation - REJUV

0	None
1	Knife
2	Scraper
3	Scraper-plane
4	Chopper
5	Pounder
7	Polish/smoothing but unknown tool
8	Poss. but unknown wear
9	Indeterminate--flake frag. & shatter

White Patina – WhPat.

0	Absent
1	Light
2	Moderate
3	Heavy
9	Burned

Number of Used Edges/Portions USED#

0	None
1, 2, 3 … etc.	
9	Indeterminate

Coded Comments – CC

1	caliche crust
2	discoidal core flake
3	red pigment on dorsal
4	pitch residue
5	old patina on dorsal

Archaic Sites

42KA4547. Just 15 flakes were recovered from the test unit of Feature 4, too few to reveal believable patterns in technological behavior. Data tables are presented here for the sake of comparison with the other sites (Tables 5.20 and 5.21). Almost three-quarters of the assemblage consists of flake fragments, and lacking platforms, these are not considered diagnostic of a specific reduction strategy or stage. Biface reduction can result in high proportions of flake fragments à la Sullivan and Rosen (1985), but at this site burning has likely fragmented many of the flakes and there is only a single biface thinning flake. Of the four identifiable flakes, three are from edge preparation, but it is impossible to say whether these relate to simple core reduction or tool manufacture. Local resources (including quartzite) account for 80 percent of the assemblage by count and more than this by weight (Table 5.21). The increase in weight is because of a single large flake fragment of alluvial cobble chert (20.9 g), which alone accounts for 77 percent of the flakes by weight. The one biface thinning flake is of alluvial cobble chert and it is the only one that certainly came from a heat-treated tool (differential luster). Three other flakes of this material might be heat treated based on overall high luster, but this is the only material with evidence of thermal alteration to improve flaking quality. As discussed later in Chapter 6, this material greatly benefits from such treatment. The assemblage contained only two flakes with less than 24 percent cortex—one of unspecified chert and one of Canaan Peak cobble chert. Perhaps the most interesting flake was the single example from tool rejuvenation, one detached from the side of a scraper with the retouched and used edge of the original tool occurring along the flake margin (resharpening by transverse truncation of the scraper—tranchet blow). This artifact provides evidence for scraper resharpening at the site and perhaps for scraper use. None of the 15 flakes exhibited obvious use-wear traces.

42KA4548. Like the site above, the 31 flakes recovered from the two test units of this site are too few to reveal believable patterns in technological behavior. The data tables for the debitage (Tables 5.22 and 5.23) reveal a moderately diverse assemblage from a mixture of simple core and biface reduction. The one bipolar flake is not considered sufficient evidence that this method of reduction was practiced at the site because other reduction methods occasionally result in debris with features that resemble those of bipolar fracture. All of the raw materials come from local sources with the possible exceptions of unspecified chert and "other chalcedony" (other meaning not clearly local). The one metasediment flake was relatively heavy (11.8 g), accounting for almost 40 percent of the flakes by weight, thus the great increase in the representation of this material by weight (Table 5.23). Heat treatment is somewhat represented in the assemblage, with two flakes exhibiting certain evidence (differential luster—one of white chert and one of alluvial cobble chert) and nine with overall high luster (possible heat treatment—seven of local chalcedony, one of alluvial cobble chert, and one of other chert). High luster with the local chalcedony invariably means heat treatment and the same usually also applies to alluvial cobble chert. The evidence for heat treatment occurs with biface reduction flakes (both pressure and percussion) as well as with flake fragments that may well also come from biface reduction. Cortex is poorly represented in the assemblage with just four flakes (13%) having some; two of these are of quartzite, one is of metasediment, and one is Paradise chert. The latter is the one flake of this material identified as derived from simple core reduction, which is also the case for the metasediment flake and one of the quartzite flakes. The flakes of coarse materials are likely derived from heavy-duty cobble tools, and the one of siltstone actually retained use-wear traces on the platform margin indicative of having been detached to refurbish a worn cobble chopper. Four other flakes were identified as refurbishing based on smoothing and some polish on the platform margins, but the exact nature of the tool remains unknown. None of the 31 flakes from this site exhibit obvious use-wear traces.

42KA4549. This site produced the largest assemblage of flakes (n = 658) from the Archaic sites and the second largest assemblage from the 13 sites overall. Only Rose Shelter yielded more debitage. The 658 flakes are tabulated by raw material and production technology in Table 5.24. There is a large proportion of undiagnostic flake fragments (55%) but a low proportion of angular shatter, some of which appears to be the result of accidental burning. Excluding these categories and the potlid spalls (adjusted percent) serves to highlight behavioral trends in reduction. Flakes obviously from bifaces (percussion thinning and pressure) account for almost half of the assemblage (46%), with the full range of reduction represented, from

Table 5.20. Debitage raw material by technology at 42KA4547.

Raw Material	Flake Fragments n	Flake Fragments %	Edge Preparation n	Edge Preparation %	Late Stage Biface Thinning n	Late Stage Biface Thinning %	Total
Chert NFS	1	100.0	0	0.0	0	0.0	1
Paradise chert	2	66.7	1	33.3	0	0.0	3
Canaan Peak cobble chert	5	83.3	0	0.0	1	16.7	6
Agatized wood	0	0.0	1	100.0	0	0.0	1
Kaibab chert	1	100.0	0	0.0	0	0.0	1
Quartzite	2	66.7	1	33.3	0	0.0	3
Total	11	73.3	3	20.0	1	6.7	15

Table 5.21. Debitage raw material by count and weight for 42KA4547.

Raw Material	Count (n)	Percent	Weight (g)	Percent
Chert NFS	1	6.7	0.1	0.4
Paradise chert	3	20.0	0.9	3.3
Canaan Peak cobble chert	6	40.0	23.6	87.4
Agatized wood	1	6.7	0.1	0.4
Kaibab chert	1	6.7	0.1	0.4
Quartzite	3	20.0	2.2	8.1
Total	15	100.0	27.0	100.0

Table 5.22. Debitage raw material by technology at 42KA4548.

Material	Shatter n	Shatter %	Flake Fragment n	Flake Fragment %	DFP Core n	DFP Core %	Bipolar Core n	Bipolar Core %	Edge Prep n	Edge Prep %	Early Biface Thinning n	Early Biface Thinning %	Late Biface Thinning n	Late Biface Thinning %	Biface Pressure n	Biface Pressure %	Total
Chert NFS	0	0.0	2	40.0	0	0.0	0	0.0	1	20.0	0	0.0	1	20.0	1	20.0	5
Paradise chert	0	0.0	2	28.6	1	14.3	0	0.0	2	28.6	0	0.0	1	14.3	1	14.3	7
Paradise chalcedony	0	0.0	3	37.5	0	0.0	1	12.5	0	0.0	2	25.0	1	12.5	1	12.5	8
Canaan Peak cobble chert	0	0.0	2	50.0	0	0.0	0	0.0	1	25.0	0	0.0	1	25.0	0	0.0	4
Other chalcedony	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Metasediment	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Quartzite	2	40.0	1	20.0	0	0.0	0	0.0	2	40.0	0	0.0	0	0.0	0	0.0	5
Total	2	6.5	10	32.3	3	9.7	1	3.2	6	19.4	2	6.5	4	12.9	3	9.7	31

Table 5.23. Debitage raw material by count and weight for 42KA4548.

Raw Material	Count (n)	Percent	Weight (g)	Percent
Chert NFS	5	16.1	1.3	4.3
Paradise chert	7	22.6	7.9	26.6
Paradise chalcedony	8	25.8	2.6	8.8
Canaan Peak cobble chert	4	12.9	0.6	2.0
Other chalcedony	1	3.2	1.0	3.4
Metasediment	1	3.2	11.8	39.7
Quartzite	5	16.1	4.5	15.2
Total	31	100.0	29.7	100.0

Table 5.24. Debitage raw material by technology at 42KA4549.

Material	Shatter		Flake Fragment		DFP Core		Bipolar Core		Edge Prep		Alternate Flake		Early Biface Thinning		Late Biface Thinning	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Chert NFS	0	0.0	8	44.4	0	0.0	0	0.0	4	22.2	1	5.6	2	11.1	2	11.1
Paradise chert	10	3.9	140	54.9	4	1.6	0	0.0	49	19.2	2	0.8	13	5.1	18	7.1
Paradise chalcedony	9	5.1	94	53.7	2	1.1	2	1.1	24	13.7	5	2.9	5	2.9	12	6.9
Canaan Peak cobble chert	2	1.6	68	55.3	0	0.0	0	0.0	19	15.4	4	3.3	4	3.3	13	10.6
Chinle agatized wood	0	0.0	8	42.1	0	0.0	0	0.0	3	15.8	3	15.8	0	0.0	1	5.3
Other petrified wood	0	0.0	9	60.0	1	6.7	0	0.0	3	20.0	0	0.0	1	6.7	0	0.0
Kaibab chert	0	0.0	9	90.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	10.0
Glen Canyon chert	1	33.3	1	33.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	33.3
Other chalcedony	1	50.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Boulder jasper	0	0.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	50.0
Honaker Trail chert	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Metasediment	0	0.0	0	0.0	0	0.0	0	0.0	1	50.0	0	0.0	0	0.0	0	0.0
Quartzite	3	9.7	18	58.1	1	3.2	0	0.0	7	22.6	0	0.0	0	0.0	1	3.2
Coarse igneous	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Indeterminate	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	26	4.0	359	54.6	9	1.4	2	0.3	110	16.7	15	2.3	25	3.8	50	7.6

(Table 5.24, Part 2)

Material	Uniface Percussion		Biface Pressure		Uniface Pressure		Notching Pressure		Scraper Spall		Potlid		Total
	n	%	n	%	n	%	n	%	n	%	n	%	
Chert NFS	0	0.0	1	5.6	0	0.0	0	0.0	0	0.0	0	0.0	18
Paradise chert	2	0.8	15	5.9	2	0.8	0	0.0	0	0.0	0	0.0	255
Paradise chalcedony	1	0.6	18	10.3	1	0.6	0	0.0	0	0.0	2	1.1	175
Canaan Peak cobble chert	1	0.8	10	8.1	0	0.0	0	0.0	1	0.8	1	0.8	123
Chinle agatized wood	0	0.0	3	15.8	0	0.0	1	5.3	0	0.0	0	0.0	19
Other petrified wood	0	0.0	1	6.7	0	0.0	0	0.0	0	0.0	0	0.0	15
Kaibab chert	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	10
Glen Canyon chert	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3
Other chalcedony	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2
Boulder jasper	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2
Honaker Trail chert	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Metasediment	0	0.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	2
Quartzite	0	0.0	1	3.2	0	0.0	0	0.0	0	0.0	0	0.0	31
Coarse igneous	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Indeterminate	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Total	4	0.6	50	7.6	3	0.5	1	0.2	1	0.2	3	0.5	658

early percussion thinning through pressure finishing and resharpening. As an individual class, flakes from edge preparation account for the largest proportion of the assemblage (41%). Because flakes from unpatterned core reduction are so few in number (9 or 3%), especially compared to biface reduction debris, it is likely that most of the edge preparation flakes come from biface reduction, especially the initial stages. The alternate flakes are certainly from early stages of biface reduction, where square and other irregular margins are flaked to establish proper edges for detaching thinning flakes. The few edge preparation flakes that are likely from non-bifacial cores are those of the coarse materials—quartzite and metasediment. These materials are most commonly used for the production of heavy-duty tools such as choppers and scraper-planes rather than bifaces. Two flakes were identified as bipolar, but given the low proportion of this category combined with the small amount of shatter, it seems unlikely that this method of reduction was actually practiced by the occupants. Core reduction and even the early stages of biface reduction can result in occasional debris with features that resemble those of bipolar fracture.

Local raw materials account for almost 90 percent of the assemblage by flake count (Table 5.25) with white chert and chalcedony together accounting for 65 percent of the debitage, Canaan Peak cobble chert for almost 20 percent of the assemblage, and the rest consisting mainly of quartzite. There is little difference between count and weight representation of the materials, because all materials, even the coarse ones, occur as fairly small debris. The average flake weight for this site is 0.38 g, considerably less than the 0.96 g average flake weight for 42KA4548 or the 1.8 g average flake weight for 42KA4547. As might be expected, the local materials contain various amounts of cortex cover (Table 5.26), with 10 percent of the flakes overall having some cortex. Obvious non-local materials include Boulder jasper, agatized wood, Glen Canyon chert, and Kaibab chert. The non-local materials mainly occur as undiagnostic flake fragments and late stage percussion thinning debris with just a few examples of core flakes and those from edge preparation and alternate flaking. This suggests that these materials came to the site in an advanced stage of reduction and evidently as well-thinned bifaces. The flakes detached from the local coarse alluvial cobbles (quartzite, metasediment, and igneous) are mainly quite small and derived from edge preparation. This stands in marked contrast to the assemblage from the two previous Archaic sites 42KA4547 and 4548, which had a few large core reduction flakes of these materials. As discussed in detail in Chapter 6, these materials are mainly used for heavy-duty cobble tools such as pounders, choppers, and scraper-planes. The large debris is usually derived from the initial preparation of these tools or when rejuvenating a used edge in a substantial way so as to increase edge acuteness. The small edge preparation flakes from these cobbles are removed for minor resharpening and to make a more regular tool edge by removing the negative bulb overhangs from large flakes.

Table 5.25. Debitage raw material by count and weight for 42KA4549.

Raw Material	Count (n)	%	Weight (g)	%
Chert NFS	18	2.7	7.0	2.8
Paradise chert	255	38.8	105.4	41.9
Paradise chalcedony	175	26.6	55.6	22.1
Canaan Pk cobble chert	123	18.7	44.3	17.6
Agatized wood	19	2.9	3.3	1.3
Other petrified wood	15	2.3	6.0	2.4
Kaibab chert	10	1.5	1.9	0.7
Glen Canyon chert	3	0.5	3.5	1.4
Other chalcedony	2	0.3	0.2	0.1
Boulder jasper	2	0.3	0.6	0.2
Honaker Trail chert	1	0.2	2.6	0.1
Metasediment	2	0.3	0.6	0.2
Quartzite	31	4.7	20.2	8.0
Coarse igneous	1	0.2	0.5	0.2
Indeterminate	1	0.2	0.1	0.04
Total	658	100.0	251.8	100.0

Almost 14 percent of the flakes in the assemblage show definite evidence of heat treatment (mainly differential luster) with almost another 44 percent possibly heat treated (Table 5.27). Most of the raw materials with possible evidence of heat treatment (overall high luster) are not naturally lustrous; thus it is likely that more than half of the flakes are from heat-treated cores or tools. Heat treatment of siliceous stone is perhaps most explicable when there is an emphasis on biface production, especially when pressure flaking is an important finishing and resharpening method. Heat treatment greatly reduces the amount of force needed to detach flakes, something that can be quite handy with percussion thinning or pressure flaking. An examination of production technology by thermal alteration reveals that evidence for this practice is greatest in pressure flakes from tools.

One hundred and four of the flakes (16%) from this assemblage exhibit traces that suggested that they were detached from used tools (Table 5.28).

Table 5.26. Debitage raw material by amount of cortex at 42KA4549.

Material	None n	None %	<25% n	<25% %	25–50% n	25–50% %	>50% n	>50% %	Total
Chert NFS	17	94.4	1	5.6	0	0.0	0	0.0	18
Paradise chert	231	90.6	9	3.5	5	2.0	10	3.9	255
Paradise chalcedony	156	89.1	14	8.0	3	1.7	2	1.1	175
Canaan Peak cobble chert	110	89.4	5	4.1	6	4.9	2	1.6	123
Agatized wood	19	100.0	0	0.0	0	0.0	0	0.0	19
Other petrified wood	12	80.0	2	13.3	0	0.0	1	6.7	15
Kaibab chert	10	100.0	0	0.0	0	0.0	0	0.0	10
Glen Canyon chert	1	33.3	0	0.0	0	0.0	2	66.7	3
Other chalcedony	2	100.0	0	0.0	0	0.0	0	0.0	2
Boulder jasper	1	50.0	1	50.0	0	0.0	0	0.0	2
Honaker Trail chert	1	100.0	0	0.0	0	0.0	0	0.0	1
Metasediment	2	100.0	0	0.0	0	0.0	0	0.0	2
Quartzite	28	90.3	1	3.2	1	3.2	1	3.2	31
Coarse igneous	1	100.0	0	0.0	0	0.0	0	0.0	1
Indeterminate	1	100.0	0	0.0	0	0.0	0	0.0	1
Total	592	90.0	33	5.0	15	2.3	18	2.7	658

Table 5.27. Debitage raw material by thermal alteration at 42KA4549.

Material	Absent n	Absent %	Possible n	Possible %	Certain n	Certain %	Burned n	Burned %	Total
Chert NFS	12	66.7	3	16.7	0	0.0	3	16.7	18
Paradise chert	101	39.6	87	34.1	32	12.5	35	13.7	255
Paradise chalcedony	16	9.1	104	59.4	38	21.7	17	9.7	175
Canaan Peak cobble chert	43	35.0	64	52.0	9	7.4	7	5.7	123
Agatized wood	2	10.5	13	68.4	4	21.1	0	0.0	19
Other petrified wood	1	6.7	11	73.3	2	13.3	1	6.7	15
Kaibab chert	3	30.0	2	20.0	2	20.0	3	30.0	10
Glen Canyon chert	2	66.7	0	0.0	0	0.0	1	33.3	3
Other chalcedony	0	0.0	1	50.0	1	50.0	0	0.0	2
Boulder jasper	0	0.0	1	50.0	1	50.0	0	0.0	2
Honaker Trail chert	1	100.0	0	0.0	0	0.0	0	0.0	1
Metasediment	2	100.0	0	0.0	0	0.0	0	0.0	2
Quartzite	30	96.8	1	3.2	0	0.0	0	0.0	31
Coarse igneous	1	100.0	0	0.0	0	0.0	0	0.0	1
Indeterminate	1	100.0	0	0.0	0	0.0	0	0.0	1
Total	215	32.7	287	43.6	89	13.5	67	10.2	658

Table 5.28. Tabulation of rejuvenation flakes by inferred tool type at 42KA4549.

Indeter.[1] n	Indeter.[1] %	None[2] n	None[2] %	Knife n	Knife %	Scraper n	Scraper %	Scraper-Plane n	Scraper-Plane %	Unknown Tool[3] n	Unknown Tool[3] %	Possible n	Possible %	Total
386	58.7	168	25.5	38	5.8	6	0.9	4	0.6	44	6.7	12	1.8	658

[1]Flake fragments, shatter, and potlids.
[2]Platform remnant bearing flakes without evidence of use.
[3]Smoothing and polishing of platform margin but platform angle less acute than expected for a cutting tool.

These traces are mainly confined to the outside edge of the platform surface (the original margin of the tool), occasionally extending onto the adjoining dorsal surface, but they sometimes occur on a flake margin (transverse truncation of a tool edge such as a scraper—tranchet blow) or its distal termination (overshot flake). Because flake fragments, shatter, and potlid spalls lack platforms, it remains unknown whether or not they had anything to do with tool rejuvenation (flake fragments can sometimes retain traces of use such as the distal end of an overshot flake). Therefore, almost 40 percent (38%) of the flakes with platforms contain evidence of having been detached from used tools.

42KA4552. This is the second largest debitage assemblage from the tested Archaic sites, with a total of 162 flakes. Most of these (124) came from the midden (Feature 1), which dates to the late Archaic, but 38 of the flakes came from the test unit around the slab-lined hearth (Feature 4), which dates to the Archaic-Formative transition. During the analysis it was immediately obvious that the flake assemblages from these two temporal periods were quite different, thus they are tabulated here separately (Tables 5.29-5.37). The Feature 1 flakes come from a wide range of reduction techniques and goals and include a diversity of raw materials (Table 5.29)—there are large core flakes from coarse materials, core reduction flakes

Table 5.29. Debitage raw material by technology for the midden unit, 42KA4552 (PNs 1 and 2).

	Shatter		Flake Fragment		DFP Core		Edge Prep		Alternate Flake		Early Biface Thinning	
Material	n	%	n	%	n	%	n	%	n	%	n	%
Chert NFS	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0
Paradise chert	3	4.8	28	45.2	4	6.5	6	9.7	2	3.2	1	1.6
Paradise chalcedony	0	0.0	8	50.0	0	0.0	1	6.3	1	6.3	2	12.5
Canaan Peak cobble chert	2	11.1	5	27.8	3	16.7	5	27.8	2	11.1	0	0.0
Chinle agatized wood	0	0.0	0	0.0	0	0.0	1	50.0	0	0.0	0	0.0
Other petrified wood	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0
Kaibab chert	0	0.0	1	33.3	0	0.0	0	0.0	0	0.0	0	0.0
Glen Canyon chert	0	0.0	2	66.7	0	0.0	0	0.0	0	0.0	0	0.0
Quartzite	2	11.1	1	5.6	8	44.4	7	38.9	0	0.0		0.0
Total	7	5.6	47	37.9	15	12.1	20	16.1	5	4.0	3	2.4
Adjusted %	--		--		21.7		29.0		7.2		4.3	

(Table 5.29, Part 2)

	Late Biface Thinning		Uniface Percussion		Biface Pressure		Uniface Pressure		Notching Pressure		Potlid		
Material	n	%	n	%	n	%	n	%	n	%	n	%	Total
Chert NFS	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Paradise chert	3	4.8	1	1.6	11	17.7	1	1.6	1	1.6	1	1.6	62
Paradise chalcedony	1	6.3	0	0.0	2	12.5	0	0.0	1	6.3	0	0.0	16
Canaan Peak cobble chert	0	0.0	0	0.0	1	5.6	0	0.0	0	0.0	0	0.0	18
Chinle agatized wood	0	0.0	0	0.0	1	50.0	0	0.0	0	0.0	0	0.0	2
Other petrified wood	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Kaibab chert	0	0.0	0	0.0	2	66.7	0	0.0	0	0.0	0	0.0	3
Glen Canyon chert	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0	0	0.0	3
Quartzite	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	18
Total	4	3.2	1	0.8	18	14.5	1	0.8	2	1.6	1	0.8	124
Adjusted %	5.8		1.5		26.1		1.5		2.9		--		100.0

Table 5.30. Debitage raw material by technology for the hearth unit, 42KA4552 (PN 3).

	Shatter		Flake Fragment		DFP Core		Edge Prep		Alternate Flake		Early Biface Thinning		Late Biface Thinning		
Material	n	%	n	%	n	%	n	%	n	%	n	%	n	%	Total
Chert NFS	1	50.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2
Paradise chert	1	11.1	2	22.2	0	0.0	1	11.1	1	11.1	2	22.2	2	22.2	9
Paradise chalcedony	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	1
Canaan Peak cobble chert	1	5.0	8	40.0	6	30.0	2	10.0	0	0.0	2	10.0	1	5.0	20
Other petrified wood	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Quartzite	0	0.0	0	0.0	0	0.0	3	75.0	0	0.0	1	25.0	0	0.0	4
Coarse igneous	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	1
Total	3	7.9	12	31.6	6	15.8	7	18.4	2	5.3	5	13.2	3	7.9	38
Adjusted %	--		--		26.1		30.4		8.7		21.7		13.0		100.0

of chert and chalcedony, and many biface pressure flakes of chert and chalcedony. The debitage from around Feature 4, however, consists mostly of medium size core and biface reduction flakes (Table 5.30) with no pressure flakes. The midden assemblage appears more representative of a diverse range of activity whereas that around the hearth appears to reflect a more limited range of activity. The differences in flake size between the two proveniences can be appreciated by the descriptive statistics for weight (Table 5.31), which clearly show that the debris from around the hearth is all roughly of the same size (little difference between mean and median and a small range), whereas debris from the midden comprises a wide range of sizes, with some very large outliers and many tiny pressure flakes. Thus, although the mean weight of midden flakes is greater than for the hearth unit flakes (7.9 g vs. 2.8 g), the median weight of the midden flakes is just 0.2 g. Raw material differences between the two proveniences (Tables 5.32 and 5.33) mainly involve the use of Canaan Peak cobble chert, which accounts for more than half of the assemblage from Feature 4, but less than 15 percent of the flakes of the midden test unit. Conversely, Paradise chert accounts for half of the flakes in the midden test unit but less than 25 percent of the flakes around

Table 5.31. Descriptive statistics for flake weight (g) for the debitage from the midden and hearth test units of 42KA4552.

Variables	Midden Unit	Hearth Unit
Minimum	0.1	0.1
Maxiumum	207.1	11.3
Sum	977.1	105.0
Median	0.2	2.2
Mean	7.9	2.8
Sat. Dev.	25.6	2.7

Table 5.32. Debitage raw material by count and weight for midden Unit 42KA4552 (PNs 1 and 2).

Raw Material	Count (n)	%	Weight (g)	%
Chert NFS	1	0.8	0.3	0.03
Paradise chert	62	50.0	212.0	21.7
Paradise chalcedony	16	12.9	21.1	2.2
Canaan Pk cobble chert	18	14.5	311.9	31.9
Agatized wood	2	1.6	0.8	0.08
Other petrified wood	1	0.8	0.1	0.01
Kaibab chert	3	2.4	0.3	0.03
len Canyon chert	3	2.4	0.3	0.03
Quartzite	18	14.5	430.3	44.0
Total	124	100.0	977.1	100.0

Table 5.33. Debitage raw material by count and weight for hearth unit 42KA4552 (PN3).

Raw Material	Count (n)	%	eight (g)	%
Chert NFS	2	5.3	1.3	1.2
Paradise chert	9	23.7	40.3	38.4
Paradise chalcedony	1	2.6	1.2	1.1
Canaan Pk cobble chert	20	52.6	51.5	49.0
Other petrified wood	1	2.6	2.6	2.5
Quartzite	4	10.5	3.3	3.1
Coarse igneous	1	2.6	4.8	4.6
Total	38	100.0	105.0	100.0

Table 5.34. Thermal alteration of debitage for midden and hearth units, 42KA4552.

	Absent		Possible		Certain		Burned		
Provenience	n	%	n	%	n	%	n	%	Total
Midden	41	33.1	48	38.7	21	16.9	14	11.3	124
Hearth	26	68.4	4	10.5	2	5.2	6	15.8	38

Table 5.35. Debitage raw material by amount of cortex for midden unit, 42KA4552 (PNs 1 and 2).

	None		<25%		25–50%		>50%		
Material	n	%	n	%	n	%	n	%	Total
Chert NFS	1	100.0	0	0.0	0	0.0	0	0.0	1
Paradise chert	51	82.3	5	8.1	2	3.2	4	6.5	62
Paradise chalcedony	12	75.0	2	12.5	1	6.3	1	6.3	16
Canaan Peak cobble chert	12	66.7	1	5.6	1	5.6	4	22.2	18
Agatized wood	2	100.0	0	0.0	0	0.0	0	0.0	2
Other petrified wood	1	100.0	0	0.0	0	0.0	0	0.0	1
Kaibab chert	3	100.0	0	0.0	0	0.0	0	0.0	3
Glen Canyon chert	3	100.0	0	0.0	0	0.0	0	0.0	3
Quartzite	9	50.0	1	5.6	1	5.6	7	38.9	18
Total	94	75.8	9	7.3	5	4.0	16	12.9	124

Table 5.36. Debitage raw material by amount of cortex for hearth unit 42KA4552 (PN3).

	None		<25%		25–50%		>50%		
Material	n	%	n	%	n	%	n	%	Total
Chert NFS	1	50.0	1	50.0	0	0.0	0	0.0	2
Paradise chert	5	55.6	0	0.0	1	11.1	3	33.3	9
Paradise chalcedony	1	100.0	0	0.0	0	0.0	0	0.0	1
Canaan Peak cobble chert	9	45.0	4	20.0	3	15.0	4	20.0	20
Other petrified wood	1	100.0	0	0.0	0	0.0	0	0.0	1
Quartzite	2	50.0	0	0.0	2	50.0	0	0.0	4
Coarse igneous	1	100.0	0	0.0	0	0.0	0	0.0	1
Total	20	52.6	5	13.2	6	15.8	7	18.4	38

Table 5.37. Tabulation of rejuvenation flakes by inferred tool type for midden and hearth units, 42KA4552.

	Indeter.		None		Knife		Scraper		Scraper-Plane		Pounder		Unknown Tool (polish)		Unknown Wear		
Provenience	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	Total
Midden	53	42.7	59	47.6	5	4.0	2	1.6	2	1.6	1	0.8	2	1.6			124
Hearth	15	39.5	14	36.8	2	5.3			2	5.3			3	7.9	2	5.3	38

Table 5.38. Debitage raw material by technology at 42KA4655.

	Flake Fragment		DFP Core		Edge Prep		Alternate Flake		Early Biface		Late Biface		Biface Pressure		
Material	n	%	n	%	n	%	n	%	n	%	n	%	n	%	Total
Chert NFS	38	44.7	1	1.2	12	14.1	2	2.4	3	3.5	12	14.1	17	20.0	85
Agatized wood	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Total	38	44.2	1	1.2	13	15.1	2	2.3	3	3.5	12	14.0	17	19.8	86

the slab-lined hearth. Both proveniences have flakes that were heat treated or probably heat treated but with much greater evidence of this practice with the midden flakes, likely because of the abundant evidence of biface pressure flaking. Differences in cortex representation between the two proveniences (Tables 5.35 and 5.36) likely relate to the previously noted distinctions in reduction technology, especially the large proportion of tiny debris in the midden, most of which likely comes from pressure flaking. By the time tools are being pressure flaked, most cortex has likely been removed. With the earlier stage flakes of average larger size around the hearth, a higher incidence of cortex is expectable. Tool rejuvenation flakes occur in both assemblages (Table 5.37), but with greater diversity in the midden. Nonetheless, there is a higher proportion of obvious resharpening debris around the hearth. Likewise the hearth unit yielded a high proportion of used flakes (4 or 11% vs. 3 or 2% for the midden). It seems possible that the flakes around the hearth were associated with some specific undertaking rather than general reduction; thus proportionally more debris exhibits use-wear and more is from tool resharpening.

42KA4655. This is the third largest debitage assemblage from the tested Archaic sites, with a total of 86 flakes (Tables 5.38 and 5.39), all but two of which are derived from a single reduction event of a single nodule. When looking at the collection as a whole it is clear that the debris comes from the percussion thinning of a middle stage biface (ca. Stage 3), with the item likely turned into a Stage 4 biface. The reduction had nothing to do with refurbishing worn edges because none of the flake platforms exhibited use-wear traces. It is interesting to observe how a limited and highly focused reduction strategy results in a moderate diversity of flake types, something that is also clear from reduction experiments. This assemblage clearly shows that the reduction strategy for edge preparation flakes must be considered in relation to what other flake types are present and well represented. In this case just a single flake was identified as simple core reduction, thus the edge preparation flakes likely relate to establishing appropriate margins for removing thinning flakes. The near absence of alternate flakes is expected for a biface that is already in Stage 3 and being further thinned. By Stage 3 much of the square and otherwise irregular edges should be removed, so there would be little need for alternate flaking. The biface that was reduced evidently had not been heat treated, but the two flakes from other cores or tools might have been heat treated. The source of the raw material used for the biface was not identified. It might come from the local alluvial gravels, but it was not typical of the chert from this source (see Chapter 6). None of the flakes exhibited cortex, further evidence that the tools had been roughed out somewhere else.

Table 5.39. Debitage raw material by count and weight for 42KA4655.

Raw Material	Count (n)	%	Weight (g)	%
Chert NFS	85	98.8	40.1	99.8
Agatized wood	1	1.2	0.1	0.2
Total	86	100.0	40.2	100.0

Formative Sites

42KA4749. The 76 flakes from this open site are characterized in Tables 5.40–5.44. There is a high proportion of flake fragments, many of which were likely derived from percussion biface thinning (Table 5.40). The platform remnant bearing flakes from which technological stage is inferable appear to be mainly from biface reduction and include all stages from alternate flaking and initial thinning to pressure flaking. Certain biface production flakes combined account for more than half of the identifiable flakes (excluding fragments: adjusted percent). Core reduction is poorly represented and is mainly of quartzite and probably

Table 5.40. Debitage raw material by technology at 42KA4749.

Material	Flake Fragment n	Flake Fragment %	Unpatterned Core n	Unpatterned Core %	Edge Prep n	Edge Prep %	Alternate Flake n	Alternate Flake %	E. Biface Thinning n	E. Biface Thinning %	L. Biface Thinning n	L. Biface Thinning %	Biface Pressure n	Biface Pressure %	Total
Paradise chert	18	47.4	1	2.6	2	5.3	3	7.9	3	7.9	6	15.8	5	13.2	38
Paradise chalcedony	11	42.3	0	0.0	4	15.4	4	15.4	3	11.5	2	7.7	2	7.7	26
Canaan Peak cobble chert	1	25.0	0	0.0	0	0.0	1	25.0	1	25.0	1	25.0	0	0.0	4
Kaibab chert	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0	1
Quartzite	3	42.9	2	28.6	1	14.3	0	0.0	1	14.3	0	0.0	0	0.0	7
Total	33	43.4	3	3.9	7	9.2	8	10.5	8	10.5	9	11.8	8	10.5	76
Adjusted	--		7.0		16.3		18.6		18.6		20.9		18.6		100.0

Table 5.41. Debitage raw material by count and weight for 42KA4749.

Raw Material	Count (n)	Percent	Weight (g)	Percent
Paradise chert	38	50.0	13.0	28.2
Paradise chalcedony	26	34.2	7.6	16.5
Canaan Peak cobble chert	4	5.3	2.3	5.0
Kaibab chert	1	1.3	0.1	0.2
Quartzite	7	9.2	23.1	50.1
Total	76	100.0	46.1	100.0

Table 5.42. Debitage raw material by thermal alteration at 42KA4749.

Material	Absent n	Absent %	Possible n	Possible %	Certain n	Certain %	Burned n	Burned %	Total
Paradise chert	19	50.0	8	21.1	3	7.9	8	21.1	38
Paradise chalcedony	5	19.2	9	34.6	5	19.2	7	26.9	26
Canaan Peak cobble chert	4	100.0	0	0.0	0	0.0	0	0.0	4
Kaibab chert	1	100.0	0	0.0	0	0.0	0	0.0	1
Quartzite	7	100.0	0	0.0	0	0.0	0	0.0	7
Total	36	47.4	17	22.4	8	10.5	15	19.7	76

Table 5.43. Debitage raw material by amount of cortex at 42KA4749.

Material	None n	None %	<25% n	<25% %	25–50% n	25–50% %	>50% n	>50% %	Total
Paradise chert	36	94.7	1	2.6	1	2.6	0	0.0	38
Paradise chalcedony	23	88.5	1	3.8	1	3.8	1	3.8	26
Canaan Peak cobble chert	4	100.0	0	0.0	0	0.0	0	0.0	4
Kaibab chert	1	100.0	0	0.0	0	0.0	0	0.0	1
Quartzite	5	71.4	0	0.0	1	14.3	1	14.3	7
Total	69	90.8	2	2.6	3	3.9	2	2.6	76

Table 5.44. Tabulation of rejuvenation flakes by inferred tool type at 42KA4749.

Indeter.		None		Knife		Chopper		Unknown Tool (polish)		
n	%	n	%	n	%	n	%	n	%	Total
33	43.4	27	35.5	2	2.6	1	1.3	13	17.1	76

related to the production of heavy-duty cobble tools. As such, the edge preparation flakes and alternate flakes are also likely related to biface reduction. By count, Paradise chert and chalcedony flakes dominate the assemblage (Table 5.41), but by weight the seven quartzite flakes account for half of the assemblage. The prevalence of Paradise chert and chalcedony is perhaps partially related to the nearby occurrence of nodules of this material. Yet few flakes of these materials retain cortex (Table 5.43), so much initial reduction was evidently done elsewhere. Supporting the idea that flake debris at the site was not from early reduction is the incidence of refurbishing flakes (Table 5.44). Sixteen of 43 flakes (excluding indeterminate flake fragments) exhibited use-traces, suggesting that they were detached from worn tools. As such, it seems that much of the flaking at this site was related to tool maintenance; specifically identified in the assemblage were resharpening flakes from knives and a chopper. No flakes exhibited obvious traces from having been used in an expedient fashion.

42KA4750. Just 48 flakes were recovered from the two test units at this site, which is too few to reach any firm conclusions about reduction behavior. Tables 5.45–5.49 characterize the assemblage, which, despite how few flakes were recovered, is quite diverse, from large quartzite core reduction debris to pressure flakes from bifaces and the resharpening of scrapers. This assemblage contains more raw material diversity than the nearby site 42KA4749, including petrified wood which is a non-local material, mostly derived from either the Morrison or Chinle Formations. Anasazi use of agatized wood for tool production is well exemplified at some sites on the Kaiparowits Plateau, especially those that functioned as hunting camps (see discussion in Chapter 6).

Rose Shelter (42KA4794). This site produced the largest assemblage of flakes (n = 713) from the 13 tested sites. Because all of the stratigraphic layers appear to date to the Formative period, the data given in Tables 5.50–5.54 are presented as an aggregate rather than by individual layers. There are a few differences between layers in raw material and technology, but in general all layers are characterized by abundant pressure flaking debris. The evident focus was on making arrow points from flakes of high-quality siliceous stone that were heat treated and then pressure flaked to fashion the tools. This is reflected by the high incidence of biface pressure flakes: almost 40 percent overall and just under 60 percent (adjusted percent) by excluding the debris of indeterminate technology (shatter, flake fragments, potlids). A quarter of the flakes exhibit certain evidence for heat treatment, even though many of these are small pressure flakes, and almost half of the assemblage exhibits a high luster suggestive of possible heat treatment. The presence of many small flakes exhibiting differential luster indicates that heat treatment was done just before the pressure flaking stage. Because the dorsal surfaces of many of the pressure flakes exhibit single flake scar surfaces (likely the ventral surface of the original flake blanks), it is evident that production began with thin flake blanks that were heated and pressure flaked. The small size of the flakes is gauged by the average flake weight for the assemblage of just 0.2 g. This includes several large quartzite flakes that combined account for fully 30 percent of the assemblage by weight; removing these reduces the average flake weight to less than 0.2 g.[1] Several of the largest flakes exhibited use-wear traces (six used flakes total) and these might have been brought to the site for use or were specifically detached from a core or large tool for immediate use, but general core reduction or percussion biface thinning was not commonly practiced in the shelter. Quite a few of the edge preparation and alternate flakes are from heat-treated flake blanks and most of these flake types were detached by pressure. This indicates the initial reduction of flake blanks to remove square edges and roughly shape them in plan view. Some

[1]It is likely significantly less because limitations of the digital scale meant that 0.1 g was the lowest possible measurement but many flakes did not register this.

Table 5.45. Debitage raw material by technology at 42KA4750.

Material	Shatter n	Shatter %	Flake Fragment n	Flake Fragment %	DFP Core n	DFP Core %	Bipolar Core n	Bipolar Core %	Edge Prep n	Edge Prep %	Alternate Flake n	Alternate Flake %
Chert NFS	0	0.0	0	0.0	1	50.0	0	0.0	0	0.0	0	0.0
Paradise chert	0	0.0	5	38.5	0	0.	0	0.0	1	7.7	2	15.4
Paradise chalcedony	2	11.8	5	29.4	0	0.0	0	0.0	4	23.5	1	5.9
Canaan Peak cobble chert	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Chinle agatized wood	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Other petrified wood	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0
Kaibab chert	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0
Quartzite	1	16.7	2	33.3	3	50.0	0	0.0	0	0.0	0	0.0
Pudding stone	0	0.0	1	50.0	0	0.0	1	50.0	0	0.0	0	0.0
Total	3	6.3	14	29.2	4	8.3	1	2.1	6	12.5	3	6.3
Adjusted %	--		--		13.8		3.5		20.7		10.3	

(Table 5.45, Part 2)

Material	Early Biface Thinning n	Early Biface Thinning %	Late Biface Thinning n	Late Biface Thinning %	Biface Pressure n	Biface Pressure %	Uniface Pressure n	Uniface Pressure %	Potlid n	Potlid %	Other n	Other %	Total
Chert NFS	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2
Paradise chert	2	15.4	1	7.7	1	7.7	0	0.0	1	7.7	0	0.0	13
Paradise chalcedony	0	0.0	2	11.8	2	11.8	1	5.9	0	0.0	0	0.0	17
Canaan Peak cobble chert	0	0.0	0	0.0	0	0.0	0	0.0	1	50.0	1	50.0	2
Chinle agatized wood	0	0.0	1	25.0	3	75.0	0	0.0	0	0.0	0	0.0	4
Other petrified wood	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Kaibab chert	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Quartzite	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6
Pudding stone	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2
Total	3	6.3	4	8.3	6	12.5	1	2.1	2	4.2	1	2.1	48
Adjusted %	10.3		13.8		20.7		3.5		--		3.5		100.0

Table 5.46. Debitage raw material by count and weight for 42KA4750.

Raw Material	Count (n)	Percent	Weight (g)	Percent
Chert NFS	2	4.2	9.5	2.1
Paradise chert	13	27.1	18.2	4.0
Paradise chalcedony	17	35.4	8.3	1.8
Canaan Peak cobble chert	2	4.2	3.4	0.7
Agatized wood	4	8.3	1.4	0.3
Other petrified wood	1	2.1	0.2	0.04
Kaibab chert	1	2.1	0.2	0.04
Quartzite	6	12.5	359.2	78.5
Pudding stone	2	4.2	57.1	12.5
Total	48	100.0	457.5	100.0

Table 5.47. Debitage raw material by thermal alteration at 42KA4750.

Material	None n	None %	<25% n	<25% %	25–50% n	25–50% %	>50% n	>50% %	Total
Chert NFS	2	100.0	0	0.0	0	0.0	0	0.0	2
Paradise chert	5	38.5	4	30.8	1	7.7	3	23.1	13
Paradise chalcedony	6	35.3	3	17.6	7	41.2	1	5.9	17
Canaan Peak cobble chert	0	0.0	0	0.0	1	50.0	1	50.0	2
Agatized wood	0	0.0	1	25.0	2	50.0	1	25.0	4
Other petrified wood	1	100.0	0	0.0	0	0.0	0	0.0	1
Kaibab chert	1	100.0	0	0.0	0	0.0	0	0.0	1
Quartzite	6	100.0	0	0.0	0	0.0	0	0.0	6
Pudding stone	2	100.0	0	0.0	0	0.0	0	0.0	2
Total	23	47.9	8	16.7	11	22.9	6	12.5	48

Table 5.48. Debitage raw material by amount of cortex at 42KA4750.

Material	None n	None %	<25% n	<25% %	25–50% n	25–50% %	>50% n	>50% %	Total
Chert NFS	1	50.0	1	50.0	0	0.0	0	0.0	2
Paradise chert	11	84.6	2	15.4	0	0.0	0	0.0	13
Paradise chalcedony	16	94.1	0	0.0	0	0.0	1	5.9	17
Canaan Peak cobble chert	0	0.0	0	0.0	0	0.0	2	100.0	2
Agatized wood	4	100.0	0	0.0	0	0.0	0	0.0	4
Other petrified wood	1	100.0	0	0.0	0	0.0	0	0.0	1
Kaibab chert	0	0.0	1	100.0	0	0.0	0	0.0	1
Quartzite	4	66.7	0	0.0	1	16.7	1	16.7	6
Pudding stone	0	0.0	1	50.0	0	0.0	1	50.0	2
Total	37	77.1	5	10.4	1	2.1	5	10.4	48

Table 5.49. Tabulation of rejuvenation flakes by inferred tool type at 42KA4750.

Indeterminate n	Indeterminate %	None n	None %	Knife n	Knife %	Scraper n	Scraper %	Scraper-Plane n	Scraper-Plane %	Unknown Tool (polish) n	Unknown Tool (polish) %	Total
21	43.8	21	43.8	2	4.2	1	2.1	1	2.1	2	4.2	48

of the edge preparation flakes have bending initiations that removed large portions of the margins from flake blanks; these odd flakes have a squarish cross-section. The Rose Spring Corner-notched points and arrow point fragments recovered from the shelter deposits (see Flaked Tool descriptions below) provide a nice complement to the flaking debris. Broken Rose Spring points were being removed from arrows and replaced with new points fashioned at the shelter. This site provides a good examle of an earlier observation that Formative hunting camps contain a modest amount of agatized wood. Local chert and chalcedony are still well represented but high-quality exotic materials account for more than 20 percent of the assemblage, with agatized wood comprising most of this (18%). The use of this material suggusts trips west of the Cockscomb and might indicate that some of the Formative groups using the shelter actually resided on semipermanent basis in this direction off the Kaiparowits Plateau. Chapter 6 explores this issue somewhat more in the disscusion of projectile point raw materials. As would be expected for an assemblage that is characterized by arrow point production from flake blanks, cortex is poorly represented.

Post-Formative

42KA4575. Just two small pieces of angular shatter were recovered from the single test unit at

Table 5.50. Debitage raw material by technology at 42KA4794.

Material	Shatter		Flake Fragment		DFP Core		Edge Prep		Alternate Flake		Early Biface Thinning		Late Biface Thinning	
	n	%n	%n	%	n	%	n	%	n	%	n	%		
Chert NFS	0	0.0	8	44.4	0	0.0	1	5.6	2	11.1	0	0.0	0	0.0
Paradise chert	1	0.4	69	29.1	1	0.4	32	13.5	19	8.0	12	5.1	11	4.6
Paradise chalcedony	1	0.4	77	34.1	1	0.4	29	12.8	17	7.5	1	0.4	8	3.5
Canaan Peak cobble chert	1	2.4	15	35.7	0	0.0	1	2.4	1	2.4	1	2.4	3	7.1
Chinle agatized wood	3	2.3	39	30.2	0	0.0	17	13.2	11	8.5	1	0.8	2	1.6
Other petrified wood	0	0.0	8	32.0	1	4.0	2	8.0	3	12.0	0	0.0	0	0.0
Kaibab chert	0	0.0	4	50.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Glen Canyon chert	0	0.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Other chalcedony	0	0.0	2	40.0	0	0.0	0	0.0	1	20.0	0	0.0	0	0.0
Boulder jasper	0	0.0	1	25.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Obsidian	0	0.0	2	40.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Quartizte	0	0.0	2	16.7	4	33.3	4	33.3	0	0.0	0	0.0	0	0.0
Total	5	0.8	228	32.0	7	1.0	86	12.1	54	7.6	15	2.1	24	3.4
Adj. %	--		--		1.5		18.0		11.3		3.2		5.0	

(Table 5.50, Part 2)

Material	Uniface Percussion		Biface Pressure		Uniface Pressure		Notching Pressure		Tool Spall-Pounder		Potlid		Total
	n	%	n	%	n	%	n	%	n	%	n	%	
Chert NFS	1	5.6	5	27.8	1	5.6	0	0.0	0	0.0	0	0.0	18
Paradise chert	2	0.8	89	37.6	0	0.0	1	0.4	0	0.0	0	0.0	237
Paradise chalcedony	0	0.0	89	39.4	0	0.0	2	0.9	0	0.0	1	0.4	226
Canaan Peak cobble chert	0	0.0	20	47.6	0	0.0	0	0.0	0	0.0	0	0.0	42
Chinle agatized wood	0	0.0	53	41.1	2	1.6	0	0.0	0	0.0	1	0.8	129
Other petrified wood	1	4.0	10	40.0	0	0.0	0	0.0	0	0.0	0	0.0	25
Kaibab chert	0	0.0	4	50.0	0	0.0	0	0.0	0	0.0	0	0.0	8
Glen Canyon chert	0	0.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0	2
Other chalcedony	0	0.0	2	40.0	0	0.0	0	0.0	0	0.0	0	0.0	5
Boulder jasper	0	0.0	3	75.0	0	0.0	0	0.0	0	0.0	0	0.0	4
Obsidian	0	0.0	3	60.0	0	0.0	0	0.0	0	0.0	0	0.0	5
Quartizte	0	0.0	0	0.0	0	0.0	0	0.0	2	16.7	0	0.0	12
Total	4	0.6	279	39.1	3	0.4	3	0.4	2	0.3	2	0.3	713
Adj. %	0.8		58.5		0.6		0.6		0.4		--		100.0

Table 5.51. Debitage raw material by count and weight for 42KA4794.

Raw Material	Count (n)	Percent	Weight (g)	Percent
Chert NFS	18	2.5	4.1	2.5
Paradise chert	237	33.2	47.4	29.1
Paradise chalcedony	226	31.7	31.2	19.1
Canaan Peak cobble chert	42	5.9	4.7	2.9
Agatized wood	129	18.1	17.1	10.5
Other petrified wood	25	3.5	6.7	4.1
Kaibab chert	8	1.1	0.8	0.5
Glen Canyon chert	2	0.3	0.2	0.1
Other chalcedony	5	0.7	0.5	0.3
Boulder jasper	4	0.6	0.4	0.2
Obsidian	5	0.7	0.5	0.3
Quartzite	12	1.7	49.4	30.3
Total	713	100.0	163.0	100.0

Table 5.52. Debitage raw material by thermal alteration at 42KA4794.

	Absent		Possible		Certain		Burned		
Material	n	%	n	%	n	%	n	%	Total
Chert NFS	1	5.6	6	33.3	2	11.1	9	50.0	18
Paradise chert	44	18.6	94	39.7	68	28.7	31	13.1	237
Paradise chalcedony	28	12.4	122	54.0	73	32.3	3	1.3	226
Canaan Peak cobble chert	13	31.0	20	47.6	6	14.3	3	7.1	42
Agatized wood	10	7.8	77	59.7	26	20.2	16	12.4	129
Other petrified wood	9	36.0	9	36.0	3	12.0	4	16.0	25
Kaibab chert	1	12.5	7	87.5	0	0.0	0	0.0	8
Glen Canyon chert	0	0.0	2	100.0	0	0.0	0	0.0	2
Other chalcedony	1	20.0	2	40.0	2	40.0	0	0.0	5
Boulder jasper	0	0.0	2	50.0	2	50.0	0	0.0	4
Obsidian	5	100.0	0	0.0	0	0.0	0	0.0	5
Quartzite	12	100.0	0	0.0	0	0.0	0	0.0	12
Total	124	17.4	341	47.8	182	25.5	66	9.3	713

Table 5.53. Debitage raw material by amount of cortex at 42KA4794.

	None		<25%		25–50%		>50%		
Material	n	%	n	%	n	%	n	%	Total
Chert NFS	17	94.4	1	5.6	0	0.0	0	0.0	18
Paradise chert	226	95.4	4	1.7	3	1.3	4	1.7	237
Paradise chalcedony	221	97.8	2	0.9	0	0.0	3	1.3	226
Canaan Peak cobble chert	38	90.5	3	7.1	0	0.0	1	2.4	42
Agatized wood	124	96.1	2	1.6	2	1.5	1	0.8	129
Other petrified wood	23	92.0	2	8.0	0	0.0	0	0.0	25
Kaibab chert	8	100.0	0	0.0	0	0.0	0	0.0	8
Glen Canyon chert	1	50.0	1	50.0	0	0.0	0	0.0	2
Other chalcedony	5	100.0	0	0.0	0	0.0	0	0.0	5
Boulder jasper	4	100.0	0	0.0	0	0.0	0	0.0	4
Obsidian	5	100.0	0	0.0	0	0.0	0	0.0	5
Quartzite	10	83.3	1	8.3	0	0.0	1	8.3	12
Total	682	95.7	16	2.2	5	0.7	10	1.4	713

Table 5.54. Tabulation of rejuvenation flakes by inferred tool type at 42KA4794.

None		Knife		Scraper		Pounder		Unknown Tool (polish)		Unknown Wear		Indeter.		
n	%	n	%	n	%	n	%	n	%	n	%	n	%	Total
445	62.4	12	1.7	10	1.4	1	0.1	7	1.0	7	1.0	231	32.4	713

this site. These pieces are not even certainly of cultural origin and the material is an unidentified chert. They provide no useful interpretive information.

42KA4662. The debitage assemblage from this small open hunting camp dating to the historic period is much like that from Rose Shelter in terms of technology. The flakes are characterized in Tables 5.55–5.57. The tables for cortex and rejuvenation flake type were omitted for this site because they contain so little information. All but one flake lacks cortex (99%), which is the lowest incidence for any of the tested sites. Three flakes retained evidence indicating removal from bifacial cutting tools (knives), but 94 flakes contained no evidence and 40 flakes were indeterminate (lacking platforms). The assemblage from this site consists of two different reduction objectives, both involving Paradise chert and chalcedony. One of these is simple core reduction of chert or chalcedony cores and it accounts for a relatively minor proportion of the debris. The other is pressure flaking of heat-treated flake blanks to produce arrow points and it accounts for the majority of the flakes. The core reduction involved detaching flakes from prepared cores (hence the lack of cortex) using stone hammers. None of the core reduction flakes had been heat treated, so this practice only involved flakes after they had been removed from the cores. Because none of the flakes at this site were used, it appears that core reduction was used expressly to produce flake blanks for arrow point manufacture. Because the assemblage of pressure flakes from heat-treated flake blanks occurs around a heath, it is probable that heat treatment was done on site. Selected core flakes were "cooked" in the fire, perhaps while also roasting game (faunal bone was abundant), and these were pressure flaked to make arrow points. Two arrow point fragments from production errors were recovered, along with a heat-treated flake that appears to be a tool broken during the initial stage of alternate flaking and edge preparation (see the following tool descriptions). The occurrence of differential luster on just under half (48%) of the flakes, nearly all of which are tiny pressure flakes, indicates that the flake blanks were perhaps not extensively flaked to produce the points. Indeed this is what the Desert Side-notched points collected from the Kaiparowits Plateau indicate (see Chapter 6 discussion). In other words, thin flakes were used for point production so that a thin section is selected for and then most of the production effort entails plan shaping. Virtually all of the Desert Side-notched points from the Kaiparowits Plateau retain remnants of the original flake blank on one and frequently both surfaces. With such an approach it is common for remnants of the original flake blank to be preserved on the dorsal surfaces of pressure flakes; these remnants have a matte-like appearance that contrasts with the luster on the scars of flakes removed after heat treatment. Based on the pattern of pressure flake scars relative to the remnant surfaces of the original flake blank, combined with the angle between the platform and flake margins, it is clear that the flake blanks were mainly flaked by moving left to right with the force directed back to the left.

Flaked Stone Tools

In total, 58 flaked stone tools were recovered during the testing project. These items are listed in Table 5.58 by site according to general tool type. The used flakes listed here were also analyzed as debitage and reported above. Table 5.59 provides details about each of the stone tools. Most of the sites have too few tools to merit any site-specific discussion.

Archaic Sites

42KA4549. This site produced the second largest flake assemblage of the tested sites, so it is not surprising that it, along with 42KA4552, also yielded the second largest assemblage of flaked stone tools. This site had the highest number of bifaces, which is consistent with the emphasis on biface reduction seen in the flake assemblage. The bifaces tend not to have evidence of use and most appear broken in production. Biface 3.2.1 however

Table 5.55. Debitage raw material by technology at 42KA4662.

Material	Shatter		Flake Fragment		Unpatterned Core		Edge Prep		Alternate Flake		Biface Pressure		Uniface Pressure		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Paradise chert	5	9.3	11	20.4	2	3.7	8	14.8	9	16.7	18	33.3	1	1.9	54
Paradise chalcedony	2	2.5	22	27.8	0	0.0	15	19.0	9	11.4	26	32.9	5	6.3	79
Quartzite	0	0.0	1	25.0	0	0.0	2	50.0	1	25.0	0	0.0	0	0.0	4
Total	7	5.1	34	24.8	2	1.5	25	18.2	19	13.9	44	32.1	6	4.4	137

Table 5.56. Debitage raw material by count and weight for 42KA4662.

Raw Material	Count (n)	Percent	Weight (g)	Percent
Paradise chert	54	39.4	17.6	62.2
Paradise chalcedony	79	57.7	9.7	34.3
Quartzite	4	2.9	1.0	3.5
Total	137	100.0	28.3	100.0

Table 5.57. Debitage raw material by thermal alteration at 42KA4662.

Material	Absent		Possible		Certain		Total
	n	%	n	%	n	%	
Paradise chert	26	48.1	5	9.3	23	42.6	54
Paradise chalcedony	17	21.5	19	24.1	43	54.4	79
Quartzite	4	100.0	0	0.0	0	0.0	4
Total	47	34.3	24	17.5	66	48.2	137

Table 5.58. Frequency of various tool types at tested Kaiparowits Plateau sites (site numbers prefixed by 42KA).

Tool Type	4547	4548	4549	4552	4749	4750	4662	4794	Total	Percent
Used flake			5	4	1	4		3	17	29.8
Retouched flake				1			1	3	5	8.8
Retouched tool		1							1	1.7
Biface	1		5	2		1		2	11	19.0
Drill				1					1	1.7
Dart point				1	1	2			4	6.9
Arrow point						1	2	8	11	19.0
Cobble tool?				1					1	1.7
Cobble chopper					1				1	1.7
Cobble pounder			1					1	2	3.4
Cobble scraper-plane				1					1	1.7
Core			1	1		1			3	5.2
Total	1	1	12	12	3	9	3	17	58	100.0
Percent	1.7	1.7	20.7	20.7	5.2	15.5	5.2	29.3	100.0	

Table 5.59. Descriptions of the flaked stone tools recovered from the tested Kaiparowits Plateau sites.

Temporal Period	Site No.	Item No.	Artifact Type	Description
Archaic	42KA4547	2.1.1	Biface	Stage 2/3 biface fragment of heat-treated Canaan Peak cobble chert broken in production by a combination of flaws and fracture; no obvious use-wear.
Archaic	42KA4548	4.1.1	Retouched tool	An odd, small retouched tool of Paradise chert; appears to be a pie-shaped section from a biface (radial break portion?); microflaking along broken edges might result from scraping use but difficult to determine how the item might have been held.
Archaic	42KA4549	1.1.1	Biface	Tip portion of a stage 4 biface of heat-treated Paradise chert broken in production by a combination of overshot and incipient fracture plane; no obvious use-wear but some production related edge abrasion.
		1.1.2	Biface	Small tip portion of a stage 4 biface of Canaan Peak cobble chert that appears heat spalled; no obvious use-wear.
		1.1.3	Biface	A small midsection fragment (near tip) of a Stage 5 biface (perhaps a dart point) of Paradise chert broken by perverse fracture; no obvious use-wear.
		1.3.1	Cobble pounder	A quartzite cobble with one unidirectionally flaked edge that appears to have been used in some sort of percussive or abrasive fashion resulting in pronounced wear facets—perhaps pulping some substance against a stone; also used as a hammerstone.
		2.1.1	Used flake	Paradise chert flake fragment used for cutting along one margin
		2.1.2	Used flake	An early stage biface thinning flake of petrified wood used for scraping along one margin, broken on the used margin.
		2.1.3	Used flake	An early stage biface thinning flake of reddish-brown chert (Canaan Peak cobble chert) used for scraping on two margins.
		3.1.1	Used flake	Paradise chert flake (probable early stage biface thinning) used for scraping on one edge.
		3.1.2	Used flake	Core flake (or early stage biface thinning) of chalcedony (likely heat-treated Paradise chert) used for cutting on two margins.
		3.1.3	Biface	End fragment of a Stage 3 biface of Canaan Peak cobble chert; poorly thinned because of stepped flake; possible scraping use-wear along one margin that also appears partially flaked for resharpening; artifact might not have been part of a bifacial thinning strategy but a thick bifacial tool as discussed in Chap. 6.
		3.1.4	Core	Core of Canaan Peak cobble chert that appears affected by post-depositional burning; might have been used for scraping.
		3.2.1	Biface	A deeply serrated stage 5 biface missing its base of heat-treated Paradise chert; serrations exhibit extensive smoothing and polish from scraping use (striations run perpendicular to the edge).
Archaic	42KA4552	1.1.1	Drill	Columnar piece of quartzite angular shatter (split from the cone of percussion) extensively rounded and smoothed from use as a drill against a hard abrasive substance.
		1.1.2	Cobble tool?	A large flake removed from a quartzite cobble chopper/pounder evidently to refurbish a worn edge; subsequently flaked on ventral surface but no obvious use-wear.
		1.1.3	Cobble scraper-plane or pounder	A quartzite cobble with opposing unidirectionally flaked edges; one edge was used as a scraper-plane (use rounding and smoothing of flaked edge) but most wear traces removed by reflaking with little subsequent use; the flaked edge on the opposite end of the cobble flaked was used for pounding.
		2.1.1	Biface	Stage 2 fragment of coarse Canaan Peak cobble chert that might have been used but lacks obvious and interpretable wear traces.

Table 5.59 (cont.)

Temporal Period	Site No.	Item No.	Artifact Type	Description
		2.1.2	Core	A somewhat discoidal-shaped core of coarse Canaan Peak cobble chert; no obvious use-wear.
		3.1.1	Used flake	A blade-like biface thinning flake of Paradise chert used for cutting on one margin and scraping on the opposite margin.
		3.1.2	Used flake	A flake fragment of Canaan Peak cobble chert (likely core reduction) used for cutting on one margin.
		3.1.3	Used flake	A biface thinning flake from a heat-treated tool of Canaan Peak cobble chert (chalcedonic variety) used for cutting or whittling on one edge.
		3.1.4	Used flake	A probable early stage biface thinning flake of Paradise chert perhaps used for cutting.
		3.1.5	Retouched flake	A flake of heat-treated (or accidentally burned) petrified wood unidirectionally retouched on one margin (after heating), evidently to make a side-scraper; tool broken and portion does not exhibit obvious use-wear.
		3.2.1	Dart point	Small tip portion of Canaan Peak cobble chert, serrated but lacking obvious use-wear; perhaps broken by perverse fracture.
		3.3.1	Biface	Stage 5 biface base of Paradise chert broken by perverse fracture; no obvious use-wear but some production related edge abrasion; well-thinned by percussion flaking with some pressure flaking.
Formative	42KA4749	1.5.1	Cobble chopper	Large quartzite cobble primary flake retouched onto ventral, used as a chopper on two margins.
		2.3.1	Used flake	A small distal end fragment of a used flake of Paradise chert; extensive use-wear traces that seem most consistent with using of the tool in whittling.
		3.1.2	Elko Eared	A recycled point of obsidian (probably a base discarded after the tip snapped); unmistakable differential weathering of the glass, with the flake scars that form the original point highly weathered and those resharpening the blade unweathered (fresh looking); use-wear traces on the retouched tip perhaps from cutting.
Formative	42KA4750	1.1.1	Used flake	A biface thinning flake of coarse chert (Canaan Peak cobble chert?) used on two margins for scraping.
		1.1.2	Used flake	A flake fragment of Paradise chert (likely biface thinning) used on one margin for scraping.
		1.1.3	Used flake	Small segment of a flake of Paradise chert perhaps used for whittling; broken after use, removed from a heat-treated core.
		2.3.1	Core	Fragment of Paradise chert core with many flaws and a large bending break, no obvious use-wear.
		5.3.1	Sand Dune Side-notched?	A whole shallow side-notched dart point of agatized wood badly crazed and discolored by burning; blade serrated but burning has made these less obvious; small part of tip removed by heat spall; no obvious use-wear.
		5.3.2	Arrow point	Midsection fragment of an arrow point (missing stem and small part of tip) of agatized wood; likely Rose Spring Corner-notched; no obvious use-wear; stem snapped off postdepositionally after exposure to fire.
		5.3.3	dart point	Midsection of a probable dart point of Paradise chert used as a cutting tool; use rounding of broken edge at tip shows that the tool was used after this portion snapped off; the other break resulted from bending, perhaps while the tool was in use.
		5.2.4	Biface	Stage 2 biface fragment of Paradise chert; exhibits heavy bipolar attrition on one side and some battering plus large spall initiation on the opposing margin; the wear is consistent with use of the tool as a wedge.

Table 5.59 (cont.)

Temporal Period	Site No.	Item No.	Artifact Type	Description
		5.2.5	Used flake	Quartzite refurbishing flake from a cobble scraper-plane used on one margin for cutting of a hard material.
Formative	Rose Shelter 42KA4794	1.1.2	Cobble pounder/ chopper	Quartzite refurbishing flake from a cobble pounder; retouched along one margin and used for some chopping/pounding task; the unretouched proximal and distal ends also used—the acute distal end for chopping and the rounded platform end for pounding.
		2.1.1	Biface	Tip portion of a stage 5 biface of Paradise chert (perhaps heat-treated) with extensive smoothing and polish of both edges and tip extending onto faces—cutting use; organic residue that looks animal along one edge; broken by a bending break perhaps while using the tool.
		3.1.1	Biface	A recycled stage 5 biface fragment (perhaps a dart point midsection) of heat-treated Canaan Peak cobble chert; differential weathering of flake scars indicates that a biface fragment was scavenged and partially retouched along one margin; no obvious use-wear on reflaked margin but old margin exhibits extensive smoothing and polish from cutting use; tool fragment was heat-treated before being reflaked so perhaps the goal was to produce an arrow point (arrow point production was the principal reduction activity at the site).
		3.1.2	Retouched flake	A core flake of Paradise chert bidirectionally edged along portion of distal edge and extensively used as a cutting tool.
		3.1.3	Retouched flake	A flake of Paradise chert unidirectionally edged along one side but with no obvious use-wear traces; tool is broken; perhaps snapped during the initial stage of pressure flaking to fashion an arrow point.
		5.1.1	Arrow point	Stem portion of an arrow point of Paradise chert that appears heat-treated, likely Rose Spring Corner-notched.
		13.2.1	Used flake	A core flake of petrified wood used for cutting on one margin and perhaps for scraping on another margin.
		14.1.2	Used flake	A blade-like flake of Paradise chert likely detached during early biface thinning; used on both margins for cutting; flake might have been scavenged because of differential weathering of the flake scars.
		14.1.3	Used flake	An early stage biface thinning flake from a heat-treated artifact of Paradise chert; used for cutting on two margins.
		15.1.1	Arrow point	Tiny tip portion of an arrow point made on a flake of heat-treated agatized wood, snapped in production by a bending fracture; no use-wear.
		17.1.1	Retouched flake	Small corner fragment of a retouched flake of heat-treated Paradise chert evidently used as a scraper.
		17.1.2	Arrow point	Stem portion of an arrow point of unknown chert that is discolored and crazed by burning; likely Rose Spring Corner-notched.
		17.1.3	Arrow point	Tip portion of an arrow point of Paradise chert (chalcedony variety), likely heat-treated; smoothing and polish on the tip and edges indicates use of the item from drilling.
		17.3.1	Anasazi stemmed	Point base and midsection of agatized wood, discolored from burning but despite this, it is evident that the tool was made on a flake detached from a heat-treated artifact (likely a biface); no use-wear.
		17.3.2	Arrow point	Barb fragment of an arrow point of heat-treated agatized wood; likely Rose Spring Corner-notched; appears to be made on an old flake/tool that was patinated; no use-wear.

Table 5.59 (cont.)

Temporal Period	Site No.	Item No.	Artifact Type	Description
		19.5.1	Arrow point	Barb fragment of an arrow point of chalcedony (likely heat-treated), perhaps Rose Spring Corner-notched.
		19.6.1	Rose Spring Corner-notched	Midsection of point made on a recycled flake of Paradise chert (clear contrast in the weathering of flake scars); stem and tip are snapped; some use-wear on edges perhaps from use of the tool for cutting but some of this is also from use of the flake before becoming a point.
Post-Formative	42KA4662	1.1.1	Arrow point	Unfinished base portion of an arrow point made on a heat-treated flake of Paradise chert; tip removed by perverse fracture; no use-wear.
		1.1.2	Retouched flake	A flake of Paradise chert that is minimally retouched, possibly used as a scraper but cannot be certain; might be an arrow point production mistake in the early stages of manufacture—the removal of square edges by alternate flaking.
		2.1.1	Arrow point	Barb portion of an arrow point of heat-treated Paradise chert that snapped off during basal notching, in part because of a natural flaw in the stone; likely Desert Side-notched; no use-wear.

exhibits extensive use-wear and is a most interesting tool. It is a percussion-thinned tool with pronounced serrations on both edges; these "teeth" exhibit extensive smoothing and polish from use, but unexpectedly the striations on the rounded and smoothed projections indicate use in a scraping manner perpendicular to the edge. This might be a variation on the denticulate scrapers seen at some of the Kaiparowits Plateau sites (see Chapter 6). The other biface with possible use-traces might well be a type of bifacially retouched tool seen at certain sites on the Kaiparowits Plateau that was not actually part of a bifacial thinning strategy. This is discussed in greater detail in Chapter 6. Tools of this type were flaked bifacially but this seems to have been directed at resharpening rather than thinning, because the artifacts are usually quite thick relative to their width, such that a thinned tool could never be produced.

The five used flakes from the three units at this site constitute four more than were observed during survey, but as the site forms says "doubtless careful inspection or surface collection would reveal many more tools." This is certainly true for used flakes, all but the most obvious of which would be overlooked during survey recording. The flakes were used for both cutting and scraping tasks and most seem to be biface thinning flakes.

The one flaked cobble tool is interesting because it reveals some of the functional variability exhibited by this general tool group, most of which are technologically identical—a unidirectionally flaked cobble used on the prepared edge. This particular tool exhibits an obvious wear-facet that appears consistent with using the tool in some sort of percussive-abrasive task such as pulping or crushing a substance against another stone, especially an abrasive stone such as a sandstone slab.

42KA4552. This Late Archaic and Archaic-Formative transitional site also yielded 12 flaked stone tools. Seven of these, including all of the used flakes, came from around the slab-lined hearth that is radiocarbon dated to the first few centuries of the Christian era. The used flakes exhibit wear traces suggestive of cutting and perhaps these artifacts relate to some activity conducted around the hearth. The retouched tools from around this feature are small fragments evidently broken in production and discarded. The other five tools came from the test unit of the late Archaic midden; these differ in that there are no used flakes and several large nodular tools or cores. Although much tiny flaking debris came from the midden, there are no fragments of pressure-retouched tools, or even advanced stage percussion-thinned bifaces. Perhaps the most interesting tool is the columnar quartzite spall evidently used as a drill. Percussion flaking of quartzite with stone hammers frequently results in shearing of flakes along the axis of percussion and in the process smaller longitudinal spalls can separate, with the item considered here a good

example. In this particular case the spall was evidently hafted and used as a drill against some hard abrasive substance. One of the flaked quartzite cobble tools from the midden exhibits wear traces suggestive of use as a scraper-plane, but most of this evidence had been removed by reflaking of the cobble edge with little subsequent use.

Formative Sites

42KA4749. The one tool of special interest from this site is the recycled Elko Eared point of obsidian. There is an unmistakable difference in weathering between the flake scars that formed the original point and those from much later resharpening and reuse. It appears that the tip of the original point snapped off, leaving about half the base and the original user probably then discarded it. The second user refashioned a tip on the point by pressure flaking the broken end but leaving the base essentially unmodified. The refashioned tip of the point appears to have been used, likely for cutting. With obsidian it is usually easy to identify the recycling of old points because glass weathers quite rapidly when lying on the ground surface, but with chert this is not always the case, especially without the aid of a microscope.

42KA4750. The more formal flaked tools from this site come from the test unit of the midden deposit on the slope, whereas the test unit at the base of the rock escarpment yielded three used flakes and a core. The used flakes reveal a diversity of tasks. Two dart points and an arrow point came from the midden test unit. One of the points is whole but badly crazed from burning; it is tentatively identified as Sand Dune Side-notched, an early Archaic type that would be out of place here unless scavenged. The burning of this item precludes identification of differential surface weathering on flake scars, as with the Elko Eared point from the previous site. The other dart point is a midsection fragment with cutting-related use-wear that extends over the broken edge at the tip, showing that the tool was used after this portion snapped off. The arrow point is a midsection fragment that was discarded with just its tip missing, but that subsequently was exposed to fire and then had its stem removed post-depositionally (perhaps even during excavation) because the stone was crazed and weakened. The stem was not recovered in the test unit but the overall morphology is consistent with a Rose Spring Corner-notched. The Stage 2 biface fragment is interesting because it exhibits clear evidence of having been used as wedge.

42KA4794. Rose Shelter yielded the most flaked stone tools, 17 in all, as well as the most flakes. Almost half of the tools are arrow point fragments, most snapped in production, but there are also bases. Not included in the count is the arrow point base recovered from the shelter during the Phase 1 survey, a base with pitch still adhering to it (Geib, Huffman and Spurr 1999:Figure 5.28). The arrow point production fragments are expectable given the flake assemblage, which is dominated by pressure flakes, including many obviously removed from flake blanks. The debitage and point fragments are consistent with use of the shelter for retooling hunting equipment. Broken arrow points were removed from foreshafts and replaced by new points made on location.

Four of the tools from this site exhibit differential weathering which indicates the scavenging of old flakes and tools for reuse. Three of these are old flakes, with two of them being fashioned into arrow points (17.3.2 and 19.6.1) and one simply used as a cutting tool. The fourth example is a biface fragment that exhibits extensive use-wear on an old margin but none on the opposing reflaked margin—perhaps this item was collected to be reflaked into an arrow point but was discarded after some initial effort.

One of the interesting aspects of the tool and flake assemblage from this site is that all but one of the points and nearly all of the flakes would have been lost if we had not used 1/8" mesh. The other site where this is especially obvious is the Post-Formative hunting camp 42KA4662. Artifact loss would not be a problem if it did not alter our understanding of what took place in prehistory, but had we not used 1/8" mesh at Rose Shelter and the Post-Formative hunting camp, the lithic reduction activity at both sites would appear vastly different. Gone would be the arrow point fragments and pressure flakes from point production.

Post-Formative

42KA4662. This was the only Post-Formative site from which testing recovered flaked stone tools. These consist of two arrow point fragments broken in production and a marginally retouched flake that might have been a flake blank for an arrow point or perhaps a simple tool. Surveyors observed a single arrow point tip fragment around

the hearth tested at this site, one that exhibited no patina and weathering. Based on this find, combined with the presence of surface charcoal pieces and unburned bone, the site was assigned a Post-Formative temporal affiliation. This assignment is substantiated by a radiocarbon date on one of the bones from around the hearth, and one of the recovered arrow point fragments provides corroborative evidence. This fragment (2.1.1) is a barb portion removed by a production mistake while basal notching. The mistake was perhaps unavoidable, in that a small natural flaw in the stone was the evident point of initiation for the fracture. Desert Side-notched is the single arrow point type of the region that was basally notched. The other arrow point might be classified as Cottonwood triangular, but it was broken in production (tip removed by perverse fracture) and was most likely intended to be a Desert Side-notched. This point fragment and the tip portion noted during survey were made on thin flakes that had been heat treated and then pressure flaked to final form. The flake blank surfaces remaining on the unfinished points have a matte surface, whereas the pressure flake scars forming the point are lustrous. Many of the pressure flakes from the site also exhibit differential luster on their dorsal surfaces, clearly indicating removal from thin, heat-treated flake blanks.

GRINDING TOOLS AND OTHER STONE ARTIFACTS

Testing recovered several small fragmentary examples of grinding tools and a few other miscellaneous stone artifacts. Because there are so few items, each is described individually. For this same reason, there are no meaningful statistical manipulations; the most convenient and useful way to present the data is in a table (Table 5.60). Some discussion of individual items or groups of items is presented below as warranted.

The discussion of grinding tools is limited primarily to observations on the extent of their preservation, which directly relates to the goals of the testing project. Except for the mano from the Formative site 42KA4750, all of the tools are small fragments, but those from the Archaic sites also have poorly preserved use-surfaces. The metates not collected from several of the Post-Formative sites are exceptionally well preserved, whereas all of the grinding tools at the Archaic sites are like those recovered from testing—small, badly weathered portions.

The most interesting of the other stone artifacts is the possible atlatl weight (PN5.4) from the Formative site 42KA4750 (Figure 5.32). This well-made siltstone artifact is polished from extensive handling. The speculation that it might have served as an atlatl weight is based on its one flat side as well as the degree of production investment and handling polish. All atlatl weights that the analyst has seen from Southwestern sites have a flat side to ensure firm contact against the wood to prevent slippage. While the rest of the recovered remains and the ^{14}C date are indicative of a Formative occupation, the site easily could have an earlier component, dating to a time when atlatls were more likely to have been used.

Another interesting stone artifact is what appears to be a jar cover fragment; it came from slumped deposits of Rose Shelter. This is a thin slab of sandstone that had been shaped into a circle roughly 18–19 cm in diameter. Slabs similar to this have been found placed on utility jars as lids, sometimes held in place with clay.

CERAMIC ARTIFACTS

The testing project recovered a total of 10 sherds from two sites: eight from 42KA4750 and two from Rose Shelter. These sherds were analyzed like those collected from survey, so Chapter 6 should be consulted for methods and a general discussion about ceramic types. Here we present just the descriptive details of the collected sherds by each site.

42KA4750

Five of the eight sherds collected during testing at 42KA4750 were from the test unit located next to the shallow overhang (Unit 2), two came from the test unit of the midden deposit (Unit 1), and one was from the surface next to this test unit. During the Phase 1 survey, NNAD archaeologists collected a nip from the latter sherd. There are three jar sherds of Emery Gray: one from Unit 1 and the surface specimen, both of which might come from a single vessel, and one from Unit 2. These three sherds are the only examples of Fremont pottery found during the testing project and they are clearly derived from at least two different vessels based on differences in temper. Both of the midden sherds are tempered with the somewhat glassy basaltic andesite that is common to the Escalante River basin (Geib and Lyneis's [1996] temper type A), whereas the third sherd contains a more granular salt-and-pepper basaltic

Table 5.60. Descriptions of the grinding tools and other stone artifacts recovered from the tested Kaiparowits Plateau sites.

Temporal Period	Site No.	Item No.	Artifact Type	Description
Archaic	42KA4548	1.2	Slab metate	A small interior fragment; medium grain Kaiparowits Formation sandstone that is badly weathered; used on one face, no obvious peck marks, 2.1 cm thick.
	42KA4549	1.1.4	Stone disk (gaming piece?)	A whole sandstone disk ground to shape around entire circumference and on one face that is slightly convex; the opposite face is slightly convex and appears natural; somewhat polished around entire margin, perhaps from handling (?); 15.5 mm in diameter and 3.2 mm thick; made of medium grain Kaiparowits Formation sandstone.
		1.2	Slab metate	3 interior fragments from a probable single tool; medium grain Kaiparowits Formation sandstone that is poorly preserved and caliche encrusted; used and pecked on both faces, one of which has a slight basin; 2.1 cm thick.
		3.3	Slab metate	A small interior fragment; medium grain Kaiparowits Formation sandstone that is poorly preserved; used and pecked on one face; 1.8 cm thick; might or might not be from slab metate 1.2 above.
Formative	42KA4749	1.4	Mano	An end fragment (partial) of coarse, non-local vesicular sandstone; appears burned and somewhat discolored; preserved thickness is 5.5 cm but lightly thicker towards tool middle; used on one face which has a slight rocker use-bevel (use of other face indeterminate); because of vesicularity use surface not pecked; likely a one-hand mano.
	42KA4750	1.2	One-hand mano	Whole and rectangular shaped, well made and heavily used on both faces; pecked on the faces and around the margins; 12.1 cm long, 9.1 cm wide, and 2.4 cm thick; made of dense medium grain sandstone that does not appear immediately local.
		5.4	Atlatl weight (?)	An end fragment of a well made stone cylinder with one flat side (D-shaped in cross-section); made from a hard siltstone; exhibits production striations that are somewhat obscured by polish from extensive use/handling; original length is unknown, but the fragment measures 1.4 cm long; it is 1.7 wide and 1.6 cm high; there is a 3 mm diameter hole near the center of the intact end that is ca. 1.5 mm deep; the curving outer margin of this end exhibits a series of small incised grooves—10 are obvious with 3 other possible examples.
	Rose Shelter 42KA4794	1.2.1-1.2.2	Slab metate	2 interior fragments from a single tool (no refit) of well-cemented, non-local fine grain sandstone; used and heavily pecked on one face; 3.0 cm thick; these match a small fragment from the Fea. 1 hearth (PN17.5), and because both are also ash discolored the tool likely originated in this feature.
		1.2.3-1.2.4	Slab metate	2 fragments (corner and edge) from a single tool (no refit) of local medium grain Straight Cliffs Formation sandstone; used and heavily pecked on one face; 4.2 cm thick; discolored by burning.
		4.2		Jar lid (?); a fragment of a shaped circular piece of thin sandstone roughly 18-19 cm in reconstructed diameter; fragments represents ca. 1/5 of the original artifact; the slab measures 1.6 cm thick and was roughly spalled to shape.
		17.5		Slab metate, small interior fragment that is also split along bedding plane—identical non-local sandstone as the metate fragments of PN1.2.1&2 and no doubt from the same tool.
Post-Formative	42KA4732	2.2		Slab metate, 4 burned interior fragments from a probable single tool of medium grain local Straight Cliffs Formation sandstone; used but not pecked on one face, the grinding surface of which is well preserved even though burning has made the sandstone more friable; 5.3 cm thick.

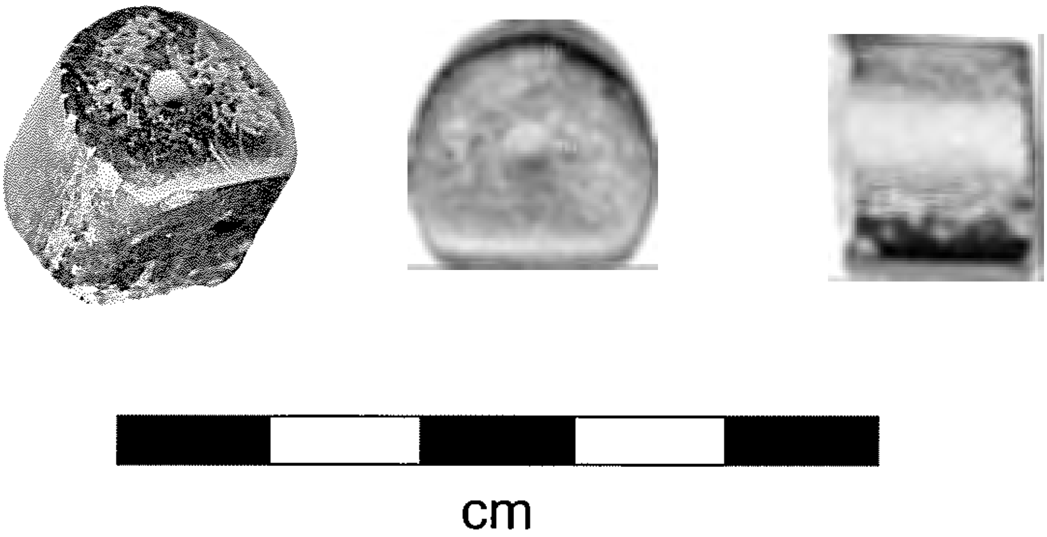


Figure 5.32. Possible atlatl weight from 42KA4750.

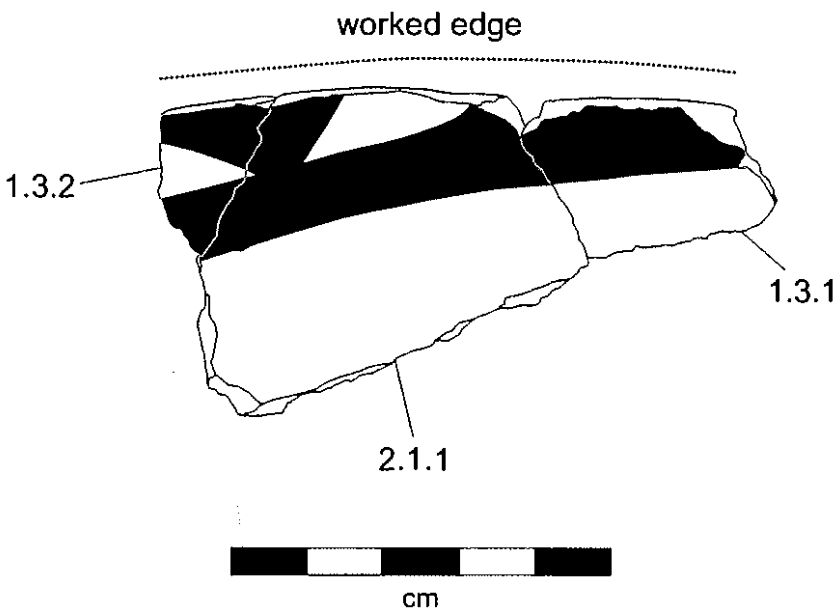


Figure 5.33. Worked North Creek Black-on-gray bowl sherd from Unit 2 of 42KA4750.

andesite like that common to the San Rafael Swell (Geib and Lyneis's [1996] temper type C).

The other five sherds from the site appear to be from a single North Creek Black-on-gray bowl with a fugitive red exterior; indeed three of them refit. The refitting sherds are all part of a fragment with a worked edge (Figure 5.33). The two portions that do not refit are small but they have identical paste, temper, surface color, and fugative red slip. One of these non-refitting portions came from the midden test unit, but all other fragments came from the unit next to the overhang. The worked edge, which has a length of slightly over 8 cm, is somewhat rounded from abrasion but not like that used as a pottery scraper. This item might have been used as some sort of scoop and was perhaps a much larger vessel portion before breaking and being discarded. The largest fragment of this artifact came from the same provenience as the radiocarbon dated juniper seed. With a two-sigma calibrated age range of A.D. 1035–1250, this date accords well with the postulated temporal span for the use of North Creek Black-on-gray on the Kaiparowits Plateau.

Rose Shelter (42KA4794)

Test excavations recovered two sherds from this shelter: one from slumped deposits so its relation to site stratigraphy is unknown and one from the upper ashy deposits of Feature 1 at the top of Stratum 2. The unprovenienced sherd is a poorly finished decorated jar sherd with watery carbon paint that is probably North Creek Black-on-gray. It has a white paste with quartz sand temper and lacks a carbon streak. The other sherd is unclassified; it is from a plain utility jar with brownish paste (7.5YR4/3, dark brown) and angular coarse quartz temper. The exterior is rough and temper protrudes, but it also appears that the exterior was wiped while the clay was still wet with something like a brush. Oxidation of the sherd in a kiln to 950°C turned the paste to red, 10R5/8. This sherd appears similar to some early Formative (BMIII) sherds from the Escalante River basin.

PERISHABLE ARTIFACTS

As might be expected, the only perishable artifacts came from Rose Shelter. This was the only sheltered site tested where one might expect to find such artifacts. The deposits of Rose Shelter where we tested were semi-damp, both because of ground water moving through the back of the shelter and because of dripline erosion. Indeed, loss of deposits from dripline erosion was one of the motivating factors for the testing program. Despite the less than fully dry conditions, two perishable artifacts as well as various nonartifactual plant and animal remains were found. Preservation doubtless improves further back within the shelter from our test units, thus there is every reason to suspect that additional perishable artifacts are preserved within the site and that the two reported here are merely a sampling. This said, the shelter is not likely to contain a trove of perishable artifacts given both its small size, the thinness of its deposits, and the apparent use of the site as a hunting camp. The two perishable artifacts recovered from the shelter consist of an arrow shaft fragment (PN13.1) and a piece of string (PN19.1). Each of these is described in turn with Figure 5.34 showing both.

The arrow shaft fragment is a piece of common reed (*Phragmities* sp.) ca. 20 cm long and 0.9 cm in diameter near the one joint. The piece is split lengthwise and broken at both ends. The reason that we are certain it is an arrow shaft fragment is the band of red pigment present at one of the broken ends. The pigment band is minimally 7 mm wide. Immediately adjacent is a band of clean (unstained) reed that must have been wrapped with sinew or some similar sort of binding; examples of this sort of clean band where a wrap once was are commonly seen on certain wooden artifacts. There are no other signs of wraps on this fragment. Painted arrow shafts are quite common in both the ethnographic and archaeological record of the Southwest (e.g., Fowler and Matley 1979:Figure 50; Cosgrove 1947).

The string fragment is a Z-cabled piece made of yucca fibers; it measures about 45 cm long and 4 mm in diameter. It is frayed at both ends and in places the string is somewhat damaged by ground moisture. The yucca fibers are well prepared but not finely shredded as is commonly seen in many Basketmaker yucca strings. The cord consists of two Z-spun yarns that are S-plied together, then two of these plies are Z-cabled to make the final form of the string: the notation is zS2[Z]2 after Wendrich (1991:30–32).

TESTING CONCLUSIONS

Alternative Dating Methods

The radiocarbon dates obtained thus far tend to support the relative temporal placement of the sites that were proposed based on alternative dating methods. The two dated sites thought to

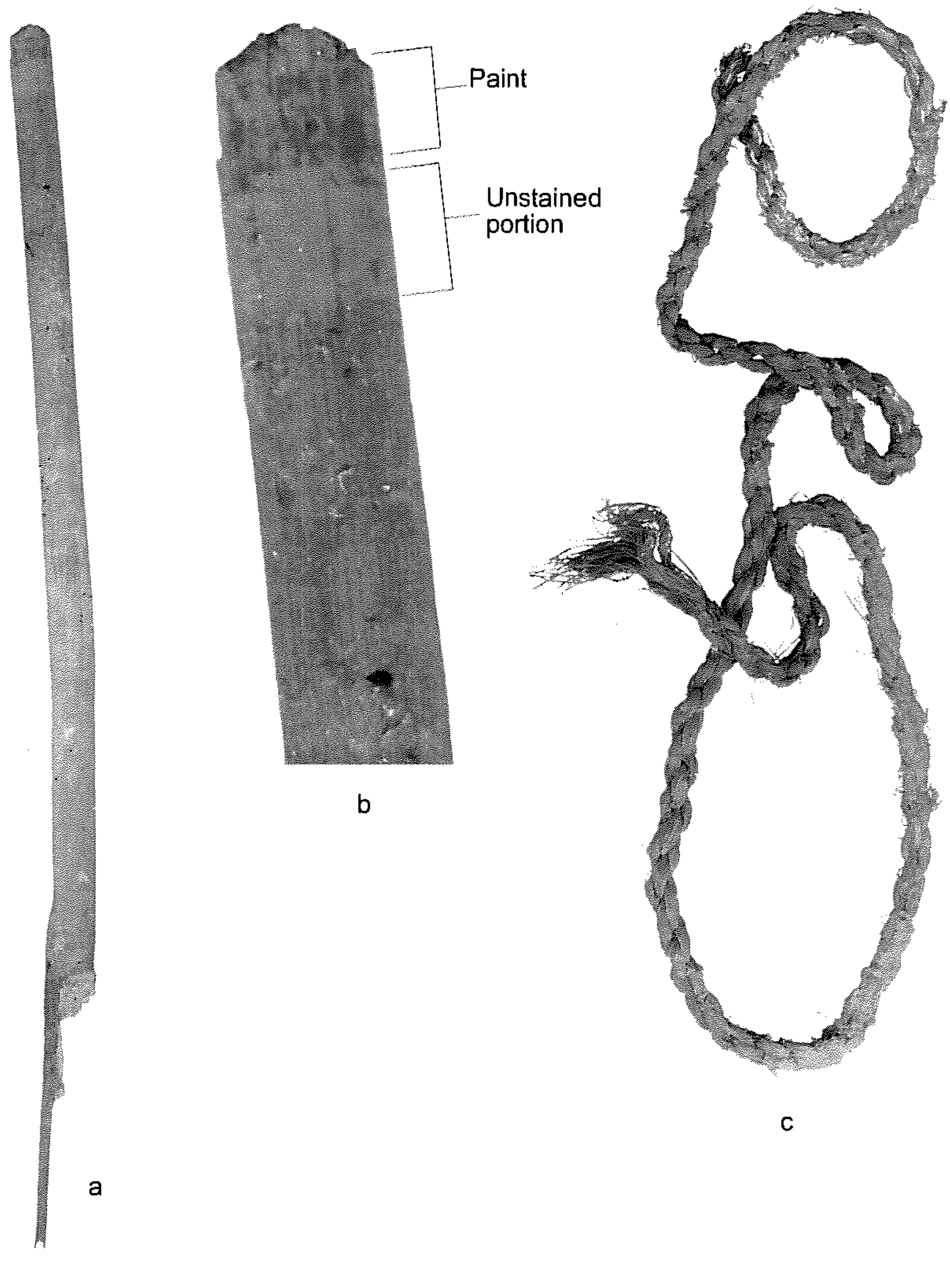


Figure 5.34. Perishable artifacts recovered from Rose Shelter (42KA4794): a) arrow shaft fragment of common reed; b) close-up of arrow shaft showing painted end; c) Z-cabled cordage of yucca fibers, $zS_2[Z]_2$.

have been Post-Formative—42KA4575 and 4622—have radiocarbon ages that place them in the interval between A.D. 1400 and about 1900. The two dated sites thought to have been Formative—42KA4749 and 4750—have radiocarbon ages that place them in the interval between A.D. 200 and 1200. Finally, the two dated sites thought to have been Archaic—42KA4547 and 4522—have radiocarbon ages that place them in the interval between 2500 B.C. and 400 A.D.

The most important clues to the relative age of sites appear to be the presence/absence and relative size of surface charcoal in hearths and middens, the presence/absence of weathering and patination on flakes and flaked stone artifacts, and the degree of erosion and dispersion of remains, including grinding tool fragmentation and weathering. At the most recent end of the temporal spectrum are the two sites that produced radiocarbon dates within the last several hundred years, 42KA4575 and 4622. Both sites had hearths with charcoal chunks exposed on the surface and low dispersion of remains. The latter was especially true for 42KA4622, where there was a dense concentration of flakes and bone within a meter of the hearth. The hearth charcoal exposed on the surface of both sites was noticeably larger and better preserved (more angular) than the hearth charcoal exposed on the surface of the two dated Formative sites, 42KA4749 and 4750. At the Formative sites the surface charcoal consisted of tiny pieces (flecks), nothing that one would refer to as chunks. The Archaic sites lacked surface charcoal altogether. The dated hearth at 42KA4547 consisted of a black circular charcoal stain; even subsurface charcoal was scarce in this feature. The dated midden at 42KA4522 had moderately dark sediment from charcoal staining and included abundant burned rocks and a few pieces of burned bone, but no surface charcoal pieces. The dated hearth at this site likewise consisted of a dark charcoal stain without any surface charcoal pieces. Our observations on charcoal condition are not quantified, and this might be something worth attempting in the future, but these general observations appear adequate at present for the sort of relative temporal ordering of remains that is useful during survey.

Of course, evaluation of surface charcoal at open sites requires features, and the majority of sites on the Kaiparowits Plateau lack features. Thus, relative temporal ordering of sites based on artifacts is clearly important and in this regard patination of flakes and flaked stone artifacts and the extent of grinding tool fragmentation and weathering clearly seem useful. At both sites dated to the Post-Formative period (42KA4575 and 4622), the flaking debris was unpatinated and unweathered; as we frequently said in the field and mentioned on site forms, the artifacts looked "freshly" flaked. At 42KA4575 the freshly flaked stone artifacts or those with pristine unweathered surfaces included an obsidian flake and scraper. Obsidian is particularly useful in such an evaluation because of how its surface becomes abraded (pitted), faded, and dull in appearance with prolonged surface exposure. Chert weathers less quickly than obsidian, so Formative age debitage also commonly had a freshly flaked appearance. This is not true of most Archaic age sites including the two that are radiocarbon dated (42KA4547 and 4522). Many of the flaked stone artifacts at these sites appeared patinated and those that were not obviously patinated nonetheless appeared weathered (not freshly flaked). Added to this is the condition of grinding tools. At both of the Archaic sites grinding slabs were highly fragmented and weathered, consisting of pieces smaller than a hand. At 42KA4522 the grinding slab fragments occurred in the late Archaic midden. In marked contrast were the whole, well-preserved grinding slabs at the Post-Formative sites, including the dated site 42KA4575 (the tested but undated site 42KA4732 had two well-preserved grinding slabs).

Of course, no matter whether one is using traditional diagnostics or various alternative methods such as those examined here, it is essential not to consider single pieces of evidence in a vacuum but to consider as many strands of evidence as possible. The stray Pinto point on an otherwise Anasazi-looking sherd and lithic scatter is inadequate evidence for proposing two components, but if the point occurs on a portion of the site with patinated flakes then the case for two components would be greatly strengthened. Likewise the best relative temporal placements are those based on several corroborative lines of evidence. At the Post-Formative site 42KA4622 the congruent evidence consisted of (1) surface charcoal chunks, (2) debitage that looked freshly flaked and an arrow point tip, (3) tight clustering (minimal dispersion) of remains around the feature, and (4) unburned, well-preserved bone on the surface. At the Post-Formative site 42KA4575 the converging lines of evidence consisted of (1) surface charcoal chunks, (2) debitage that looked freshly flaked, including obsidian artifacts, and (3) a complete, well-preserved grinding slab. In contrast, the late Archaic sites (42KA4547 and 4522) had a similar (1) lack of

surface charcoal chunks within intact features, (2) debitage that was mostly patinated or otherwise looked weathered (not freshly flaked), and (3) badly fragmented and weathered grinding slabs. In addition, the remains at 42KA4547 looked badly eroded (deflated and sheet washed) and perhaps size-sorted due to slope wash.

Feature Types

Another important reason for testing Phase 1 sites was to better understand the nature of various features recorded on the Kaiparowits Plateau. One of our interests was with features identified as middens (or possible middens) at nine of the Phase 1 sites (eight of which were considered Archaic). These features consisted of extensive, dense concentrations of burned rock (sandstone chunks and alluvial cobbles), debitage and flaked stone tools (sometimes crazed and spalled), frequent grinding tools, and occasional burned bone; these remains at some sites occurred in a matrix of obvious charcoal-stained soil (Feature 1 of 42KA 4552 for example) but at other sites charcoal staining was absent or at least subtle (Feature 4 of 42 KA4547 for example). In the Phase 1 survey report we (Geib, Huffman and Spurr 1999:5–84) speculated that these features may constitute refuse areas for discarded hearth and roasting pit fill and artifacts. As such, they may denote sites of more intensive or longer-term use, such as seasonal base camps. Alternatively, the middens may represent an aggregate of multiple thermal features, or one large, diffuse roasting feature.

All four of the tested Archaic sites on Long Flat had middens, although at one of these (42KA 4548) surveyors did not specifically identify the feature as a midden. At this site, a test unit revealed that what had been recorded as three separate features was actually part of a single burned rock and artifact scatter that appeared different based on natural processes (burial by eolian sand and differential erosion). At only one of the sites, 42KA4552, was the midden intact, and even here there was evidence for some loss of deposit depth (thickness) from deflation or slopewash. Nonetheless, the test unit revealed that the midden deposit at this site had a minimum depth of 18 cm and throughout it contained burned rock, artifacts, burned bone, and charcoal in a dark charcoal-stained and flecked clay deposit. The subsurface nature of the deposit duplicated its surface appearance, thus use of the term midden to describe this deposit seems well justified. We also believe that this is true for the other three Archaic sites, but that the middens at these sites had deflated, leaving the imperishable burned rocks and stone artifacts as a lag deposit on thin underlying residual sediment. Deflation eliminated charcoal and burned bone and left the artifacts and burned stone on a single surface, but with some exceedingly high densities (up to 313 flakes per unit in the midden at 42KA4549). It seems most likely that the midden at 42KA4552 was intact primarily because it occurred on a clay slope, whereas the deflated Archaic middens occurred on loose sandy substrata prone to deflation.

We believe that the midden deposit at 42KA 4552 and the other Archaic sites was not simply the result of secondary refuse disposal as at a Puebloan habitation. Rather, the middens were probably activity areas where debris accumulated in abundance but incidentally while conducting various cooking, processing, and production tasks. So for example, we believe that horizontal exposure of the intact midden at site 42KA4552 would disclose a series of discrete hearths or roasting pits scattered throughout the deposit. The single unit within the midden at this site did not disclose any evidence for in situ burning but a good example of this scenario of features-within-and-creating-a-midden is provided by the test unit in Feature 1 at the Formative site 42KA4750. We thought that this unit would simply provide a sample of what appeared to be a midden deposit, but it exposed part of one hearth and perhaps a second. In this case, there was no doubt that the deposit of burned rocks and artifacts within a matrix of charcoal-stained soil was in large part the result of in situ activity (such as cooking, tool use, and reduction), rather than just secondary deposition.

The tested hearths revealed more diversity than anticipated, at least in details that probably relate to differences in feature function or to the types of food that were cooked or processed. The Feature 1 hearth in Rose Shelter was the only one that clearly had free access to air (was not smothered) and likely served more like our modern campfires—as a source of warmth and light as well as for cooking (in this case for game). The fill of this hearth consisted almost entirely of white to light gray ash, with a thin charcoal layer only at the very bottom of the feature where air could not reach. The fires or hot coals of the other tested hearths had clearly been smothered, evidently in some sort of cooking process, resulting in abundant charcoal. Of course, the charcoal was often reduced to dust and flecks by roots, wetting and drying, insect and rodent burrowing, and other

post-depositional processes, especially in the oldest features. Some of the basin hearths contained no burned rocks, some had abundant burned rock, and some clearly had a layer of sediment that had been purposefully placed over the hot coals. Two of the Post-Formative hearths were surface features with topographic expression above the ground rather than depth below the ground. These features were seen only on the most recent forager sites. Given the evident extent of deflation of Archaic age sites, if these earlier foragers commonly created similar features, there is exceedingly little chance that they would have been preserved over the millennia. Both of these surface fires involved lots of rock that was placed on and mixed with the hot coals and both seem to have been used for cooking game based on the animal bone that occurred in and around each feature.

Deflation and Erosion

Somewhat related to the previous topic, particularly with regard to whether scatters of fire-cracked rock were eroded hearths or middens, is the extent of deflation and erosion of Kaiparowits Plateau sites. Many of the Phase 1 sites seemed badly deflated, with artifacts resting as a lag deposit; this appeared especially true for sites with a probable Archaic temporal affiliation. The testing project confirmed that those Archaic sites thought to have been deflated were indeed deflated, with artifacts and FCR resting as a lag deposit (sites 42KA4547, 4548, and 4549). Portions of two of these sites (4548 and 4549) had been covered by eolian sand, but testing revealed that this sediment simply buried already deflated areas rather than covering intact deposits. The one tested Archaic site not deflated and eroded was 42KA4522, and this was evident from survey; the likely reason for preservation in this case, as mentioned previously, was the clay matrix of the site.

Despite extensive deflation and erosion that rendered entire site assemblages as lag deposits, we believe that many of these sites still retain certain aspects of integrity that make them important sources of archaeological data for understanding prehistory. An intriguing finding of the testing program is the presence of charcoal-stained sediment and charcoal flecks in rodent and bug holes underlying eroded features. We believe that this is more than just happenstance, that the stained and flecked fill of these burrows is cultural fill intruded down from overlying features and deposits when they were intact, prior to being deflated. Anyone who has excavated prehistoric features has observed that rodent and bug holes below features of all ages commonly contain cultural fill. As the critters dig down through hearths or middens or structures, they intrude cultural deposits into lower, culturally sterile sediment. In this particular case we suggest that the animal burrows served to bring cultural fill down to a depth below the level of deflation and thereby preserve some charcoal for making age determinations. This might seem to be a classic case of trying to make a silk purse out of a sow's ear, but if we are interested in using the surface archaeological record on the Kaiparowits Plateau to inform about Archaic foragers it perhaps behooves us to find creative ways to squeeze as much information as possible from sites. This might include relying on charcoal found below eroded cultural features to provide some degree of chronometric control.

Another aspect revealed by testing is the larger-than-anticipated size of the artifact assemblages at some sites. Despite being deflated, some sites have far more remains than were evident from the surface, and thus they can have a greater amount of lithic technological and functional information than previously realized. For example, the test units at 42KA4549 recovered from 97 to 313 flaked stone artifacts per square meter, far more than were apparent from the surface; the site form lists a maximum density of 10 artifacts per square meter. By extrapolating from the three test units it is likely that this one site contains a lithic assemblage with tens of thousands of flakes and a few hundred flaked stone tools. The sheer size of the assemblage at this and other tested Archaic sites promises to provide a wealth of information. This is even more the case at a site like 42KA4549 because it appears that erosion dropped the remains vertically but did not move them much horizontally. As such, the site likely retains a moderate degree of spatial structure with regard to activity patterning or differential site use through time. Of course, 42KA4549 is situated on moderately level terrain, whereas sites on slopes, such as 42KA4547, appear to have horizontally displaced and perhaps size-sorted assemblages.

CHAPTER 6

SUMMARY OF NATIVE AMERICAN ARTIFACTS AND FEATURES

NNAD's sample survey of the Kaiparowits Plateau resulted in documentation of 710 archaeological sites and 816 isolated occurrences. Of the site total, 670 are Native American, 19 have both Native American and Euro-American components, and 21 are Euro-American only. For the isolated occurrences, 754 are Native American and 62 are Euro-American. The intent of this chapter is to provide an overall descriptive characterization of the Native American artifacts and features documented by the survey. The following chapter discusses site types and their distribution across the project area, and Chapter 8 presents synthetic summaries of the major Native American temporal periods. The isolated occurrences are discussed to some extent herein, but the emphasis is on remains documented as sites (689 total). Euro-American remains recorded as sites (40) and isolated occurrences (62) are discussed separately in Chapter 9. The summary data presented in this chapter on tools and features come principally from a database that we created from the site forms (see Appendix B), which greatly facilitated data manipulation in SYSTAT. Some information was obtained by directly querying the site form database. This chapter is organized into several parts beginning with a discussion of stone tool raw materials and ending with features.

STONE TOOL RAW MATERIALS

Stone artifacts comprise the bulk of cultural remains found during the Kaiparowits Plateau Survey. Even at the few dozen Anasazi structural sites that we recorded, stone artifacts are more numerous than ceramics. Except for a few isolated hearths and storage features, every prehistoric site is chiefly characterized by a scatter of stone flaking debris and tools. Because of this, stone tool raw materials, production technology, and functional classes are important aspects of the archaeological record that require definition and description. Here we detail the stone tool raw materials commonly used by inhabitants of the Kaiparowits Plateau, followed by a discussion of important reduction objectives and strategies.

Prior to the start of NNAD's survey, we had some indication that material for flaked stone tools occurred on the Kaiparowits Plateau. Kearns (1982:74) mentioned that the Quaternary gravel deposits distributed sporadically across the northwestern portion of the plateau were "prime sources for stone tool materials." More specifically, he stated that "the Quaternary pediments on Horse Mountain contain numerous lithic materials in the form of cobbles. These include cherts and chalcedony in addition to limestone, quartzite, and miscellaneous igneous materials" (Kearns 1982: 74). Nevertheless, the abundance of raw materials for flaked stone tools on portions of the plateau still came as something of a surprise. This is especially true for coarse, tough materials such as quartzite, various igneous rocks, and metasediment.[1] Well-rounded alluvial cobbles of these materials comprise the vast bulk of the Quaternary gravel deposit draped across the entire top of Horse Mountain and extending down onto the north edge of Long Flat. The cobbles pave the surface of every major wash draining from Horse Mountain and Canaan Peak; the largest of these drainages—Wahweap, Last Chance, Right Hand Collet, and Alvey Wash—carry the cobbles their entire distance until emptying into the Colorado River (or the Escalante River and then the Colorado in the case of Right Hand Collet and Alvey Wash). These cobbles of tough rock were commonly exploited for heavy-duty tools such as choppers, pounders, and scraper planes. Chert alluvial cobbles occur mixed with the coarse materials but in substantially reduced proportions. Partially co-occurring with the alluvial cobbles are nodules of mottled white chert grading to chalcedony. The nodules are highly angular and have lag cortex, clearly indicating a different primary source than the alluvial cobble chert. This material occurs on Horse Mountain and the high ridge that separates

[1]Some of the rocks that we call metasediment might be classified during laboratory analysis as fine-grained igneous. The metasediment cobbles are mostly green and black to dark gray in color.

Paradise Canyon from Escalante Canyon. One rich deposit of this material was encountered just outside Survey Unit 73 on Paradise Bench, and others likely occur in this general area. Nodules of this chert and chalcedony also occur within the south-flowing washes that drain these features—Wahweap and Last Chance. As one travels down the large washes away from the gravel deposits on Horse Mountain, the quantity and size of chert and chalcedony nodules and cobbles are reduced. In cobble deposits on the floor and alluvial terraces of Wahweap Creek where it crosses East Clark Bench, chert and chalcedony still occur, but small nodule size and rarity probably limited exploitation here to chance finds.

Lacking specific descriptions of the lithic resources local to the Kaiparowits Plateau, especially the chert and chalcedony, NNAD field crews were uncertain when the survey began as to which materials were local and which nonlocal. By the second session of Phase 1 fieldwork, we had a moderate understanding of this and by the third session, local materials were well known. We collected samples of various rock types to characterize the materials and conduct limited reduction and heat-treatment experiments. The second phase of fieldwork helped to round out our understanding of the local materials as well as provide an opportunity to sample a few materials from off the Kaiparowits Plateau. The various material types available in the area are described below, with the greatest detail furnished for those materials that we sampled and experimented with. Figure 6.1 maps the known source locations for the principal resources; it must be realized that extensive exploration of the area might add to the distribution on this map. Also, the map does not include the materials in and along drainages.

Local Flaked Stone Resources

NNAD's survey helped to document the diversity and distribution of flaked stone tool raw materials available on the Kaiparowits Plateau. Portions of the plateau are mantled by gravel deposits that contain cobbles of a great variety of rock types, including chert, chalcedony, quartzite, dense silicified mud- and siltstone that we called metasediment, and coarse igneous porphyries. Kearns (1982:74) found a similar array of raw materials in the northwest portion of the Kaiparowits Plateau, a rugged area of narrow ridges and deep ravines and canyons. There are three principal local resource groups: a mottled white chert/chalcedony that we have named Paradise chert, alluvial cobble chert from the Canaan Peak Formation, and coarse alluvial cobbles of diverse rock type from this same formation. Weakly silicified siltstone is a fourth local material that had limited use and was mainly restricted to Smoky Mountain.

Paradise Chert

Included in this material type are nodules of mottled white chert and chalcedony;[2] they are lumped together because it appears that both originated from the same primary deposit and single nodules can grade from a chert to a chalcedony. There are nodules that are either chert or chalcedony, but there are also nodules that are a mix of both. It appears that white chert is more common than chalcedony at the source locations, and flaking debris of white chert seems more common than chalcedony flaking debris at most prehistoric sites of the area, though there are sites where the reverse is true. The white chert is usually mottled, with abundant angular or amorphous cream to yellowish to pale brown opaque inclusions (or blotches) within a matrix that is more translucent and chalcedony-like (Figure 6.2). The chalcedony has these same blotches, but usually fewer of them and they are more translucent like the matrix rather than opaque. Some chalcedony nodules have few inclusions or blotches or ones that are small and somewhat translucent thus less noticeable.

The nodules of Paradise chert/chalcedony range in size, with the largest example observed measuring 18 cm in maximum dimension. It is possible that even larger specimens exist. Hand-sized nodules, those that measure roughly 10 cm in maximum dimension, or smaller seem most common. The nodules are highly angular and have a white patinated lag deposit cortex; they have not been transported far from their primary deposit in washes or streams. Although nodules of white chert and chalcedony appear to be partially coextensive with deposits of alluvial cobbles, they clearly have a different origin. Moreover, at a large scatter of nodules just north of Survey Unit 73 on Paradise Bench the chert was found largely by itself without the alluvial cobbles. The primary source for the white chert/chalcedony remains unknown but it might be derived from the pink to white freshwater limestone of the Canaan Peak or

[2]We use the standard archaeological definition of chalcedony as a semitranslucent to translucent cryptocrystalline silicate, whereas chert is an opaque cryptocrystalline silicate.

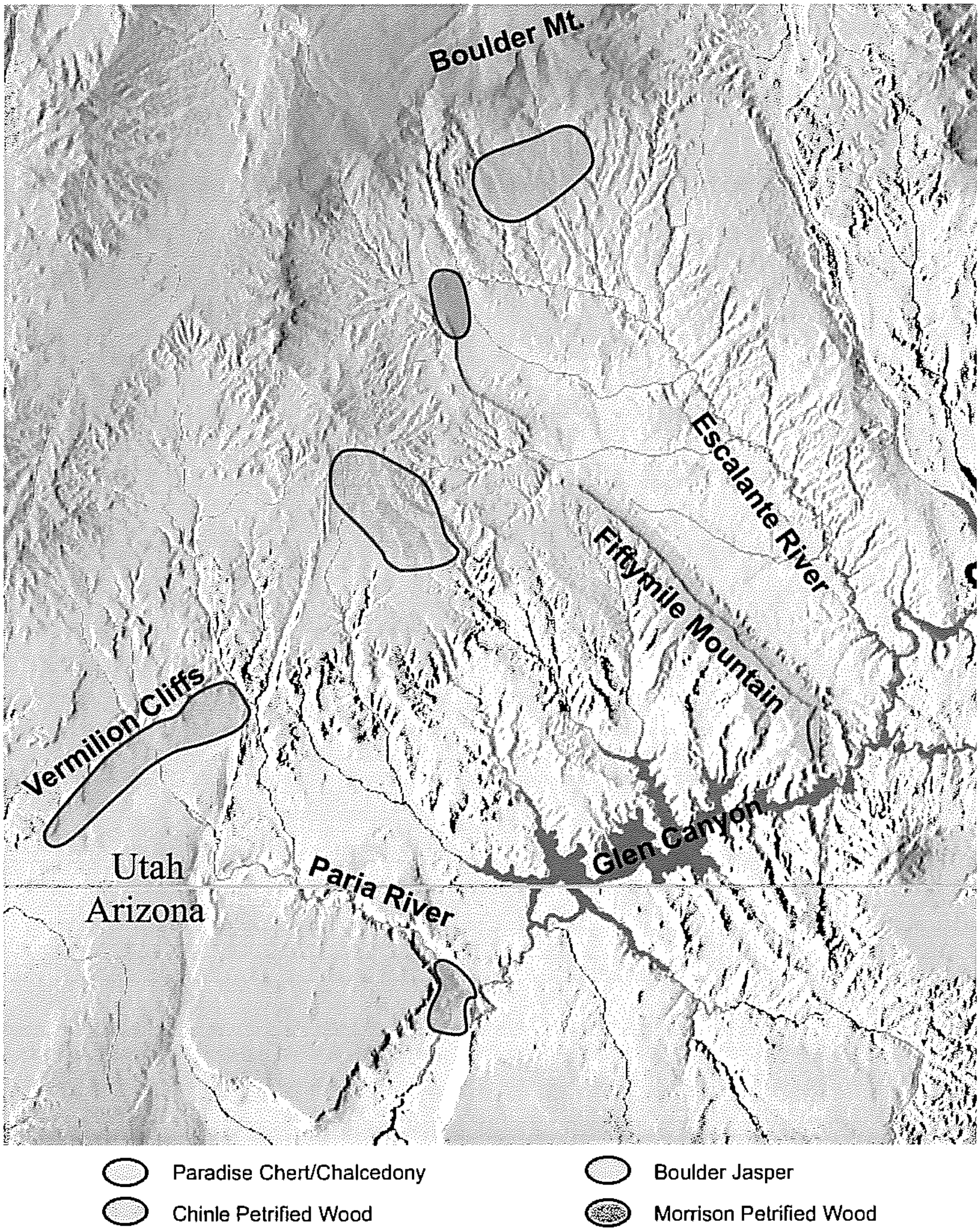


Figure 6.1. Major known sources of flaked stone on and around the Kaiparowits Plateau (base map courtesy of Chalk Butte Inc., Boulder, Wy.).

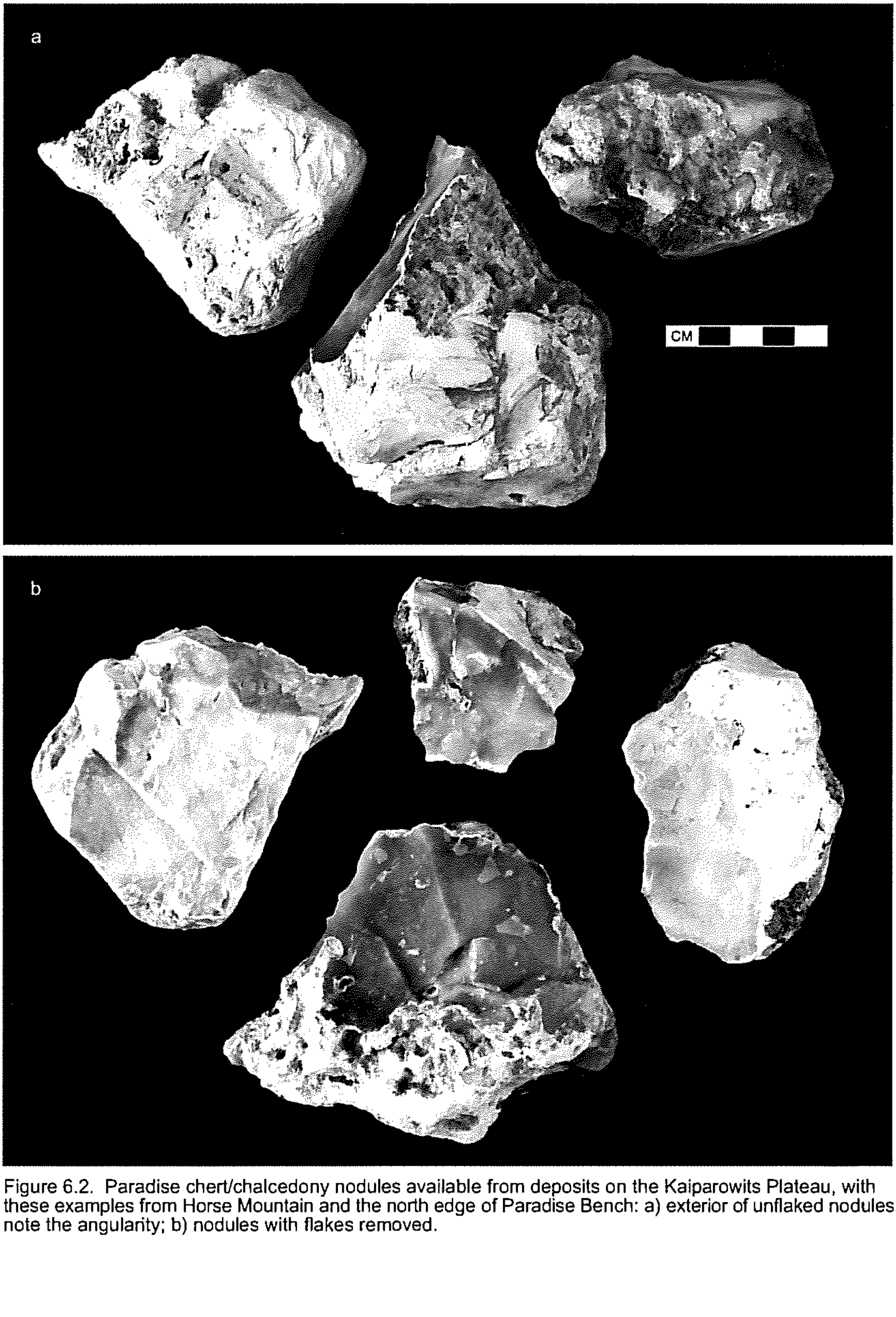


Figure 6.2. Paradise chert/chalcedony nodules available from deposits on the Kaiparowits Plateau, with these examples from Horse Mountain and the north edge of Paradise Bench: a) exterior of unflaked nodules, note the angularity; b) nodules with flakes removed.

Wasatch Formations, although the geologic texts that we consulted made no mention of chert outcrops. Given the topographic position of this chert as a lag deposit upon and above the Kaiparowits Formation, it must derive from some Tertiary Formation. Whatever the primary source, it was evidently fairly localized over Horse Mountain and the northern portion of Paradise Bench because nodules of this material do not occur around Canaan Peak, namesake for the Canaan Peak Formation, nor are they mixed with the alluvial cobbles of canyons that drain northward from the peak such as Right Hand Collet Canyon and Alvey Wash.

The quality or flakeability of Paradise chert/chalcedony varies from excellent to moderate depending upon crystalline coarseness (ca. 3.0 to 4.0 on Callahan's [1979:Table 3] ease of workability scale). The material that is chalcedony or that has more of a chalcedonic quality is usually the easiest to flake. Some of the very opaque white chert is more intractable, though producing a thinned biface or projectile point from this material is still possible. Because the nodules are tabular or blocky angular, they have many appropriately angled surfaces for detaching decortication flakes. The white cortical patina on the exterior of nodules is up to 1 mm thick but is hard and lacks incipient cones, so there is usually no problem with using cortical surfaces for platforms or with the removal of cortex. Many nodules have internal flaws and fracture planes that impede the removal of flakes or cause nodules to break apart. It is easy, however, to find flaw-free nodules and even those with flaws can be used to detach useful flakes.

When raw, Paradise chert and chalcedony can be flaked by both percussion and pressure methods. Heat treatment, however, vastly improves the flakeability of the stone and there is abundant evidence that this was practiced throughout prehistory, from the Archaic through the Post-Formative. Laboratory heating of chert and chalcedony flake blanks in an electric oven produced an excellent change in quality at 230°C.[3] In contrast, flake blanks of Canaan Peak cobble chert, discussed next, remained unaffected by this temperature and had to be heated to at least 300°C to have a slight improvement and 340°C to achieve the same type of change noted at 230°C with Paradise chert. After heat treatment, Paradise chert/chalcedony is easily flaked by both percussion and pressure (ca. 2.0 to 3.0 on Callahan's [1979:Table 3] scale) and the post-treatment flake scars are highly lustrous (Figure 6.3). The differential luster seen on the heated flake blanks and debitage matched that noted in the field at many prehistoric sites. Batches of flake blanks heat treated at 300°C and 340°C are even easier to flake by both percussion and pressure; the post-treatment flake scars are more lustrous. At 380°C, however, the material is becoming overheated in that the rock is brittle, platforms crush easily, and the flake scars are strongly rippled. We observed examples of this in the field. At this high temperature there is a marked change in the chert, with the angular or amorphous cream to yellowish to pale brown opaque blotches becoming pink and reddish. Prehistoric artifacts with this overheated color change occur in the project area; some of these had evidence of uncontrolled burning (natural fires), but other examples seem to have been overheated during treatment.

Canaan Peak Cobble Chert

This chert differs from the material described above in both color and origin. It occurs as well-rounded alluvial cobbles and is most commonly very pale brown, pale yellow, and yellow in color. The alluvial chert nodules form part of a dense cobble deposit capping Horse Mountain and other ridges extending off Canaan Peak. The cobbles originate from a conglomerate at the base of the Canaan Peak Formation (called the Wasatch Formation by Gregory and Moore 1931:115). There is a heavy mantle of cobbles on ridges and flats close to Canaan Peak, but the cobbles decrease in abundance away from this high portion at the northwest corner of the Kaiparowits Plateau, with the cobbles eroding down to become concentrated within washes. Consequently, vast portions of the Kaiparowits Plateau are virtually free of natural cobbles and their occurrence in such places is usually the result of cultural activity. So, for example, nearly all of Fourmile Bench is devoid of cobbles, all except the far northern extent, where the bench grades into Horse Mountain. Even further removed from the cobble source, Nipple Bench and Smoky Mountain totally lack deposits of these materials.

The chert cobbles have characteristic alluvial cobble cortex consisting of countless superimposed Hertzian ring cracks from having bounced along a streambed bumping into other hard rocks

[3]This temperature (230°C) was obtained slowly over the span of 4 hours and was then maintained for another 4 hours, at which time the kiln was turned off; it took about 8 hours for the kiln to cool sufficiently to remove the flakes.

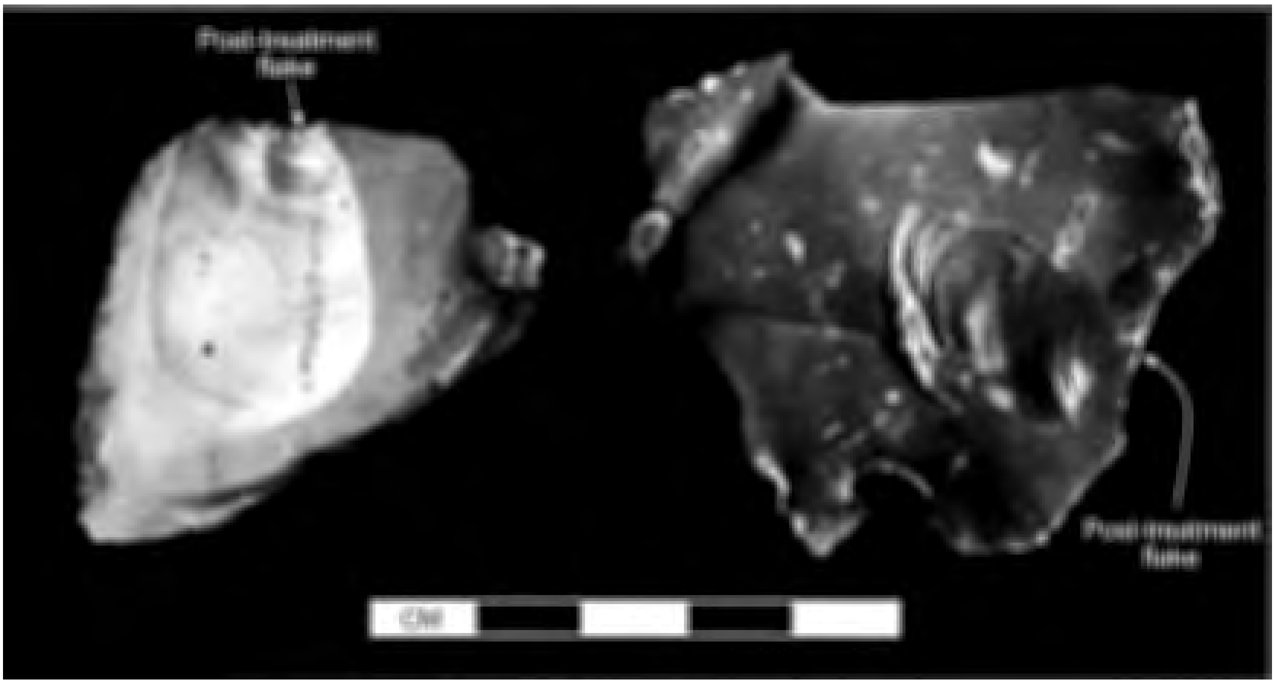


Figure 6.3. Examples of heat treated flake blanks of Canaan Peak cobble chert (left) and Paradise chert/chalcedony (right) showing the differential luster of post-treatment and pretreatment flaked surfaces. The Paradise chert/chalcedony flake blank was heated to 230° C, whereas the flake blank of Canaan Peak cobble chert had to be heated to 380° C to produce an equivalent change in flakability.

(Figure 6.4). Natural examples of the chert reveal that it is most commonly very pale brown, pale yellow, and yellow in color, but also ranges into gray shades. On prehistoric sites, however, there are many examples of this material in pink and red shades. More thorough sampling may reveal naturally occurring pink and red chert cobbles, but based on the heat-treatment experiments described below it is evident that many of the pink and red shades result from heat treatment. It is also true that the pink and red examples of this material tend to be of higher quality (more lustrous and finer textured) than the naturally occurring alluvial cobble chert, but this quality was obtained with heat treatment in the laboratory. In general, single nodules of the alluvial cobble chert tend to be relatively uniform in color, with broad subtle gradations and banding of mainly one color, sparsely flecked with minor small blotches of other colors. The exceptions to this are cobbles of fossiliferous chert. The fossils are mostly minute shell and other organism fragments that impart a speckled appearance. A rare occurrence is chert cobbles that are translucent and brownish (caramel) colored that acquire a reddish cast when heat treated. Surveyors saw occasional artifacts of this material during Phase 1, but not until Phase 2 did they find a natural cobble of this material, proving that it was local. Gregory and Moore (1931) mentioned that a black chert occurs within the Canaan Peak (Wasatch) Formation conglomerate but we did not observe this; perhaps they refer to what we called fine-grained igneous or metasediment.

Because Canaan Peak cobble chert occurs as well-rounded nodules, it has few appropriately angled striking surfaces for flake detachment compared to Paradise chert/chalcedony. Another problem is the countless preexisting ring cracks, some of which extend into the cobbles for several millimeters or more and disrupt the fracture plane during flake detachment. The roundness of the cobbles is also a limitation because it generally precludes production of a bifacial tool from an entire cobble; bifaces usually have to be made on flake blanks or on split nodules. This would not be a great limitation if the cobbles were large, but they are most often fist sized or smaller (10 cm in maximum dimension or less). This is perhaps an important reason why field crews rarely saw a large biface of this material. There are projectile points of this chert, including one large (6.7 cm long), well-made example shown on the cover of this report.

The quality of Canaan Peak cobble chert

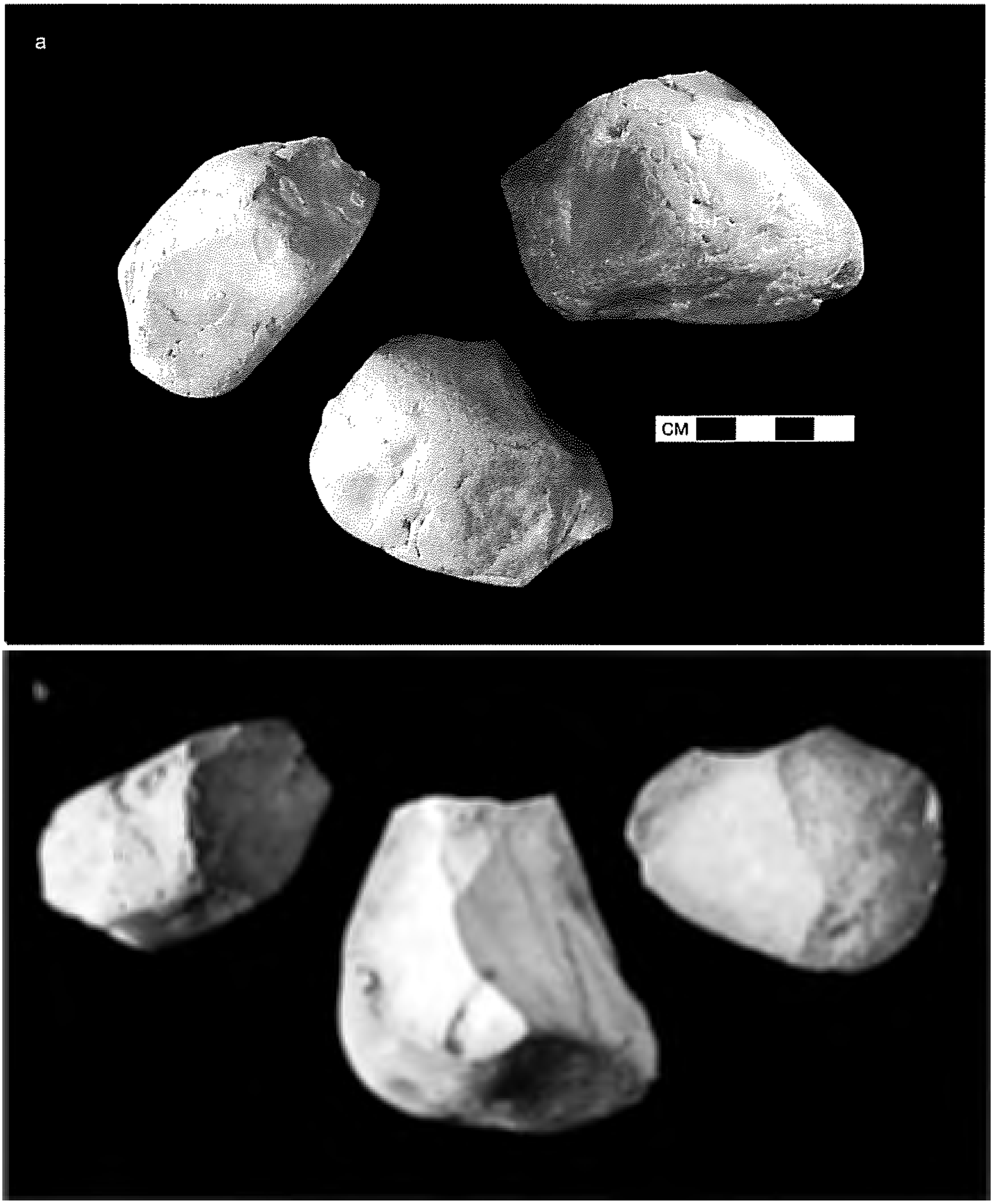


Figure 6.4. Canaan Peak cobble chert available from secondary deposits on portions of the Kaiparowits Plateau: a) exterior of unflaked nodules, note the rounded forms and alluvial cortex; b) nodules with flakes removed.

ranges from relatively easy to flake to quite tough (ca. 4.0 on Callahan's scale). In nearly all cases, even the best cobbles of this chert that we found were more difficult to flake (harder material) than the good-quality nodules of Paradise chert/chalcedony. In addition, it is our general impression that cobble chert of inferior quality is more abundant than that of good quality and that good-quality Canaan Peak cobble chert is far less prevalent than good-quality Paradise chert/chalcedony. A caveat to this is that some exceptional examples of Canaan Peak cobble chert were noted at sites but we rarely located examples of this material in the gravel deposits. Nearly all of the exceptional examples, however, were pink or red in color, suggesting that the chert had been heat treated.

Although Canaan Peak cobble chert is generally somewhat tougher on average than the good-quality Paradise chert/chalcedony, proper heat treatment cancels these differences, making both materials easy to flake. Flake blanks of cobble chert were included with those of Paradise chert/chalcedony in our first heat-treatment experiment, where the temperature reached 230°C. Paradise chert/chalcedony had a good improvement in flaking quality at this temperature but not the Canaan Peak cobble chert. It remained unaffected as to flakeability; however, a slight pinkish cast was imparted to some portions of the stone. Flake blanks were again heated, this time to 260°C, but still with no improvement in flaking quality. As expected, when the stone remains unaffected, post-heat-treatment flake scars lack gloss or luster. On the third round, flake blanks were heated at 300°C and this finally produced a change in workability plus a marked color shift. The improvement in flaking quality was moderate, nowhere near the improvement seen with the Paradise chert/chalcedony at 230°C. Post-treatment flake scars exhibited a slight luster but one sufficiently subtle that an analyst likely would not suspect that the chert had been heat treated. The most obvious clue to heat treatment was the notable color change. As a typical example, a flake blank shifted from very pale brown (10YR8/3 and 8/4) to light red (2.5YR 7/6–7/8 and 10R6/6). The color shift was even more pronounced for the cortex: from strong brown (7.5YR5/8) to red (10R4/6). This color change results from oxidation of iron. The reddish cast extended only 1 mm or less into the flake blank, so that complete flaking of a heat-treated flake blank would expose the original underlying color. The differential coloration resulting as post-treatment flakes remove the pinkish surface color of the heat-treated flake blank would provide the clearest indication that heat treatment had occurred. Field crews observed this at prehistoric sites of the region and we observed it as well on some of the collected projectile points (Figure 6.5). The reddened cortex resulting from heat treatment was commonly seen on prehistoric sites.

Heating the Canaan Peak cobble chert to 340° C produces an excellent change in flaking quality, similar to that observed at 230°C for the Paradise chert/chalcedony. With this level of heating the cobble chert is easily flaked by both percussion and pressure and the post-heating flake scars are lustrous. More significant with regard to field identification is a marked color change through to the center of the flake blank, from very pale brown (10YR8/3 and 8/4) to light red (2.5YR7/6-7/8 and 10R6/6). The surface of the flake blank is redder (10R6/8) than at 300°C, as is the cortex color, which is dark red (10R3/6). At 380°C the chert has an even better flaking quality and the color change is slightly more intensified (Figure 6.6). It should be noted that there is always a range of response to heat treatment within a single raw material class, even one that appears remarkably uniform. It is thus expectable that the limited experiments conducted so far have not disclosed the full range of variability. It is generally true that the finest-quality chert and flint will heat treat at lower temperatures than coarser chert and flint, and the contrast between the response of the Paradise chert/chalcedony and Canaan Peak cobble chert seems to bear this out (but cf. Boulder jasper below). Our experiments suggest that it would be best to heat treat Paradise chert/chalcedony separate from the Canaan Peak cobble chert because of their different responses. The cobble chert requires substantially higher temperatures to produce the desired effects, temperatures that might well ruin the other material. Heat treatment makes an excellent improvement in the flaking quality of both local materials, but whereas the untreated Paradise chert/chalcedony can be flaked without too much effort and skill into bifacial tools (at least with the best-quality nodules), untreated alluvial cobble chert is more difficult to flake into bifacial tools.

Coarse Alluvial Cobbles

The most common flaked stone resources in the area consist of well-rounded alluvial cobbles of coarse tough materials. Quartzite is by far the most abundant and appears to have been the most heavily exploited. It occurs in a variety of colors

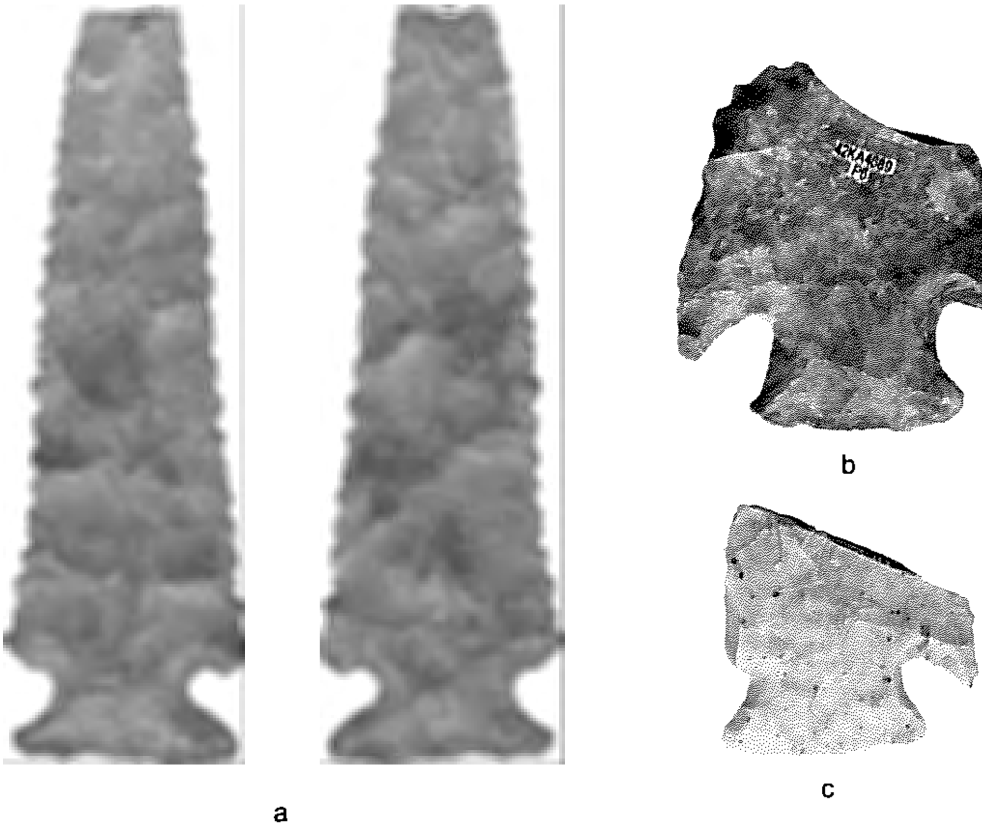


Figure 6.5. Examples of Elko Series projectile points exhibiting differential coloration from the tool having been heat treated with post-treatment flakes removing the color: a) a dramatic example made of Boulder jasper, P1 from 42KA5323; b and c) examples made of Canaan Peak cobble chert, P6 from 42KA4689 (b) and P2 from 42KA4619 (c).

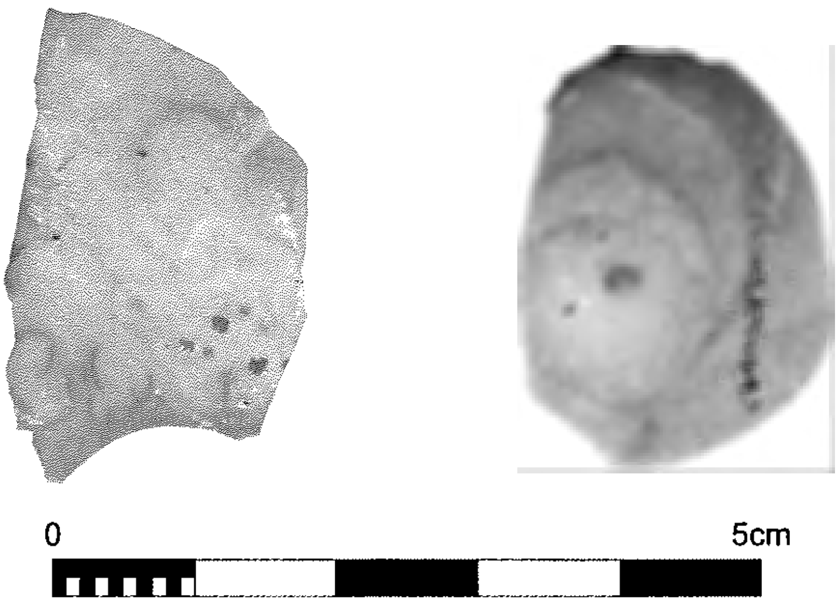


Figure 6.6. Two flakes from the same nodule of Canaan Peak cobble chert showing the color change resulting from heat treatment: the flake on the left shows material in its natural state, flake on the right was removed from a flake blank heat treated at 380° C.

from light brown and yellow to dark green and almost black. The texture of the quartzite is nearly always quite coarse, making the material poorly suited to bifacial reduction. Indeed, surveyors did not observe a single bifacially thinned tool made from local quartzite.[4] The quartzite cobbles were flaked to make heavy-duty core tools such as cobble choppers (see discussion below). Large core flakes from the quartzite cobbles, often decortication flakes, were flaked for use as choppers or pounders, or were directly used for these purposes without modification. Some of the cobble flakes appear to have been used without modification as expedient cutting and scraping tools.

The other common types of coarse alluvial cobbles consist of igneous rocks of different textures and dense, apparently welded sedimentary cobbles that we have called metasediment. The igneous rocks are all dark in color and range in texture from porphyritic to aphanitic. Many of the metasediment cobbles are various shades of green. These materials, like quartzite, were used nearly exclusively for heavy-duty tools such as cobble choppers, pounders, and scraper-planes. There seems to have been a greater tendency to exploit large core flakes of these materials rather than quartzite for expedient cutting and scraping tasks. The finest-textured igneous and metasediment cobbles were flaked to produce bifacial tools, even projectile points, but this required considerably more production skill compared to using the local chert or chalcedony. Field crews collected an isolated Elko Eared point of metasediment on Paradise Bench (IO284) and found a Stage 5 biface fragment of metasediment at site 42KA4845 on this same bench. These are the exceptions though, and with the abundance of quality chert and chalcedony in the area there should have been little need to exploit the tough cobbles for facially thinned tools. A few sites, however, contain a moderate amount of bifacial reduction debris of metasediment—one example is 42KA5221 on Collet Top.

The primary source of the alluvial cobbles is the basal conglomerate of the Canaan Peak Formation, which has eroded, leaving vast deposits of pebbles, cobbles, and boulders spread across the landscape and concentrated along major drainages. Gregory and Moore (1931:115) observed that "slopes are so coated with loose boulders as to make travel difficult, and the banks of Little River near its head in Canaan Peak, are composed of boulders that are piled to heights of 20 to 40 feet." We encountered the former situation in Survey Unit 164 at the northeast edge of Long Flat, where there is a vast cobble-covered slope that resembled a huge dissected rock garden. The heavy mantle of cobbles is restricted to the northwest portion of the Kaiparowits Plateau and as one moves away from this area the cobbles become concentrated within washes. Consequently, vast portions of the Kaiparowits Plateau are virtually free of natural cobbles and cultural activity is the reason for their occurrence on sites of Smoky Mountain, Brigham Plains, Horse Flat, and most of Fourmile Bench. The coarse cobbles are available from deposits along most of the large drainages of the Kaiparowits Plateau including Wahweap Creek, Last Chance Creek, Collet Canyon, and Alvey Wash.

Silicified Siltstone

While surveying on Smoky Mountain we observed debitage and bifaces of a gray, poorly silicified siltstone. We did not actually find a deposit of this material, but given the abundance of siltstone artifacts at some sites situated toward the southern portion of Smoky Mountain, including cortical debris, we have little doubt that outcrops occur in the vicinity of this area. Such outcrops might be located within the dissected canyons that drain the southern portion of this mesa. The siltstone has a conchoidal fracture, but it is not highly silicified; thus the edges of tools made of this material are less durable than tool edges of chert. This lack of durability is perhaps why this material appears to have a restricted distribution, seldom occurring as artifacts away from Smoky Mountain. Prehistoric people might have used the siltstone principally on an expedient basis when caught short without better material. Smoky Mountain is, of course, well known for its coal bed fires (e.g., Chesher 2000:42) and it is possible that these fires are the reason that flakeable siltstone occurs in this area: i.e., the siltstone was fused by the heat of the coal fires (a "baked" siltstone). The problem with this interpretation is the gray color of the stone, because the rocks that are heat-affected by the coal fires are oxidized to a reddish color.

Nonlocal Flaked Stone Resources

Areas surrounding the Kaiparowits Plateau offer a variety of raw materials for the production

[4]These local cobbles are a metaquartzite; examples of bifaces or bifacial thinning flakes of silicified sandstone (or orthoquartzite) occur on occasion at sites on the Kaiparowits Plateau, but this material is not local.

of flaked stone tools and many of these found their way onto the plateau. The most important of these appears to have been petrified wood from two distinct sources and a lag deposit of yellow chert along the lower slopes of Boulder Mountain that we have named Boulder jasper. It deserves mention that petrified wood occurs naturally across much of the Kaiparowits Plateau, especially within the Wahweap Sandstone and some units of the Straight Cliffs Formation. Nonetheless, the local wood is not sufficiently silicified to make suitable flaked stone tools (on rare occassions we observed that chunks of the local wood had been expediently used as pounders or for similar tasks). As a result, we believe that all of the flaked stone artifacts of petrified wood present on the Kaiparowits Plateau originated from two principal sources off the plateau—either the Morrison Formation or Chinle Formation. Other extra-local raw materials occuring as artifacts on the Kaiparowits Plateau include Kaibab chert, Glen Canyon chert, and obsidian.

Chinle Petrified Wood

This material is available from exposures of the Petrified Forest member of the Chinle Formation west of the Cockscomb along the Vermilion Cliffs and further afield to the south at Lees Ferry and to the north in the Circle Cliffs. Most occurrences of this material in the survey area likely derived from the west, and in this regard it is notable that sites of the Brigham Plains stratum have a high proportion of petrified wood. This survey area is in closest proximity to the petrified wood sources along the Vermilion Cliffs of any of the nine sampling strata. Wood of the Chinle Formation can be poorly silicified, but there is also plenty of exceptionally fine silicified wood, most of which is chalcedonic and brightly colored (especially yellow and pink). The wood is obtainable from primary situations where petrified logs are eroding from outcrops and from secondary stream deposits. At outcrop, there are entire logs, but the many internal fractures and flaws inherent in this material limit maximum flake size. Still, flakes up to 20 cm in size can be detached and fracture-free angular chunks up to 25 cm in maximum dimension are obtainable. The amount of cortex relative to volume of material can be negligible. Some of this material is so highly siliceous and lacking of wood grain that it does not resemble petrified wood. Indeed some examples identified as wood might be bedded chalcedony streaked with color, which also occurs within the Chinle Formation. In either case, it comes from the Chinle Formation and is exotic to the Kaiparowits Plateau. The best examples of this wood can be flaked into bifacial tools without heat treatment, but the material is greatly improved with proper heating. Even the moderately silicified examples of wood can be greatly improved with heat treatment.

Chinle Chalcedony/Chert

Also occurring within the Chinle Formation along the Vermilion Cliffs west of the Kaiparowits Plateau are bedded chalcedony and chert, with any single chunk often grading from translucent to opaque. This material comes in a great variety of bright colors (reds and yellows); it is most often to some degree semi-translucent with streaks, filaments, and blotches of bright color. Chunks of this material from the Vermilion Cliffs reveal that the beds can be up to 15 cm thick, but also as thin as 2 cm. This material is usually highly lustrous in raw form and is quite easily flaked into bifacial tools without heat treatment. Nodules of this material from the Vermilion Cliffs are indistinguishable from nodules of this material from Cedar Mesa.

Morrison Petrified Wood

Our understanding of this material for the Kaiparowits Plateau region is still limited in that most of what we know comes from a visit to the Escalante State Park outside the town of Escalante, Utah, and from limited sampling of a Morrison exposure at the mouth of Collet Canyon. Petrified wood from the Morrison Formation can be poor quality for stone tool production because of preserved wood structure that interferes with fracture (fibrous texture). Nonetheless, the Morrison petrified wood available from outcrops at Escalante State Park is of high quality, consisting of highly silicified and commonly chalcedonic wood that is brightly colored. Yellow hues are especially common, but red, black, and translucent chunks are also well represented. Much of this material is riddled with internal fracture planes, but sizeable pieces are obtainable and it is often possible to produce tools from the flat spalls of material between fracture planes. Areas within the state park that contain silicified logs are covered with abundant quarry debris, much of it angular shatter, and hammerstones are numerous, some of them quite large. Evidently reflecting the spatial occurrence of this rich source, high-quality silicified wood was well represented at sites of the Collet Top sample frame, especially those toward the northern portion of this frame. At the mouth of Collet Canyon, outcrops of Morrison Formation lacked high-quality wood. The wood specimens

located there were drab in color (gray, brown, and white), opaque rather than translucent, and with a fibrous fracture because of the preserved wood structure. This sort of silicified wood might be more typical of the wood generally available from the Morrison Formation, but similar wood also occurs within the Chinle Formation.

In this report we designate the high-quality, and often chalcedonic silicified wood as "agatized wood." In the Phase 1 report (Geib, Huffman and Spurr 1999) we had assumed that all of this material was derived from the Chinle Formation and used the term Chinle agatized wood. We now know that this material can also come from the Morrison Formation. At present we do not believe that there is a reliable method to differentiate between the two while in the field, even with moderately large chunks, let alone flakes and tools. In an attempt to find a quick and efficient method for laboratory differentiation, we tried using short and long wave UV light. Such a method has shown promise for differentiating between rocks that are superficially similar (e.g., Hofman, Todd and Collins 1991). Unfortunately in this case there was considerable overlap in the UV colors, suggesting that the method is unlikely to provide clear separation between sources.

Boulder Jasper

This material is poorly represented across much of the survey area, but at many of the sites on Collet Top, Boulder jasper is well represented, sometimes being the predominant material type. In nearly all cases, the artifacts of Boulder jasper appear heat treated. Because this material seemed to be such an important resource on a portion of the Kaiparowits Plateau, but our existing sample of it was limited, we made a trip to the source area as part of this project to collect additional nodules for study. This trip allowed us to obtain a much better understanding of the range of variability of this material in raw form as well as to have sufficient samples for various experiments.

The collected nodules came from several different locations along various tributaries of Sand Creek (Big Hollow, Sweetwater, and Lake) on the lower slopes of Boulder Mountain. The nodules occur mixed with boulders of basaltic andesite and other rock as colluvial deposits on ridges and slopes (including a small proportion of chalcedony nodules not considered here). The nodules are angular and irregularly shaped, much like the nodules of Paradise chert/chalcedony that occur on portions of the Kaiparowits Plateau. The exterior of the nodules reveal that they have not been transported very far from the primary source, which remains unknown because nowhere did we find the jasper in situ. The nodules vary in size from tiny pieces not worth attempting to flake, to large chunks greater than 20 cm in maximum dimension. All that we found are mostly yellowish brown in color (10YR5/6, 5/8), a few of which also contain red streaks and mottling (ca. 10R5/8, 4/8); some are brownish yellow in color (ca. 10YR3/3, 3/4). All of the nodules are opaque, but some have intricately swirled and patterned semi-translucent silica; the latter variety is usually the highest quality stone. Some nodules have numerous small opaque blotches, some of which form small crystal pockets.

Boulder jasper is quite tough in its raw form. All of the raw nodules that we found were difficult to percussion flake and even harder to pressure flake, about 4 overall on Callahan's (1979:Table 3) scale. Some nodules were far inferior to others, but even the best examples were tough. The quality of this material is, however, vastly improved by heat treatment and a favorable change can be achieved at relatively low temperatures. In artifact form, Boulder jasper is frequently reddish in color, at least in part, and often lustrous, the material appearing to be of high quality. We found no raw nodules like this and are convinced that these characteristics result from purposeful heat treatment of the material.

Flake blanks of Boulder jasper were experimentally heat treated within a kiln at various temperatures to learn the effects of this method on the raw material. Flakes from seven different nodules covering much of the range of textural and color variability in the material were heat treated at separate intervals to maximum temperatures of 230°C, 260°C, 300°C, 330°C, and 400°C. A marked improvement in flaking quality was observed at the lowest temperature with all flakes taking on a somewhat reddish hue on the exterior surface (Figure 6.7). The improvement in stone workability at low temperature parallels that for Paradise chert/chalcedony. Flaking quality was maximized in the 260–300°C range and remained excellent through 330°C. At 400°C most of the flake blanks were adversely affected: many fragmented into small portions, others were badly potlidded and had become overly brittle. After heat treatment, Boulder jasper is easily flaked by both percussion and pressure (ca. 2.0 to 3.0 on Callahan's [1979:Table 3] scale) and the post-treatment flake scars are highly lustrous. At 260°C the flakes became totally red on their exterior surfaces (ca. 10R3/6), with the color intensifying

with higher temperatures. Through 330°C the oxidation rind remained essentially a surface phenomenon, never penetrating more than a few millimeters into the stone. Consequently, flakes detached after heat treatment remove the reddish color, such that a tool made of heat-treated Boulder jasper might appear totally yellow with no reddish discoloration. The initial flakes removed from heat-treated flake blanks or roughed-out tools of Boulder jasper have reddish, matte dorsal surfaces and yellowish lustrous ventral surfaces with a reddish halo at the flake edge. Examples of biface thinning flakes like this were seen at several of the Anasazi habitations on Collet top (Figure 6.8), evidence that the occupants brought partially thinned bifaces of Boulder jasper to their Collet Top habitations where they heat treated the tools and then further reduced them. At 400°C the reddish oxidation penetrated the entire thickness of some flake blanks.

Our reduction and heat-treatment experiments suggest to us that if prehistoric knappers intended to make bifacial tools of Boulder jasper then they probably would have heat treated the stone. In raw form the material is quite tough, but with low-temperature heating there is an excellent improvement in the flaking quality, even with marginal quality nodules. Because no raw nodules of lustrous Boulder jasper were observed, we believe that luster alone is a sufficient criterion for identifying this material as heat treated (controlling for gloss patina or sand-blasting polish). Differential coloration can also occur, where the post-treatment flakes do not totally remove the reddish oxidation rind (see Figure 6.5a for a striking example).

Of interest with regard to heat treatment were two tiny nodules found at the source area that exhibited obvious evidence of exposure to fire. The cortical exteriors of these nodules were reddened from oxidation and exhibited a few potlid fractures. Detaching flakes from each revealed the obvious luster of heat treatment. No large nodules like this were observed, but these examples serve to demonstrate that natural heat treatment can occur, at least with small material pieces.

Kaibab Chert

Kaibab chert is perhaps the most common material type occurring on sites southwest of the Kaiparowits Plateau. This chert is predominantly white in color, although pure bright red nodules are known from the Coconino Plateau on the south side of Grand Canyon and there are other colors ranging from yellow to brown. When heat treated the white chert usually takes on a pinkish cast and becomes highly lustrous. The chert is commonly fossiliferous, containing either coral or sponge structures replaced by silica and resulting in a dappled appearance. Brown (1988) identified seven varieties of this material and his report provides much greater descriptive detail. Prior to the start of survey, before learning how much quality chert is available on the Kaiparowits Plateau, we anticipated that Kaibab chert would be well represented, but this turns out not to be the case. It is possible that the presence of Kaibab chert is underrepresented because it got included with the Paradise chert/chalcedony in field analysis, particularly if the former had not been heat treated. More study is needed to refine the criteria for differentiating these two material types. During the laboratory analysis of collected projectile points, Kaibab chert was identified 13 times whereas the Paradise chert/chalcedony accounted for 168 points.

Glen Canyon Chert

The material identified as Glen Canyon Chert is a variegated, brightly colored, often semi-translucent chert of high quality that occurs in the alluvial gravel deposits along the Colorado River. Yellow, red, and purple and various shades and mixtures thereof are common, with the bright colors grading into white. Some portions are opaque, other portions are semi-translucent (chalcedony), and some of the semi-translucent portions are streaked or splotched with color. This material was infrequently identified in NNAD's survey areas on the Kaiparowits Plateau, but it is likely to have greater representation to the east on Fiftymile Mountain. There is the potential to confuse this material with Chinle chert.

Obsidian

Obsidian is quite rare on the Kaiparowits Plateau and seems to occur mainly on Post-Formative sites. Surveyors visually identified nearly all of the obsidian as likely coming from Utah sources such as Modena and Mineral Mountain (Nelson and Holmes 1979). The most common types observed in the field are a finely banded glass and an almost transparent glass. A few largely transparent obsidian pieces have slight reddish tints. Of the 398 projectile points collected, 9 are of obsidian. Five of these are of a finely banded transparent

Figure 6.7. Two flakes from the same nodule of Boulder jasper showing the color change resulting from heat treatment: flake on left shows material in its natural state, flake on right after heat treatment with a few post-treatment flakes removed at bottom edge.

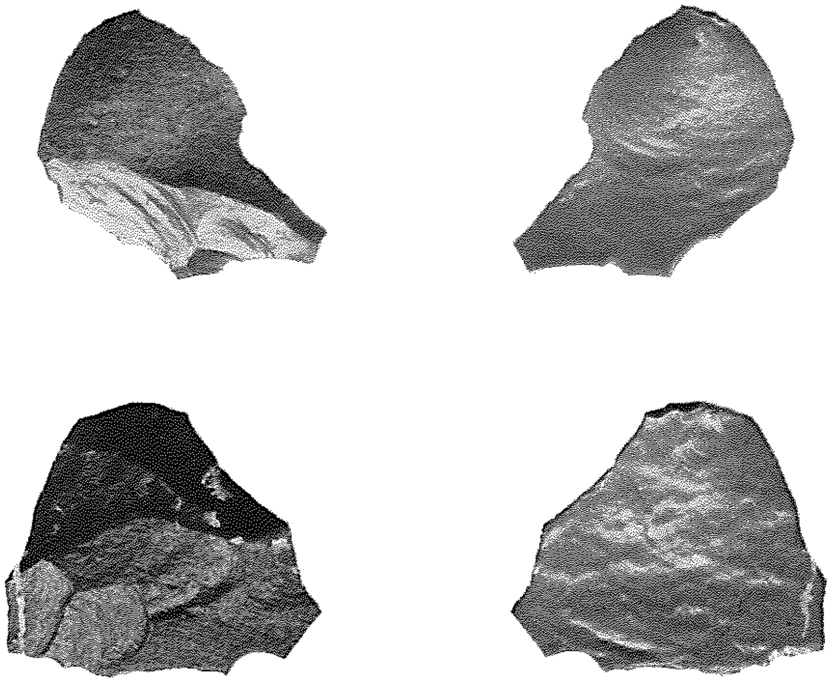


Figure 6.8. Dorsal (left) and ventral (right) surfaces of two biface thinning flakes of Boulder jasper removed from heat-treated tools showing the contrast in color and luster; flakes are from Gag House, 42KA5435, on Collet Top. The dorsal surface of the top flake exhibits a few lustrous scars from prior post-treatment removals but the multiple scars on the bottom flake all have a matte surface from roughing out the biface prior to heat treatment.

glass (like shutter blinds), two are of an opaque and highly vitreous glass with reddish brown streaking, one is of a transparent glass with minute black specks that impart an overall grayish cast, and the ninth point (IO196) has such a worn surface that the glass characteristics are obscured. Five of these points are dart sized—two being Elko Side-notched, one Pinto, and two unidentified—and four are arrow-sized and untyped. Two of the latter are point fragments snapped in production and these are the only examples that have fresh looking and unweathered surfaces; the other seven points exhibit varying degrees of weathering and surface pitting, with the highly abraded IO196 looking as though it had been in a wash for some time. One of the obsidian arrow points is an untyped side-notched that exhibits differential weathering, indicating that the item was originally probably a dart point (perhaps Elko Eared). Even the flake scars that modified the original form of this tool are pitted and weathered, indicating that the point was recycled into its current shape quite some time ago.

Obsidian was commonly seen on Post-Formative sites in low frequencies and almost always occurred as flakes, both used and unused, or at least with no obvious use-wear traces (Figure 6.9). Judging from flake attributes, most were detached from cores by simple hard hammer percussion. At site 42KA4585 an Apache tear nodule was brought there and flaked. Surveyors found two arrow point tips of obsidian, one from site 42KA4612 and one from 42KA5480. Neither site is certainly of Post-Formative age. We did not observe other examples of obsidian projectile points or larger bifacial tools at Post-Formative sites and found no examples of Desert Side-notched points of obsidian.

STONE TOOL TECHNOLOGY

Reduction strategies vary by time and by general tool class irrespective of time. By the end of the first phase of fieldwork, it was abundantly evident that several different reduction objectives and approaches had been used within the study area at various times. These are described below to provide the reader with an understanding of these technologies and their debris. General information about the abundance and distribution of the stone artifacts across the study area and through time is also presented. More finely attuned spatial, temporal, and functional trends in the data are pursued later in Chapters 7 and 8.

Projectile Points

NNAD's contract with the BLM allowed for collection of projectile points, both to enable laboratory analysis and consistent identification and to preclude the removal of these critical artifacts by relic collectors. The utility of the collection should be evident by the many different types of information obtained from these specimens, information that we could not have gathered based on field observations. Moreover, collection ensures that the specimens are around for future analysis, something that is not necessarily true for those points left in the field. Surveyors collected 398 points during the Kaiparowits Plateau Survey, 83 as isolated occurrences and 315 from sites. Many point bases were left at sites, usually small fragments often damaged by fire (those badly crazed and spalled). Crew chiefs described and typed when possible point bases left in the field, but these are not listed in the type identification table and have not been used in the other projectile point data tables of this report. NNAD's point collection rate for sites is 32 percent: 315 of the 978 total points found at sites. The collection rate for points found as isolated occurrences is 49 percent: 83 of 169 total points found unassociated with other remains.

Laboratory classification of projectile points was principally based on morphology according to existing point types of the northern Colorado Plateau (Holmer 1978, 1986; Holmer and Weder 1980), Great Basin (Hester 1973; Thomas 1981), and surrounding regions (e.g., Irwin-Williams 1973; Roth and Huckell 1992). Typological placement was by observation alone, not by measurements and comparison with metric data such as presented in Holmer (1978). The collected points may be classified using a more replicable and quantified technique such as advocated by Holmer (1978; see also Phagan 1988), another benefit of collection. All of the collected specimens are illustrated by a series of photographs accompanying this text; these should allow other researchers to evaluate our assignments and draw their own conclusions.

Table 6.1 identifies all of the 398 items collected as projectile points and listed as such on the site forms. Six of these are large notched tools (Figure 6.10) that are well beyond the probable size category of projectile points; hence they are classified as hafted knives. Obviously any of the other projectile points may have been used for a variety of tasks other than as tips for hunting implements.

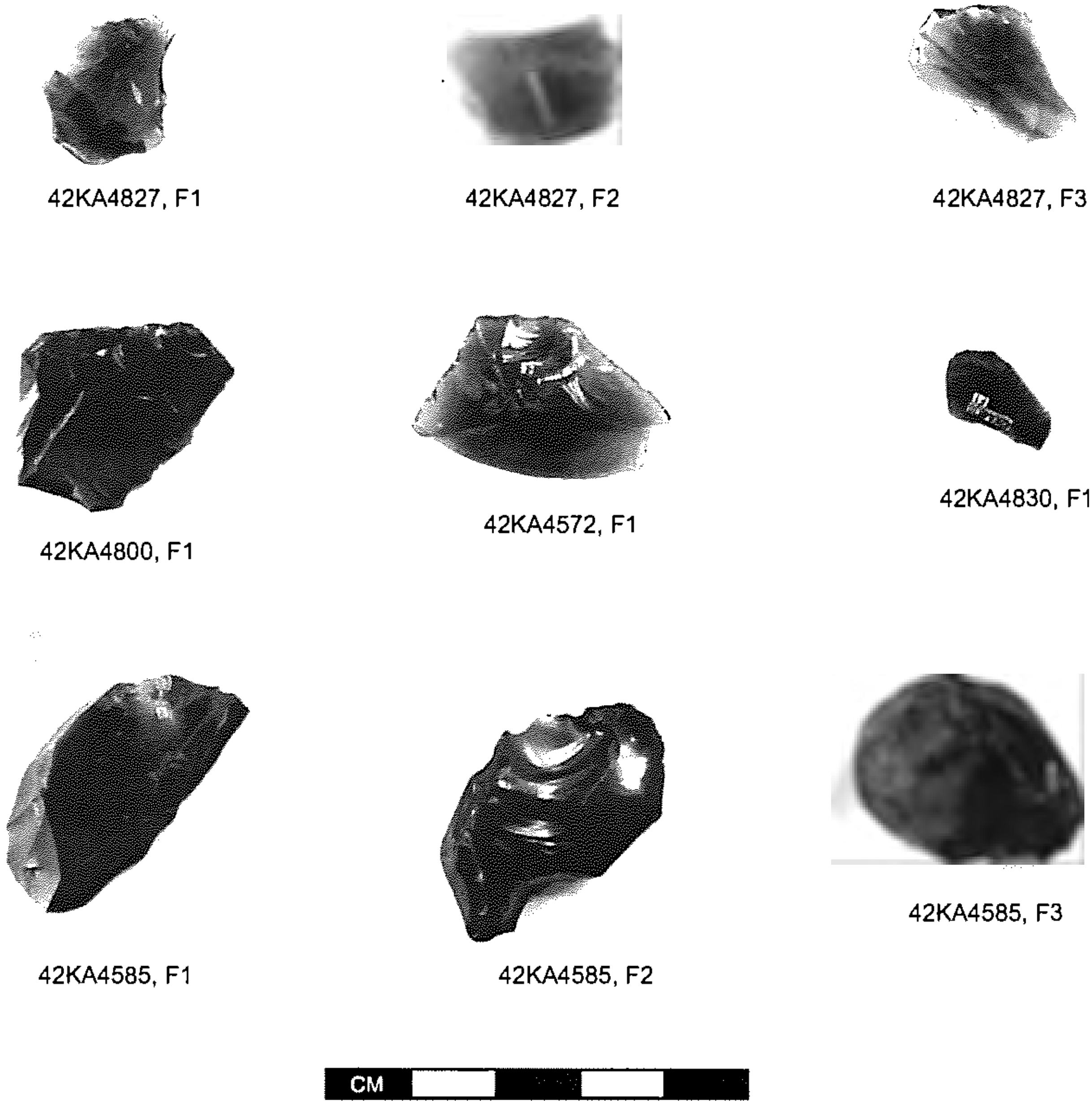


Figure 6.9. Representative examples of obsidian flakes from the Kaiparowits Plateau.

Impact fractures on many specimens indicate that the common morphofunctional ascription of projectile point is likely true for most specimens. Other secondary uses are not excluded, and several points appear to have been reused for various tasks, most after breaking. One square-stemmed dart point typed as Gypsum (?) (42KA5489, P1) had its tip reflaked somewhat for use as a drill (see Figure 6.17b). One of the untyped specimens appears to have been used as a drill or graver (42KA4689, P7; see Figure 6.23). Most of the point types are described and discussed below. The types have been grouped as shown in Table 6.2 for various comparative purposes.

Table 6.3 presents basic descriptive measurements for the point types that contained more than three specimens. Few points were complete, thus length is not well represented in this collection. Length estimates are provided for some specimens with just a tiny portion of the tip missing. Most of the points that are whole have been greatly reduced in length by resharpening and reworking,

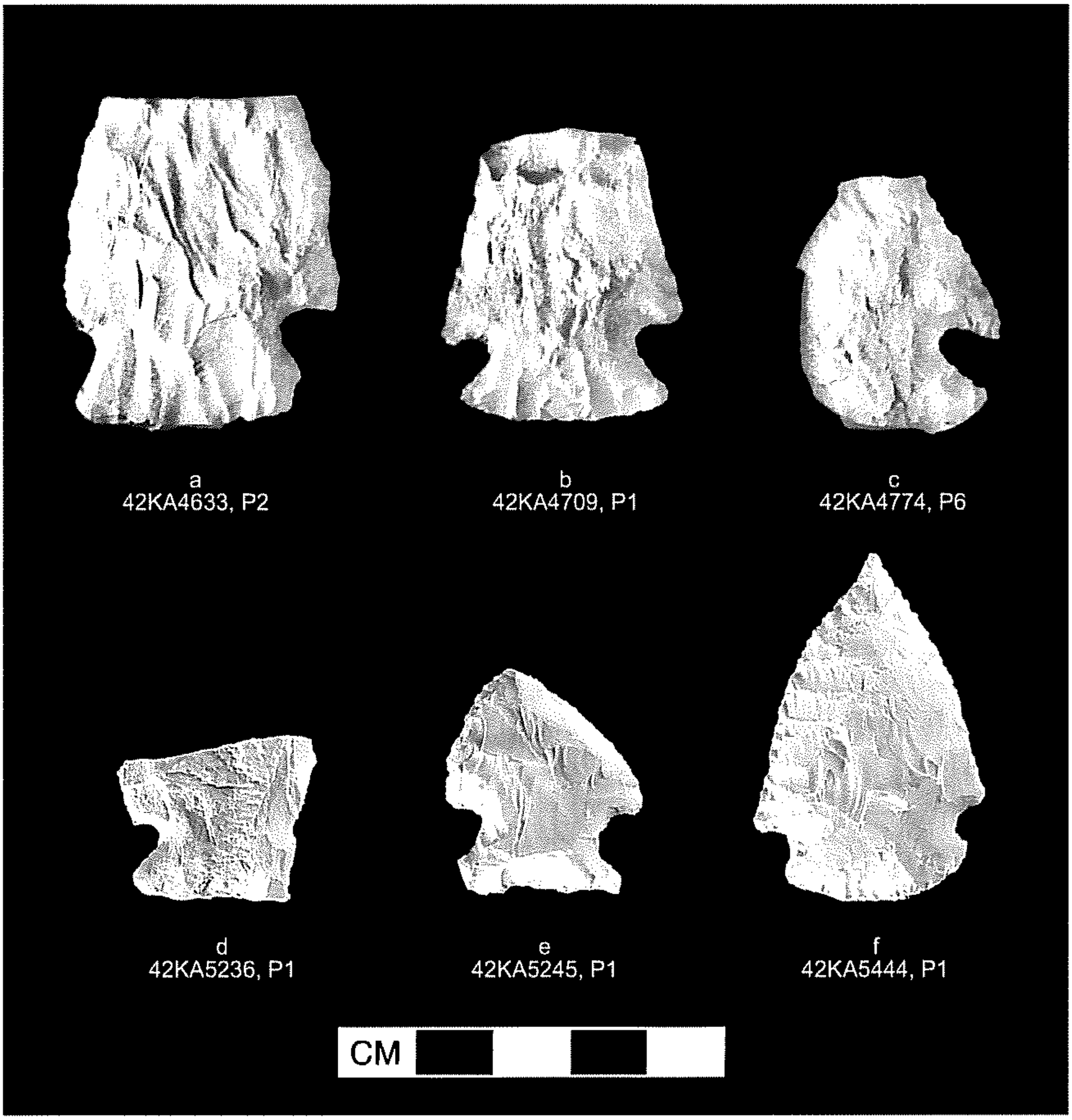


Figure 6.10. Large hafted knives collected during the Kaiparowits Plateau Survey.

thus the reported figures are a poor indication of length as originally produced. There are several instances of just a single whole projectile point for a type and these lengths are listed in the range column rather than the mean. Width in most instances reflects the primary produced dimension of the tools despite resharpening; this also applies to thickness.

Possible Paleoindian Points

Surveyors found three projectile points that might date to the Paleoindian period (Figure 6.11), although none of them were definitive in this regard. The points are tentatively identified as Paleoindian because of their production technology, but none has an immediately recognizable Paleoindian morphology such as Clovis or Eden.

Table 6.1. Projectile points collected during the Kaiparowits Plateau Survey.

Projectile Point Type	Sites	IOs	Total	Percent
Unfinished dart point	3	0	3	0.8
Untyped dart point—NFS	15	3	18	4.5
Untyped Paleoindian (?) concave base	1	1	2	0.5
Untyped Paleoindian stemmed point	1	0	1	0.3
Untyped dart point low side-notched	17	4	21	5.3
Untyped dart point high side-notched	3	2	5	1.3
Untyped dart point corner-notched	4	0	4	1.0
Untyped willow leaf	5	1	6	1.5
Untyped basally notched	3	0	3	0.8
Untyped stemmed	6	0	6	1.5
Elko Series—(corner/side-notched)	9	2	11	2.8
Elko Corner-notched	51	24	75	18.8
Elko Side-notched	35	10	45	11.3
Elko Eared	23	8	31	7.8
Northern Side-notched	11	1	12	3.0
Hawken Side-notched	2	1	3	0.8
San Rafael Side-notched	3	3	6	1.5
Sudden Side-notched	12	1	13	3.3
Gypsum (Gatecliff)	31	7	38	9.5
Pinto Series	8	3	11	2.8
McKean Lanceolate	1	0	1	0.3
Sand Dune Side-notched	3	1	4	1.0
Cortaro	5	0	5	1.3
Untyped arrow point—NFS	1	1	2	0.5
Rose Spring Corner-notched	13	2	15	3.8
Bull Creek	10	4	14	3.5
Anasazi stemmed	3	1	4	1.0
Parowan Basal-notched	1	0	1	0.3
Untyped small side-notched	2	0	2	0.5
Desert Side-notched	15	3	18	4.5
Cottonwood Triangular/Unfinished arrow points	12	0	12	3.0
Hafted knife (corner-notched)	6	0	6	1.5
Total	315	83	398	100.0

Table 6.2. Summary of points based on data of Table 6.1.

Projectile Point Groups	Count	Percent
Arrow Points[1]	68	17.3
Dart Points[1]	324	82.7
Total	392	100.0
Paleoindian	12	7.5
Archaic	93	58.5
Early Archaic[2]	27	29.0
Middle Archaic[3]	22	23.7
Late Archaic[4]	44	47.3
Formative[5]	36	22.6
Post-Formative[6]	18	11.3
Total	159	100.0
Elko Series (C/S-notched)	11	6.8
Elko Corner-notched	75	46.3
Elko Side-notched	45	27.8
Elko Eared	31	19.1
Total	162	100.0

[1]Finished or not, typed or not.
[2]Pinto, Northern, Sand Dune.
[3]High side-notched types except Northern.
[4]Gypsum, McKean, Cortaro.
[5]All arrow point types except DSN.
[6]Desert Side-notched.

Two of the points are from sites, but they lacked a clear association with the other remains; the third example is an isolated occurrence.

Stemmed. One small fragment of a probable Paleoindian projectile point (Figure 6.11a) came from site 42KA4802 on a bench above the west rim of Coyote Canyon on the far northeast edge of Brigham Plains. Although found on a site, there is no certainty that the point is associated with the other remains; indeed, the site seemed like a congery of sparse materials from various time periods whose only commonality is that they loosely shared the same piece of ground. The point is likely Paleoindian based on its size, morphology, and finely executed pressure flaking. We have not hazarded a guess as to point type for this specimen, but believe that it probably falls into the time period of large stemmed and shouldered points such as Hell Gap. The shoulder is too pronounced for points that are commonly typed as Hell Gap on

Figure 6.11. Possible Paleoindian projectile points from the Kaiparowits Plateau Survey: a) stemmed point (P1) from 42KA4802; b) rounded eared concave base point (P3) from 42KA4774; c) lanceolate concave base point of IO861.

Table 6.3. Basic measurements (in cm) for projectile point types; types with few specimens not included.

	Length				Width				Thickness			
Point Types	Mean	s	Range	n	Mean	s	Range	n	Mean	s	Range	n
Pinto	2.7	0.6	2.2–3.4	3	1.7	0.4	1.3–2.5	8	0.5	0.1	0.4–0.6	11
Northern Side-notched	0	0	3.7	1	2.2	0.4	1.7–2.8	9	0.5	0.1	0.4–0.6	12
Sand Dune Side-notched	3.9	0.2	3.7–4.0	3	1.6	0.1	1.4–1.6	4	0.6	0.1	0.5–0.7	4
Hawken Side-notched	0	0	0	0	1.9	0.2	1.7–2.0	2	0.5	0.1	0.4–0.6	3
San Rafael Side-notched	0	0	3.9	1	2.4	0.4	2.0–2.9	5	0.4	0.1	0.3–0.5	6
Sudden Side-notched	0	0	3.0	1	2.3	0.3	2.0–3.1	11	0.6	0.1	0.5–0.7	13
Gypsum	3.9	0.8	2.7–5.0	7	2.0	0.3	1.4–2.7	32	0.5	0.1	0.4–0.9	38
Cortaro	0	0	3.2	1	2.0	0.2	1.8–2.3	5	0.5	0.1	0.4–0.6	5
Elko Corner-notched	3.9	1.4	2.4–7.5	17	2.2	0.3	1.6–2.9	59	0.5	0.1	0.3–0.7	74
Elko Side-notched	3.3	0.7	2.2–4.2	7	1.9	0.2	1.6–2.7	37	0.5	0.1	0.4–0.7	44
Elko Eared	3.4	1.0	1.9–5.5	10	2.1	0.4	1.5–3.0	23	0.5	0.1	0.3–0.7	31
Rose Spring Corner-notched	2.2	0.4	1.7–2.8	8	1.2	0.2	0.7–1.5	15	0.3	0.1	0.2–0.4	15
Bull Creek	2.8	0.4	2.4–3.5	6	1.5	0.3	1.0–1.9	14	0.3	0.1	0.2–0.4	14
Desert Side-notched	2.4	0.8	1.4–3.7	7	1.4	0.4	0.9–2.6	12	0.3	0.1	0.2–0.4	18

the northern plains (e.g., Frison 1974), and the flaking is not totally right because few Hell Gap specimens show evidence of extensive pressure flaking to regularize and straighten margins (Bradley 1974:193). The extent and invasiveness of pressure flaking scars that characterize the example from 42KA4802 is not typical of Hell Gap technology. This point does not fit the Lake Mohave type either, principally because of its fine flaking; Lake Mohave points tend to be rather crudely percussion flaked and tend not to have such neatly defined shoulders as the example from 42KA4802.

The point is transversely snapped from impact, resulting in a pronounced bending fracture that removed a flake down one face, ending in a step fracture under what was probably the binding of the haft. One margin is also burinated, something that likely happened at the same time—it ends in a hinge parallel to the step termination of the impact flake. The stem is broken by a bending fracture that rolls onto the same face as the blade fracture and heads toward the tip. This likely resulted at the same time as the impact fracture of the blade, which bent the stem within the haft, snapping off the stem. The point blade near the haft has a distinct plano-convex section as though made on a flake; a possible remnant of a ventral surface is evident on the stem. All production scars appear to be from pressure flaking, with the scars on a slight angle to the long section (slightly oblique). The basic flaking scars on the blade are long and ribbon-like, about 6 mm wide. The blade margin was then straightened and sharpened by removing a series of minute flakes from both faces. The stem is heavily ground to a thickness of about 0.5 mm. The stem measures 12 mm wide at the bottom of the break; the maximum intact stem width is 15 mm, but the original width just below the blade was probably about 18 mm. The blade now measures 23 mm in maximum width, but it was likely at least 28 mm wide when whole. The fragment measures 24 mm long and has a maximum thickness on the stem of 5 mm. This point is made of agatized wood (or Chinle chert) and appears heat treated; it is not patinated.

Rounded Eared Concave Base. This is an unusual, well-made point that may be of agatized wood or some nonlocal chert (Figure 6.11b). Unlike the stemmed point, this one is heavily patinated on one face. The point is exceptionally flat for its width, which required well-controlled flaking. The maximum width at the base is 27.5 mm, tapering to 23 mm at the transverse break. Maximum thickness is 4 mm at the break, tapering to the base. The length of the fragment is 20 mm. The unpatinated face in particular shows a series of well-executed basal pressure flakes that thin the base and help to create the slight concavity. The flakes removed most lateral flake scars from this face, but one remains near the break that travels nearly the full width of the point. The patinated face also has flake scars from basal thinning and a few collateral, somewhat expanding, flake scars. The margins are ground, but not to the extent of the stemmed point. The thinness of this specimen

places it in the realm of Goshen Complex points (Bradley and Frison 1996), though the basal morphology of this item is not right for that type, nor is its width. Unfortunately, this point, like the stemmed example, is not clearly associated with any remains. It occurred on a large site (42KA 4774) toward the northwest edge of Long Flat that has remains from probably many different times. The break on the point looks recent, so another portion may well be present on the site.

Lanceolate Concave Base. This is perhaps the least likely candidate for a Paleoindian projectile point of the three considered here (Figure 6.11c); it was found as an isolated occurrence (IO861) toward the northern edge of Fourmile Bench. This point was within a survey unit that contained numerous sites, but the point was off by itself, well away from most sites. The point is a basal portion 22 mm wide and 6 mm thick with an obvious bending break that probably resulted from impact. The point is lanceolate shaped with a concave base; it is made of an unidentified reddish mottled chert that is heavily patinated. The base margins are lightly ground, but not the concavity. This well-made point exhibits remnants of both percussion and pressure flake scars, although the latter nearly obscure the former. The collateral pressure flakes are well controlled but not necessarily as finely done as that seen on most Paleoindian points. If not Paleoindian, this point might be McKean Lanceolate, a late Archaic type.

Early Archaic Types

There are several projectile point types assignable to the early Archaic period (ca. >5500 cal. B.C.) without much question. These include all long-stemmed dart points such as Jay or Lake Mohave and the short-stemmed points classified as Pinto. Notched dart points were also in common use during this interval, but unfortunately the most frequently represented notched point, Elko Corner/Side-notched, was used throughout the Archaic sequence. Northern Side-notched is a point type exclusive to the early Archaic and the somewhat provisional Sand Dune Side-notched might be another.

Lake Mohave/Jay. Although not collected and therefore not listed in the point table presented here, it is worth mentioning that one example of a heavily reworked long-stemmed dart point identifiable as Lake Mohave or Jay was recorded as IO496 on Collet Top Unit 30. This point has a stem roughly 2.8 cm long and a reworked blade portion just 1.3 cm long. The base is heavily ground on its lateral margins and flat bottom. The point is of red chert that is heavily patinated on one side, suggestive of great age. This is the only example of this early Archaic point style observed during our survey. Other surveys of the general area likewise have found few long-stemmed Archaic points: Kearns (1982:Figure 70) pictured two examples that might be classified as Lake Mohave or Jay, one of which is heavily resharpened; Hauck (1979: Figures 4-12a and 4-13b) illustrated one Lake Mohave or Jay point and a possible Bajada point (not Humboldt as suggested).

Pinto Series Points. Eleven examples of Pinto points were collected during the Kaiparowits Plateau Survey (Figure 6.12), eight from sites and three as isolated occurrences. One point was at a historic camp and might have been collected by the occupants or was perhaps an isolated occurrence fortuitously superimposed by historic remains. This also appears to be the case for one of the Pinto points on a prehistoric site: it occurred at the site periphery unassociated with other remains and is heavily patinated, unlike the flakes and other tools. Six other examples of Pinto points were recorded in the field at three sites but not collected because of their small fragmentary condition. One of these is a badly broken and reworked or reused short-stemmed point at site 42KA4663 on Horse Flat. Another is a nearly whole but miniaturized stemmed point at site 42KA4759 on Paradise Bench.

Amsden first described the Pinto point type (1935:44) from his work in the Mojave Desert of southeast California. Rogers (1939:54) subsequently recognized five different Pinto "types" but gave them numerical designations. Harrington (1957:50) named five types as forming the Pinto Series of points with variations in shoulder treatment as the primary distinguishing criteria. Harrington's five types were not synonymous with those of Rogers because they emphasized somewhat different attributes. Holmer (1986:97) condensed Harrington's five types into three—shouldered, single-shouldered, and shoulderless—but considers the lack of one or both shoulders likely the result of resharpening.

The so-called Pinto Problem in the Great Basin arose because points of somewhat similar morphology but widely different temporal spans were all being designated as part of the Pinto Series. By creating the Gatecliff Split Stem type for the morphologically distinctive and temporally later series

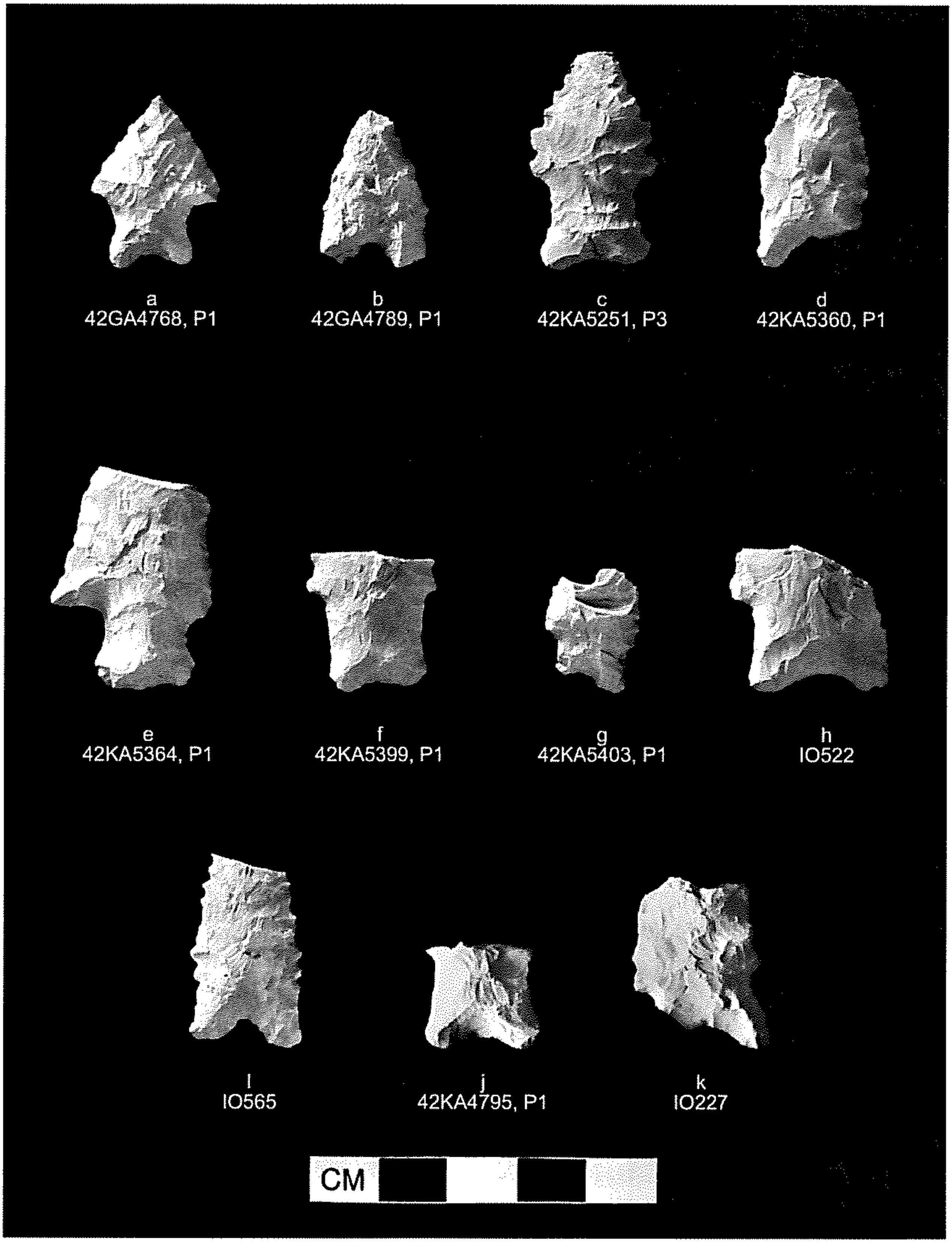


Figure 6.12. Pinto points from the Kaiparowits Plateau Survey.

of Pinto look-alikes, Thomas (1981:37–38) went far in ameliorating the problem. Holmer's (1986:97) morphometric analysis confirmed that the Gatecliff Split Stem points are significantly different in morphology from true Pinto Points. Gatecliff Split Stem points rarely occur on the northern Colorado Plateau, so most bifurcate-stemmed dart points are part of the Pinto Series. As one moves east, however, toward the San Juan basin and south onto the southern Colorado Plateau, there is another Pinto Problem that has yet to be resolved. This has to do with the morphologically similar San Jose points (Bryan and Toulouse 1943), which, according to Irwin-Williams's (1973) Oshara Sequence, date several thousand years later than Pinto points on the northern Colorado Plateau. So far, no one has provided a clear resolution of this problem, but this issue is probably moot for the Kaiparowits Plateau because it seems safe to conclude that Pinto points are early Archaic diagnostics for this region.

There is perhaps a potential classification problem on the northern Colorado Plateau in separating Pinto points from Elko Eared. The key criteria for us are the length and relatively straight sides of Pinto point stems in contrast to those of Elko Eared. Also important is the grinding of the stem, which we believe is an important technological distinction and one that is almost essential to placement in the Pinto class. Nonetheless, the Pinto point found as IO565 lacks basal grinding although it is otherwise typical of the lot, being heavily reworked and patinated. Exemplifying the potential confusion is a point from 42KA5544, which we typed as Elko Eared because of its flaring stem (ears; Figure 6.18s). The base of this point is however ground, which is not typical of Elko Eared. The Pinto point found as IO522 (Figure 6.12h) is interesting because it is made from an opaque black obsidian with red banding.

Northern Side-notched. The name Northern Side-notched is applied to moderately high side-notched dart points on the northern Colorado Plateau. Gruhn (1961) defined the type for specimens from Wilson Butte Cave in southern Idaho. Holmer (1980a, 1980b) applied the type to points recovered from both Sudden Shelter and Cowboy Cave on the northern Colorado Plateau. The mean point shape for this style (Holmer 1980a:Figure 37) shows a slightly concave base. For the specimens from Cowboy Cave, Holmer (1980b:32) stated that the base is consistently concave, but in the Sudden Shelter report Holmer (1980a:75) allowed straight-based examples. Most high side-notched dart points with flat bases, however, are more likely to be included in the Sudden Side-notched type.

From the Kaiparowits Plateau Survey, 12 of the collected points are classified as Northern Side-notched (Figure 6.13) with all but one coming from sites. The critical aspect of distinguishing these points from those classified as Elko is the placement of notches above the base on the blade, resulting in squared-off stem edges below the notches rather than pointed ones as with Elko. Most of these have just slightly concave bases, but these compare favorably with several that Holmer (1980a:Figure 35k–n) illustrated from Sudden Shelter. Several of the Kaiparowits Plateau examples seem heavily reworked, and only one is whole. The latter example is refitted because it was found in two pieces, with the tip portion badly discolored and crazed by fire (see Figure 7.3). Some of the points classified as Northern Side-notched, especially those of the top row of Figure 6.13, might be classified as Hawken Side-notched whose blades had been shortened and reconfigured by resharpening.

Sand Dune Side-notched. Five narrow dart points with shallow side-notches are tentatively classified as Sand Dune Side-notched, three from sites and two as isolated occurrences (Figure 6.14 a–e). Tipps, Hewitt and Lucius (1989:89) proposed this type based on a collection of points associated with a human burial from Sand Dune Cave (Lindsay et al. 1968). Geib and Ambler (1991) subsequently presented more information about this collection, including morphological and technological comparative data; they also identified possible examples of this style from Glen Canyon. The five examples from the Kaiparowits Plateau appear comparable in morphology and technology to the examples described and illustrated by Geib and Ambler (1991:18–19) and Tipps, Hewitt and Lucius (1989). The burial assemblage from Sand Dune Cave supports an early Archaic temporal affiliation, not only because of the stratigraphic origin of the burial pit but because of at least one associated Pinto point and a second that might be Pinto or Elko Eared. Recent excavations by NNAD on the Kaibito Plateau support this temporal placement: At the small open site AZ-K-25-28, excavation recovered a point classifiable as Sand Dune Side-notched in association with hearths that have a pooled mean radiocarbon age of 7741 b.p. (Bungart, Collette and Spurr 2001). Consequently, we assume that this point type is an early Archaic

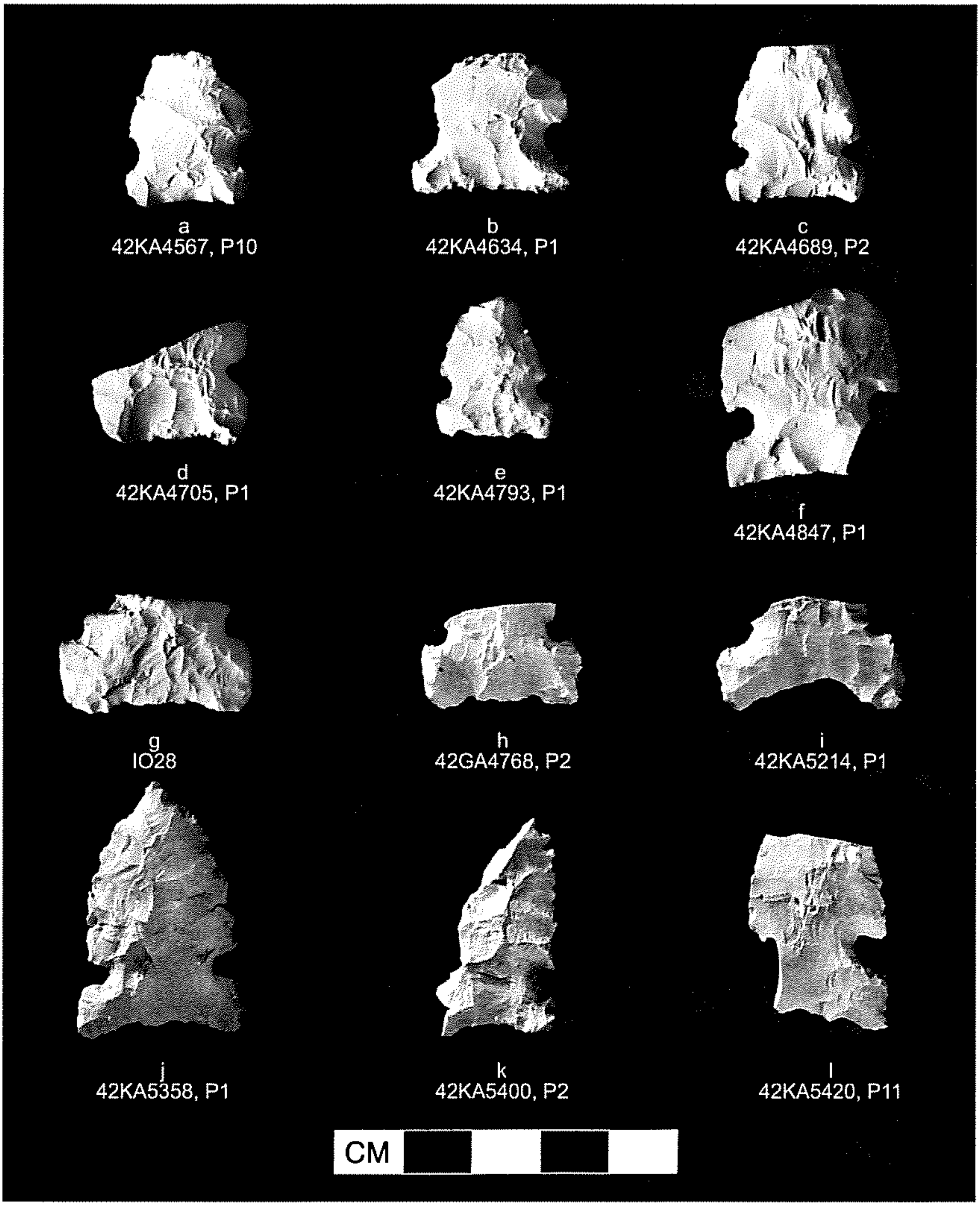


Figure 6.13. Northern Side-notched points from the Kaiparowits Plateau Survey.

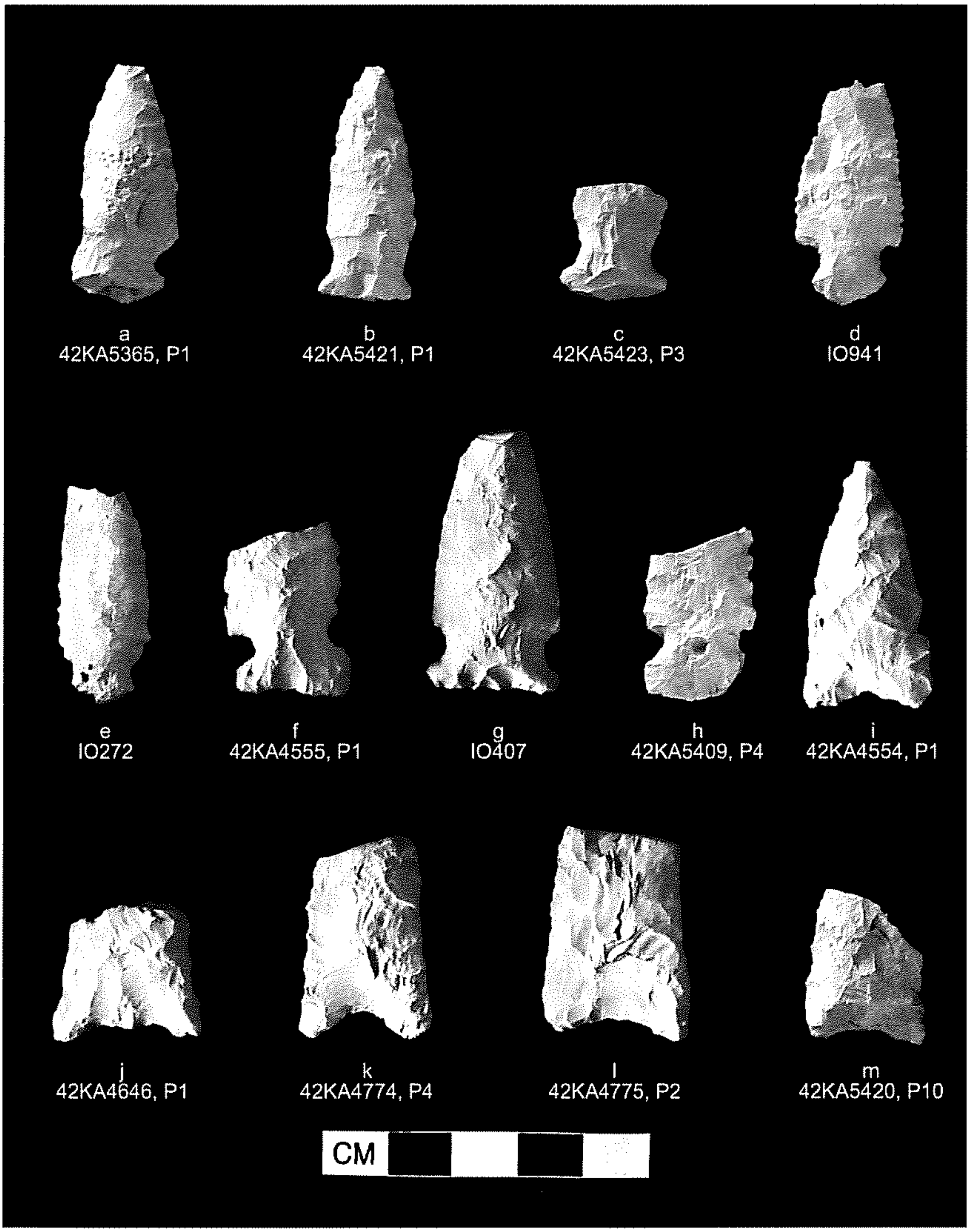


Figure 6.14. Several Archaic point types from the Kaiparowits Plateau Survey: a-e, Sand Dune Side-notched; f-h, Hawken Side-notched; i-m, Cortaro.

diagnostic. At one of the sites with this point type we found a short-stemmed point with ground margins that might be a Pinto variant (Figure 6.23 mm) and that provides potential corroboration for the early Archaic assignment.

Middle Archaic Types

The chief diagnostics for the Middle Archaic are dart points with high side-notches and basal morphologies that range from somewhat convex to greatly concave. Holmer (1978, 1980a) originally proposed three types to embrace the range of variability, but has subsequently suggested using just two types: Sudden Side-notched and San Rafael Side-notched (Holmer 1986). Low side-notched points with lanceolate blades that get included within the Plains type Hawken are also diagnostic of the middle Archaic.

Sudden Side-notched. Thirteen examples of Sudden Side-notched points were collected, 12 from sites and one as an isolated occurrence (Figure 6.15). Holmer (1980a:76) created this type to accommodate high side-notched points with a flat to slightly convex base that were recovered from Sudden Shelter. At that time he identified a group of similarly high side-notched points with rounded bases as a separate type known as Rocker Side-notched. In his subsequent analysis of points from the intermountain West, Holmer (1986:104) dismissed the Rocker type, thereby including considerably more variation in basal treatment within the Sudden Side-notched type. The principal distinguishing criterion is a high side-notch, usually placed about a quarter or more of the blade length above the base. The only other named point type with such a high notch is San Rafael, but a markedly concave base distinguishes this type (see Figure 6.16). Point thickness is one contrast with typical San Rafael points, which often are quite thin relative to width.

The one gray area is with points that are slightly concave, such as shown in Figure 6.15e, j. A few other examples like this were observed in the field but not collected. According to Holmer's type description and illustrations, he did not recognize points of this type under the Sudden Side-notched umbrella, even when the rounded base (Rocker) variants were included. Others, however, have included the slightly concave based, high side-notched points as part of the Sudden type (e.g., Tipps 1988:83, Figure 25d; Tipps and Hewitt 1989:Figure 13b). We have taken the same course here and restricted the San Rafael type to points with moderate to markedly concave bases. The Escalante Project restricted the definition of Sudden Side-notched to high side-notched points with a flat base, typing any with a slight concavity as San Rafael Side-notched (Kearns 1982: 119). As a result, we may have typed some of their San Rafael points as Sudden (e.g., the point from 42GA2277 shown on Figure 61; Kearns 1982:156). Doubtless, there will always be examples that seem somewhat too concave for Sudden but not quite enough for San Rafael. Projectile points are hardly stamped out in molds, and considerable variability is expectable. In some sense, it may not make a large difference how these intergrade points are classified. At Sudden Shelter, Holmer (1980a:Figure 42) was able to demonstrate that, although San Rafael overlapped in time with Sudden, it extended somewhat later, overlapping with late Archaic Gypsum points. It is worthwhile to differentiate Sudden from San Rafael, but it probably is not worth agonizing about how to classify the intermediate specimens. There is also potential for point forms that are gradational between Northern and Sudden Side-notched; Kearns (1982: 191) also mentioned the morphological continuum that exists between Sudden, Northern, and San Rafael types.

There is one essentially whole but heavily reworked Sudden Side-notched point in the collection, but the rest are fragments: one is snapped across the notches and the others have their tips snapped off. As a group these points are rather thick (mean of 5.5 mm), especially where the notches are placed, thus there is probably a greater chance for a tip fracture than a notch break. Tip fractures allow for resharpening, and most examples of this type seem to have been reflaked. A notch break results in two small portions unsuitable as projectiles. Several other sites contain uncollected portions of probable Sudden Side-notched points; there are also two isolated occurrences of this point type that were likewise not collected. Examples of this point type left in the field usually consisted of bases snapped across the notches.

San Rafael Side-notched. This is another type that Holmer (1980a:76) created for high side-notched points recovered from Sudden Shelter. This type has a markedly concave base and is usually quite thin for its width. The points of this type are similar to those identified as Mallory on the northern plains (Frison 1978; Lobdell 1974). This type is found in comparatively low frequen-

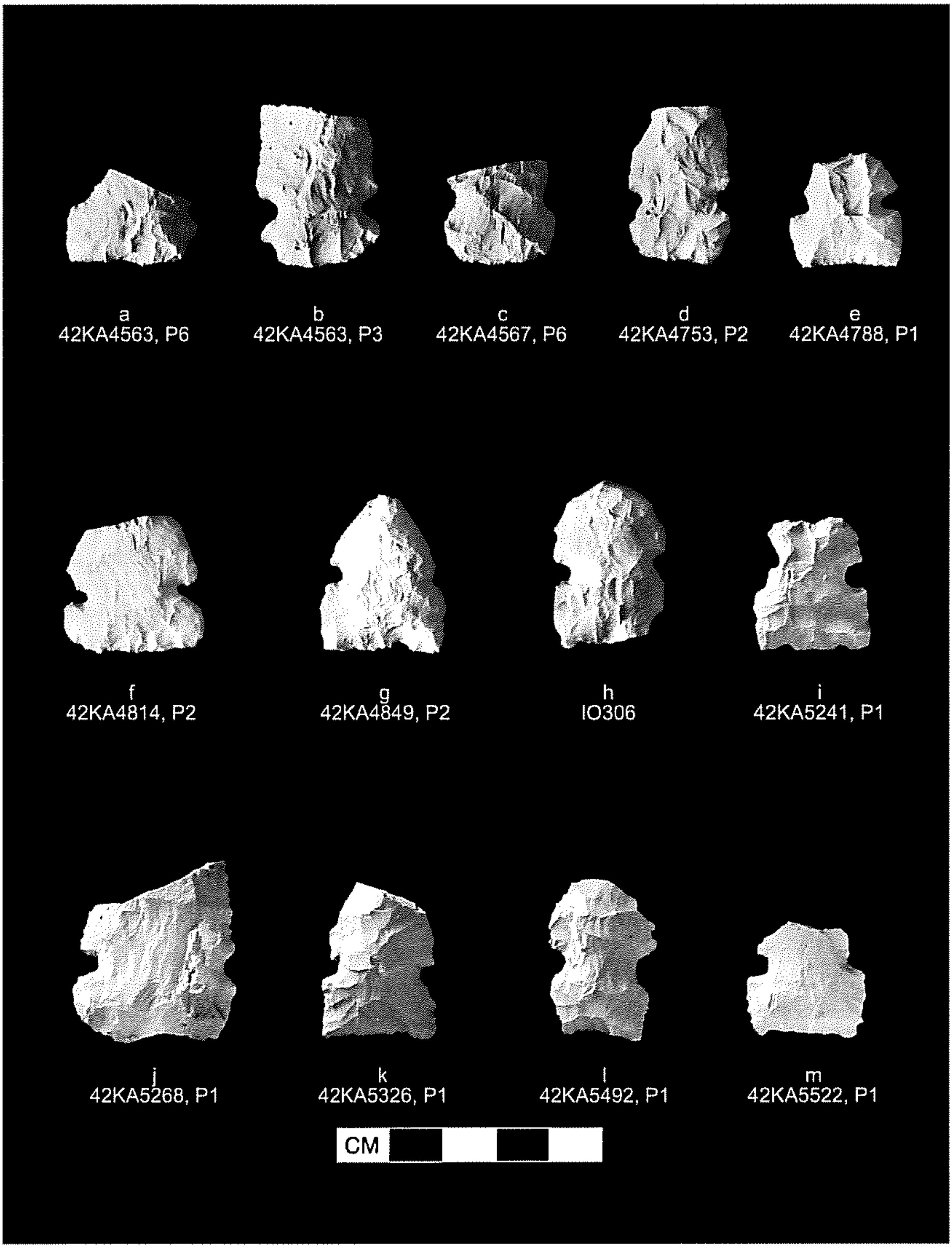


Figure 6.15. Sudden Side-notched points from the Kaiparowits Plateau Survey.

cies across southern Utah and northern Arizona; just six examples are identified in the points collected from the Kaiparowits Plateau (Figure 6.16). One of the points occurred at a Fremont temporary camp (42KA5411) and was probably scavenged from elsewhere. A search of the site and IO databases revealed that field crews observed just one other possible example of this point style at a site. We did expect to find more examples of San Rafael Side-notched because Kearns (1982:190) documented 16 San Rafael points for the Escalante Project and seven of these occurred on sites on the northwest portion of the Kaiparowits Plateau (Tract II). As mentioned above, the Escalante Project typed all high side-notched points with a basal concavity, no matter how slight, as San Rafael Side-notched, whereas we only included those with a moderate to strong concavity in this type.

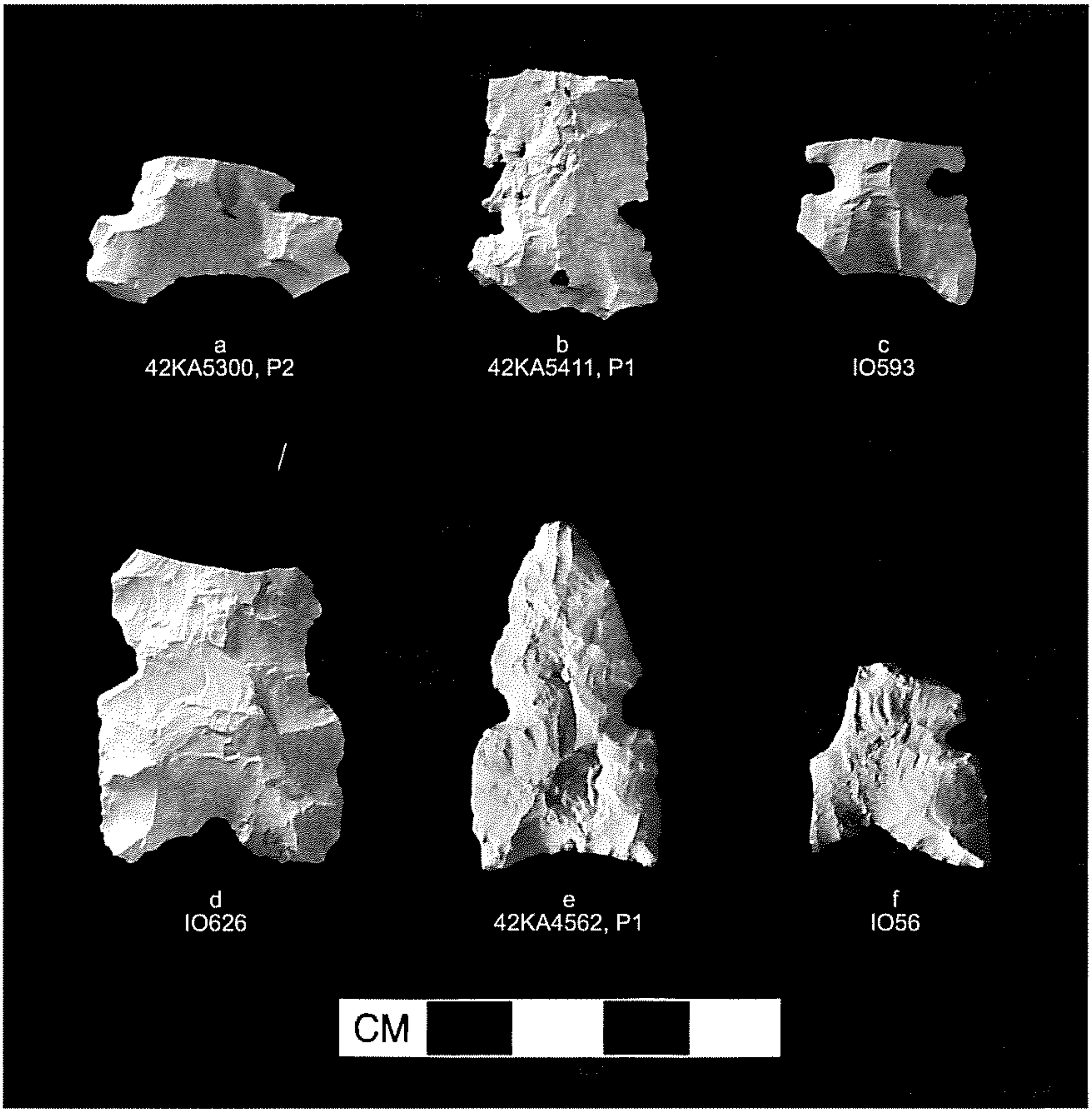


Figure 6.16. San Rafael Side-notched points from the Kaiparowits Plateau Survey.

Thus our numbers are not strictly comparable.

The collected specimens from the Kaiparowits Plateau Survey effectively illustrate the extremes in basal morphology commonly included in this type: from a moderate basal concavity to a pronounced concavity with what amounts to a notch at its apex. The example from 52KA5300 looks quite odd because it appears to have been reflaked below the notches after breaking, evidently to isolate small projections for use. The item collected as IO626 is an exceptionally well made example of this type with an even and thin section largely produced by percussion flaking; it has a width to thickness ratio of 7:1 (it measures 2.7 cm wide and 0.4 cm thick).

Hawken Side-notched. Holmer (1980a) extended this Plains type (Frison, Wilson and Wilson 1976) to the northern Colorado Plateau to classify the Sudden Shelter point assemblage. A key trait for separating this type from Northern Side-notched is its long lanceolate blade. In contrast, the preform type for Northern Side-notched is essentially an isosceles triangle, as with Elko Series points. Only three points collected during the Kaiparowits Plateau Survey are tentatively identified as this type (Figure 6.14f–h), two from sites and one as an isolated occurrence. The more complete example was found as an isolated occurrence on Paradise Bench; it measures 20 mm wide (14.5 mm wide across the notches) and 6 mm in maximum thickness. It probably had a complete length of 45 mm, though the blade may well have been resharpened. The specimen shown in Figure 6.14f is hardly typical, with one notch placed higher than the other. The Escalante Project identified only a single Hawken Side-notched point from a site off of the Kaiparowits Plateau. In general it seems that this point style is poorly represented in southern Utah and is perhaps difficult to consistently separate from odd versions of Northern Side-notched, at least with the small point fragments most commonly found during survey.

Late Archaic Types

Gypsum. The most common temporally diagnostic projectile point found during the Kaiparowits Plateau Survey is the Gypsum point. Thirty-eight examples were collected (Figure 6.17), 31 from 27 sites (4 with 2 points each) and 7 as isolated occurrences. At another 11 sites surveyors identified Gypsum points but did not collect them and also recorded but did not collect four Gypsum points as isolated occurrences. The Gypsum type is also known as Gatecliff Contracting stem following Thomas (1981). This is one of the most common Archaic point styles found on the northern Colorado Plateau and is one of the better temporal indicators. The points are the predominant late Archaic type at sites such as Sudden Shelter and Cowboy Cave. The evident occurrence of Gypsum points in deposits from the Archaic-Formative transition at Cowboy Cave (Unit V), and a few other cave sites of the eastern Great Basin, led Holmer (1978; 1986:105) to conclude that the type dates to between roughly 4500 and 1500 B.P. Berry and Berry (1986:309–310) argued that Gypsum points were not produced after about 3000 B.P. and that evidence for continuation of the type past this time, such as at Cowboy Cave, is erroneous, the result of prehistoric mixing of remains from pit digging. Schroedl and Coulam (1994) supported this speculation at Cowboy Cave in their reanalysis and revised interpretation of the site. On the Kaiparowits Plateau, it is likely that sites with this point style date prior to roughly 3000 B.P. It is worth mentioning, however, that Eccles and Walling-Frank (1998:10.25) reported Gypsum points from an Archaic-Formative transition site (Basketmaker II) near Colorado City on the western edge of the Grand Staircase. Consequently, the terminal age of Gypsum points is perhaps still open to debate, at least for a portion of southern Utah and northern Arizona.

Four of the collected Gypsum points are whole or nearly whole (small tip portions missing), and the rest are basal fragments snapped at varying distances above the stem. The Gypsum points left in the field were usually smaller fragments than those collected, sometimes just stem portions or examples badly damaged by fire. These points tend to snap at the tip, leaving the bases intact, which is perhaps one reason why they are so easily identified. The two whole points are both reworked, with the one found as IO313 quite extensively so (indeed it appears to be made from a point fragment). The points exhibit a great range in size (see Table 6.3), from the truly large specimen found as IO221 on Brigham Plains to what appears like an arrow-sized Gypsum point from site 42KA4594. The former measures 26 mm wide whereas the latter measures just 15 mm wide; they are however almost equally thick at 6 mm and 5 mm respectively. Size variability is perhaps simply a reflection of the size of the flake blank available when a tool was made, plus the likelihood that size was irrelevant for Gypsum hunters.

It is worth mentioning that a few of the Gypsum points have distinctly square stems. The best

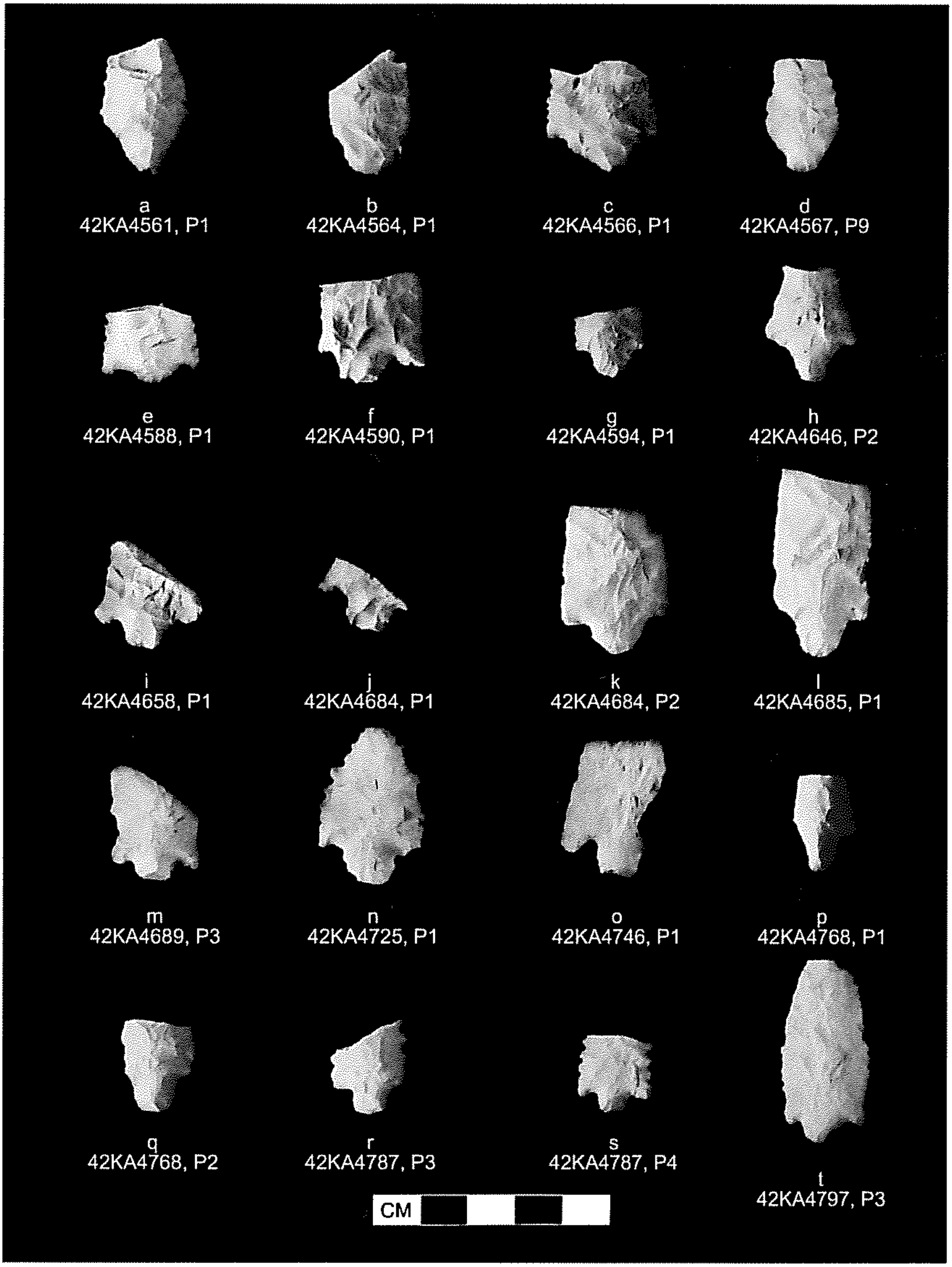


Figure 6.17. Gypsum points from the Kaiparowits Plateau Survey.

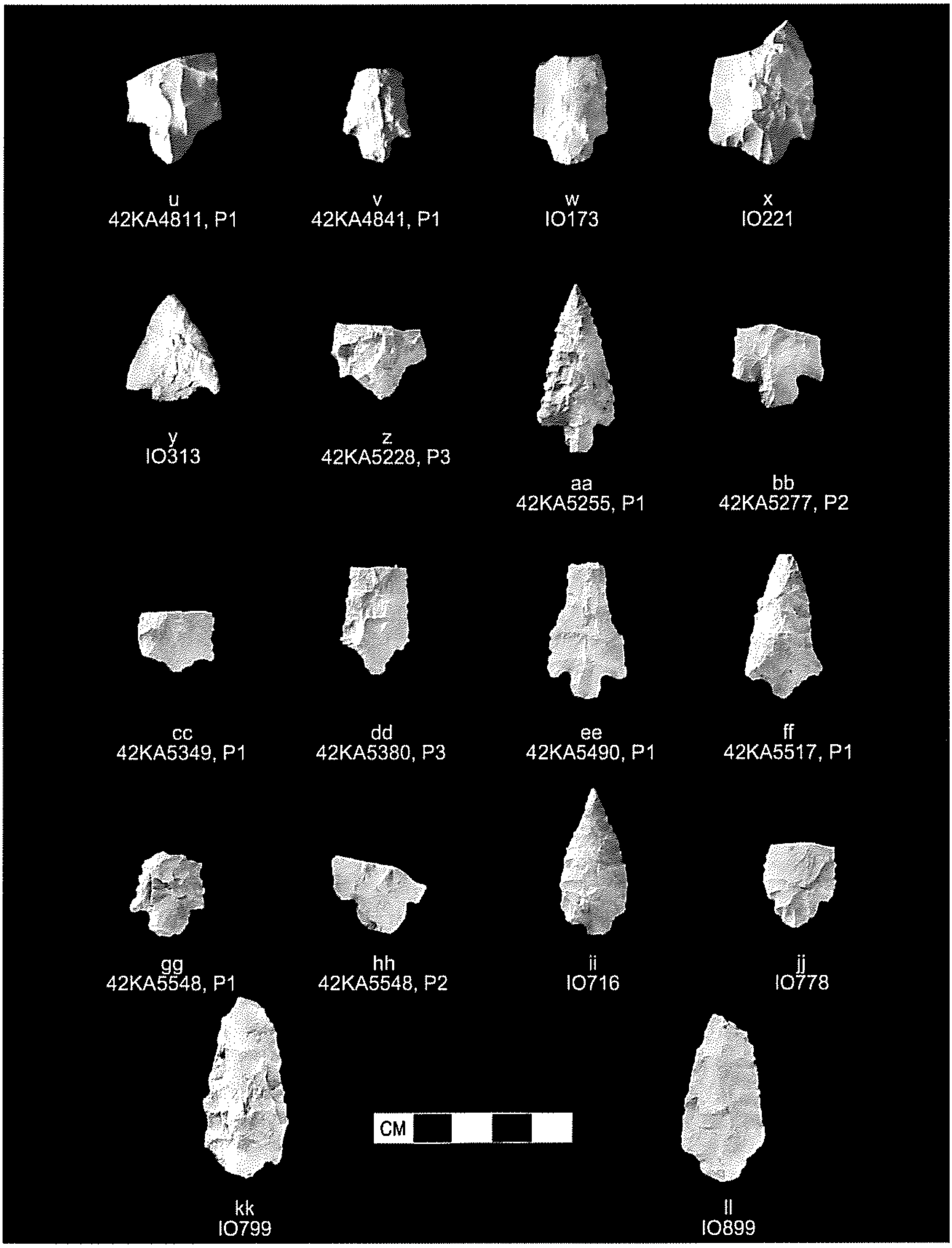


Figure 6.17b. Gypsum points from the Kaiparowits Plateau Survey.

examples of these are a whole point from 42KA 5255 (aa of Figure 6.17b), a base from 42KA5277 (bb of Figure 6.17b), and an example from 42KA 5490 (ee of Figure 6.17b) reworked into a drill. These might simply represent the range of variability in the Gypsum type. But, the finding of square-stemmed points from early Archaic deposits of Old Man Cave (Geib 2000a) suggests that this sort of point form may date far earlier than is commonly thought. The stratigraphic assignment of the Old Man Cave specimens to the early Archaic was confirmed by two nearly equivalent 7300 B.P. radiocarbon dates: grass packed around one of the points and pitch from the square stem of another point. Whether this dating has relevance for the Kaiparowits Plateau remains to be seen. For the present, however, we classified the points in question as Gypsum and assigned the sites they came from as late Archaic in age.

Cortaro. Five points collected from the Kaiparowits Plateau Survey are identified as Cortaro (see Figure 6.14i–m), a type that Roth and Huckell (1992) named for points from southern Arizona. These are dart-sized triangular points, somewhat like Cottonwood Triangular enlarged several times. Like Gypsum points they are unlikely to be confused for other types, except perhaps for Pinto points that have been extensively reworked, making them shoulderless. This should present little confusion, however, because the margins of Cortaro points are not ground, whereas an extensively reworked Pinto point will still have basal grinding. McKean lanceolate is similar but the blade is elongate and leaf-shaped rather than triangular, usually expanding slightly in width above the base. The flaking on Cortaro points from southern Arizona is described as relatively crude and the examples from the Kaiparowits Plateau represent no great flintknapping feat. They may not be as crude as their potential southern counterparts because of better-quality materials on the Kaiparowits Plateau (i.e., something other than basalt, rhyolite, and low-grade chert). In this sense, the four examples from the Kaiparowits Plateau are less thick than those of southern Arizona (mean of 5 mm compared to 6.5–7.3 mm; Roth and Huckell 1992:Table 1); they are of comparable width. In southern Arizona the points are thought to date from somewhat before 4000 B.P. to around 2800 B.P. or shortly thereafter (see Roth and Huckell 1992:362–366). In essence this places the points at about the same time as Gypsum points. Consequently, we consider the Cortaro type a late Archaic temporal diagnostic.[5] Perhaps supportive of an Archaic age, two of the Cortaro points were patinated, one moderately so.

Elko Series Points

Projectile points classified as part of the Elko Series are the most common dart-sized projectile point found during the Kaiparowits Plateau Survey (Figures 6.18–6.22). One hundred sixty-two examples of three Elko point types were collected and many more examples were left in the field. Heizer, Baumhoff and Clewlow (1968; Heizer and Baumhoff 1961) named the Elko Series for distinctive points from excavations at rockshelters such as Wagon Jack, in Elko County, Nevada, within the western Great Basin. Of the four types or variants recognized by Heizer, Baumhoff and Clewlow, corner-notched, side-notched and eared are used in this report. The contracting stem type is now designated as Gypsum (or Gatecliff Contracting Stem by Thomas 1981). Holmer (1986:102) argued that "the corner-notched and side-notched varieties are not separate forms but constitute a continuum between the two extremes... all should be referred to as Elko Corner-notched." In any large sample of Elko points the gradational nature of notching angle is evident, yet there is a difference to a flintknapper between making a corner-notch and a side-notch. The notching mechanics might be the same but it is not just a random choice to start notching either above the base of the preform (resulting in a side-notch) or from the corner (resulting in a corner-notch). Of course, a mistake in side-notching that removes the tang projection will result in a corner-notched point. The reverse, however, is not true—a mistake in corner-notching that results in the removal of the barb does not create a side-notched point. There may also be somewhat of a difference in how the foreshaft is configured to accommodate the different notching angles. It is also worth pointing out that in the group of Elko Side-notched points there are some where the notch was made with the force directed straight into the point (perpendicular to the long dimension), whereas others were notched on an angle with the force directed similar to that with corner-notching. The latter results in side-notched points that more clearly mimic the corner-notched form, whereas the former method results in points that appear distinct. Good

[5]In southern Arizona this type is considered middle Archaic, reflecting a difference in the temporal placement of the middle and late subdivisions of the Archaic.

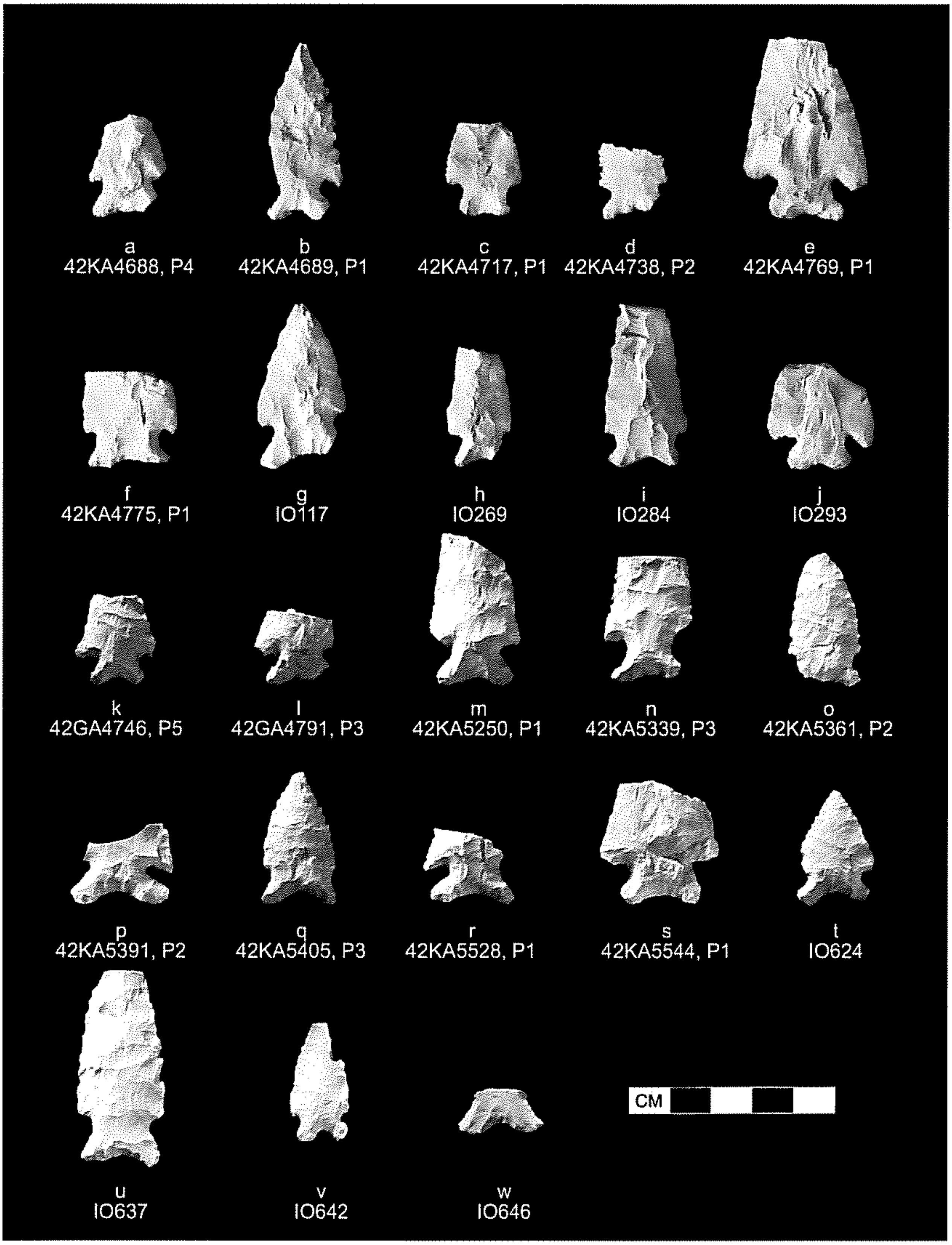


Figure 6.18. Elko Eared points from the Kaiparowits Plateau Survey.

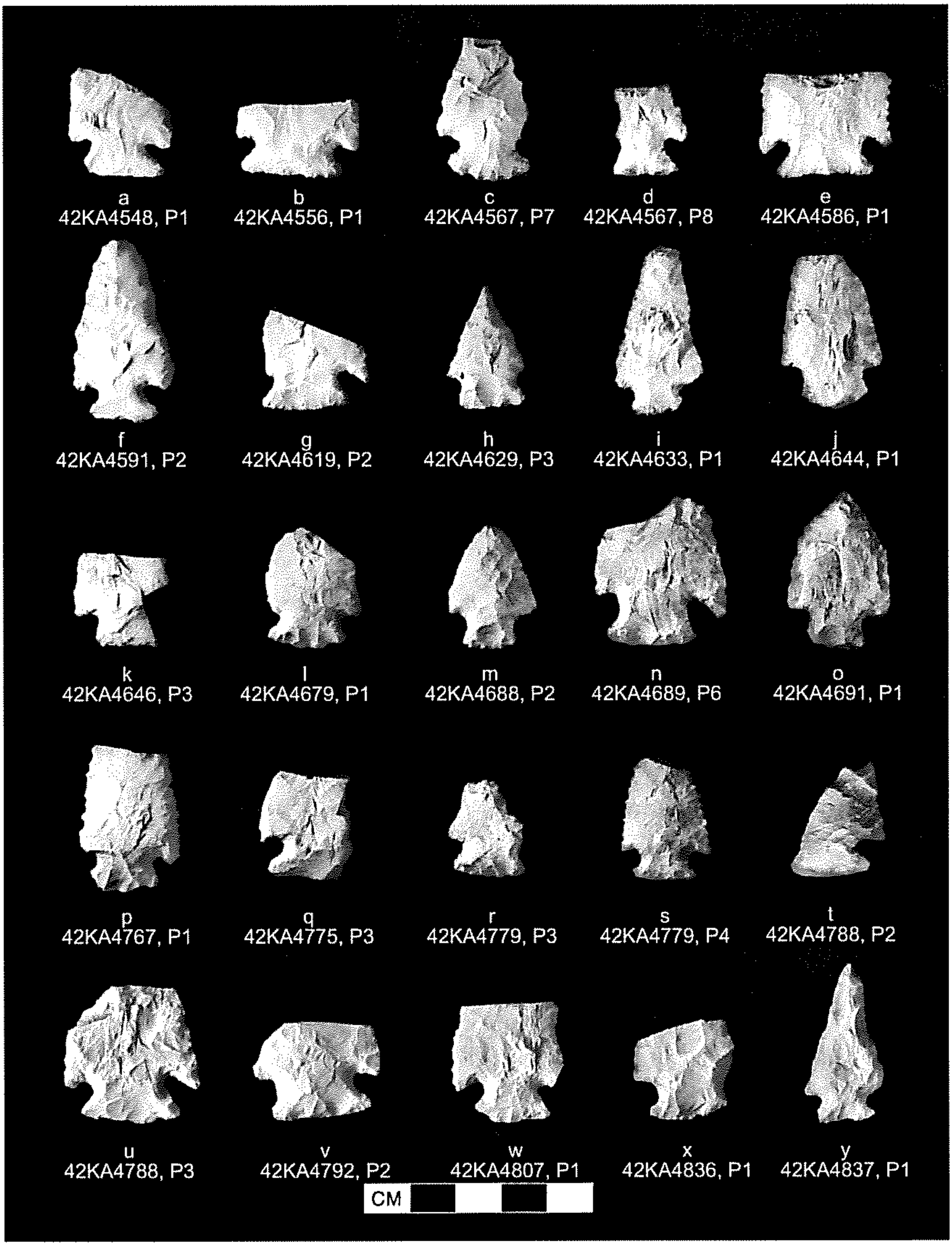


Figure 6.19. Elko Corner-notched points from the Kaiparowits Plateau Survey.

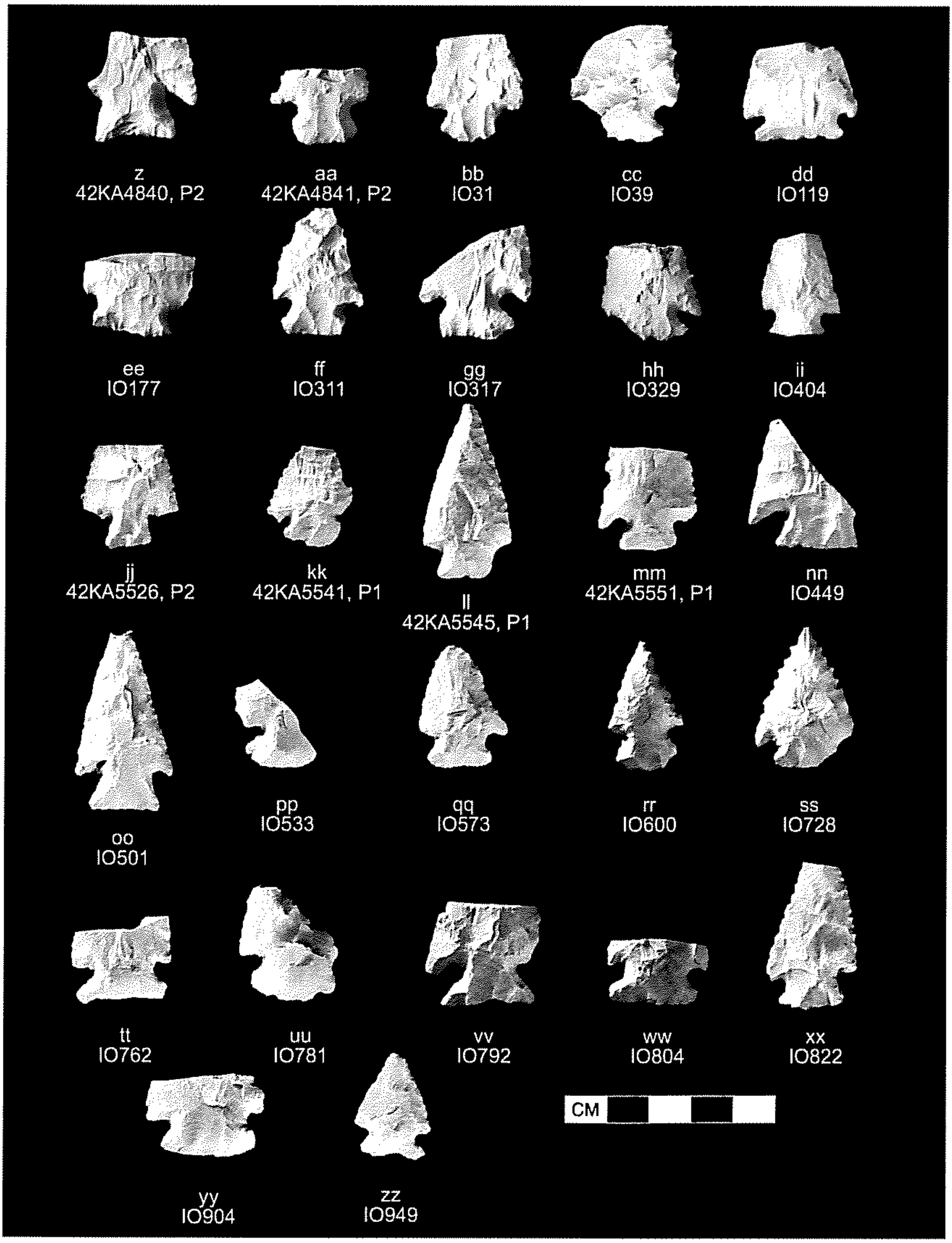


Figure 6.19b. Elko Corner-notched points from the Kaiparowits Plateau Survey.

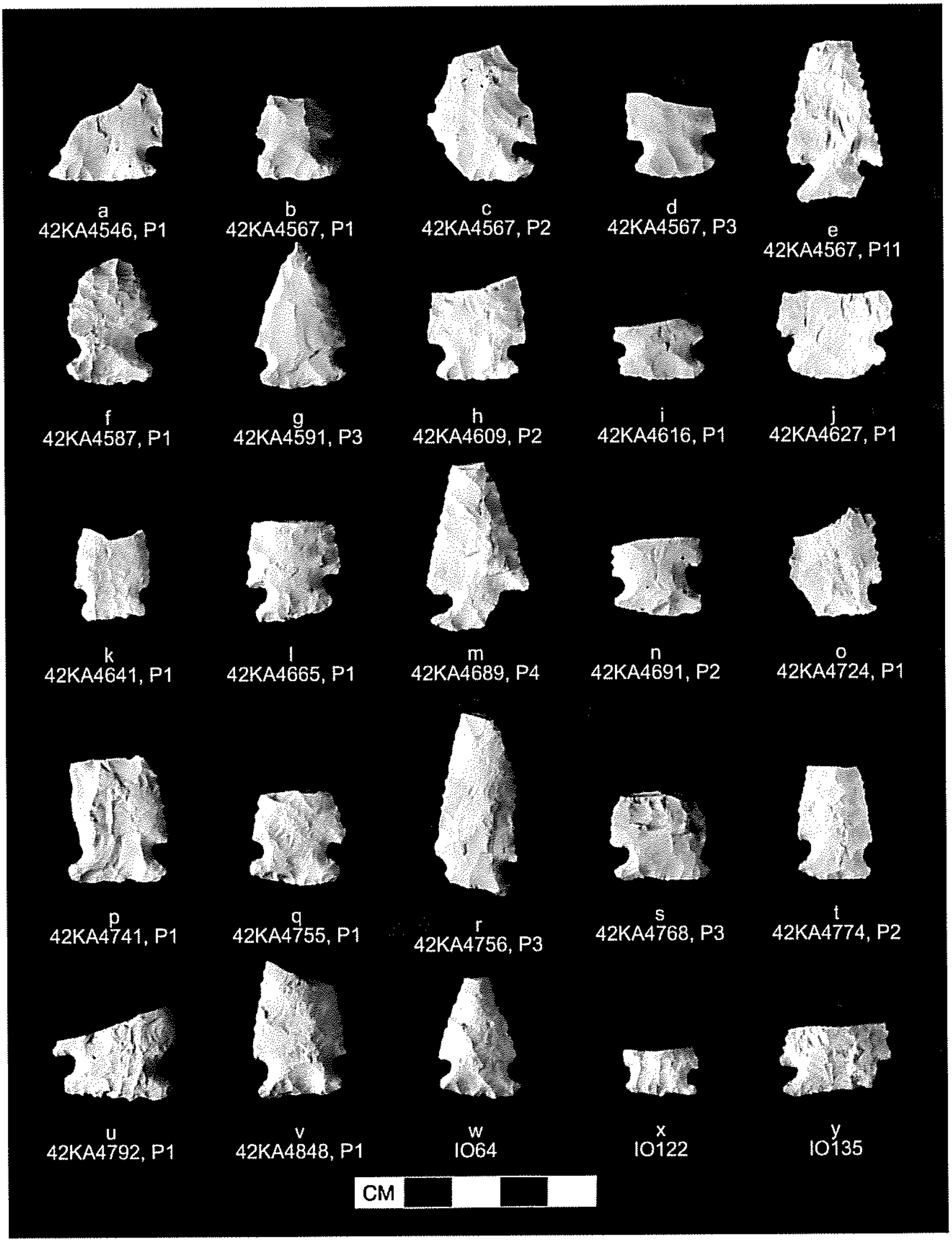


Figure 6.20. Elko Side-notched points from the Kaiparowits Plateau Survey.

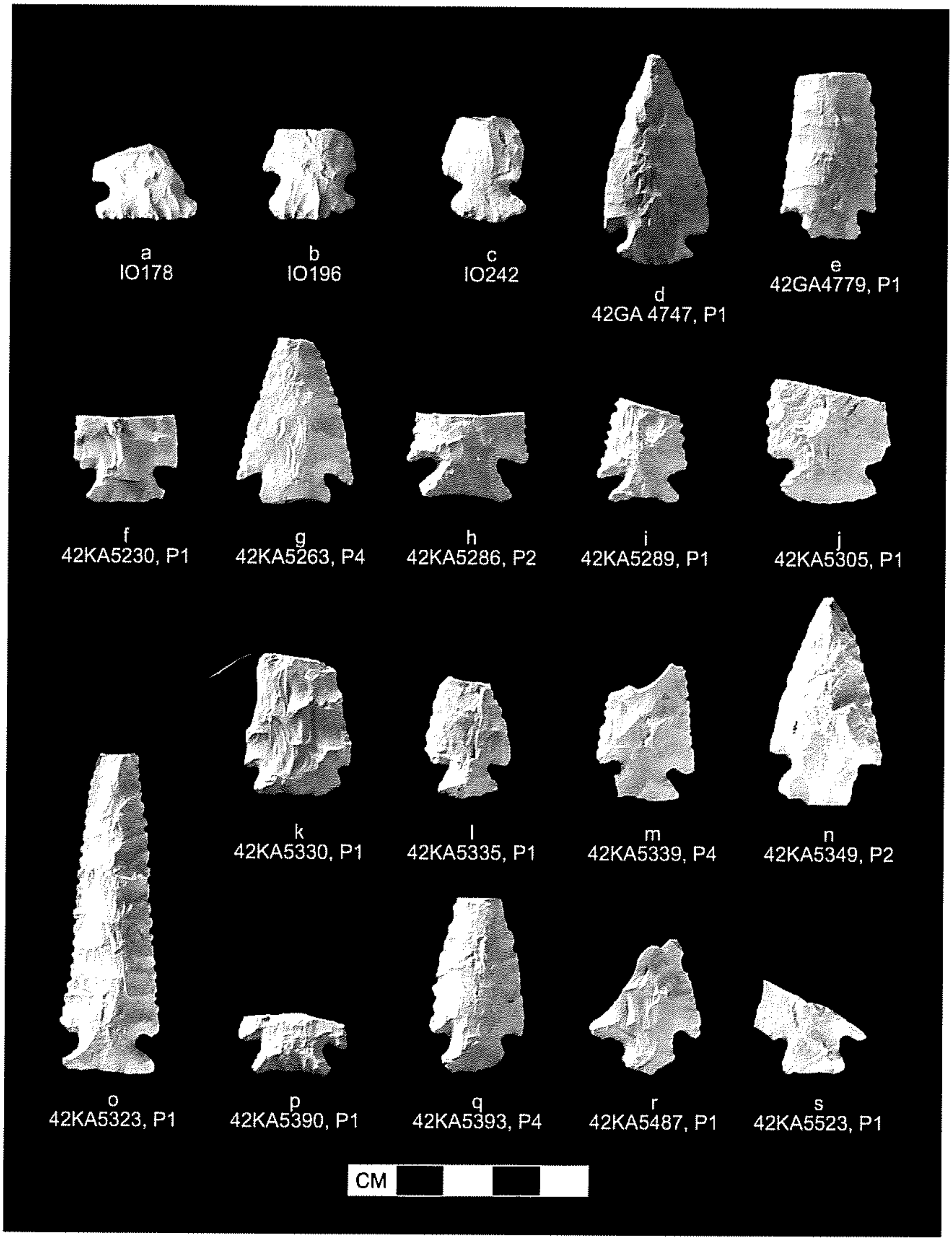


Figure 6.21a. Elko Corner-notched and Side-notched points from the Kaiparowits Plateau Survey.

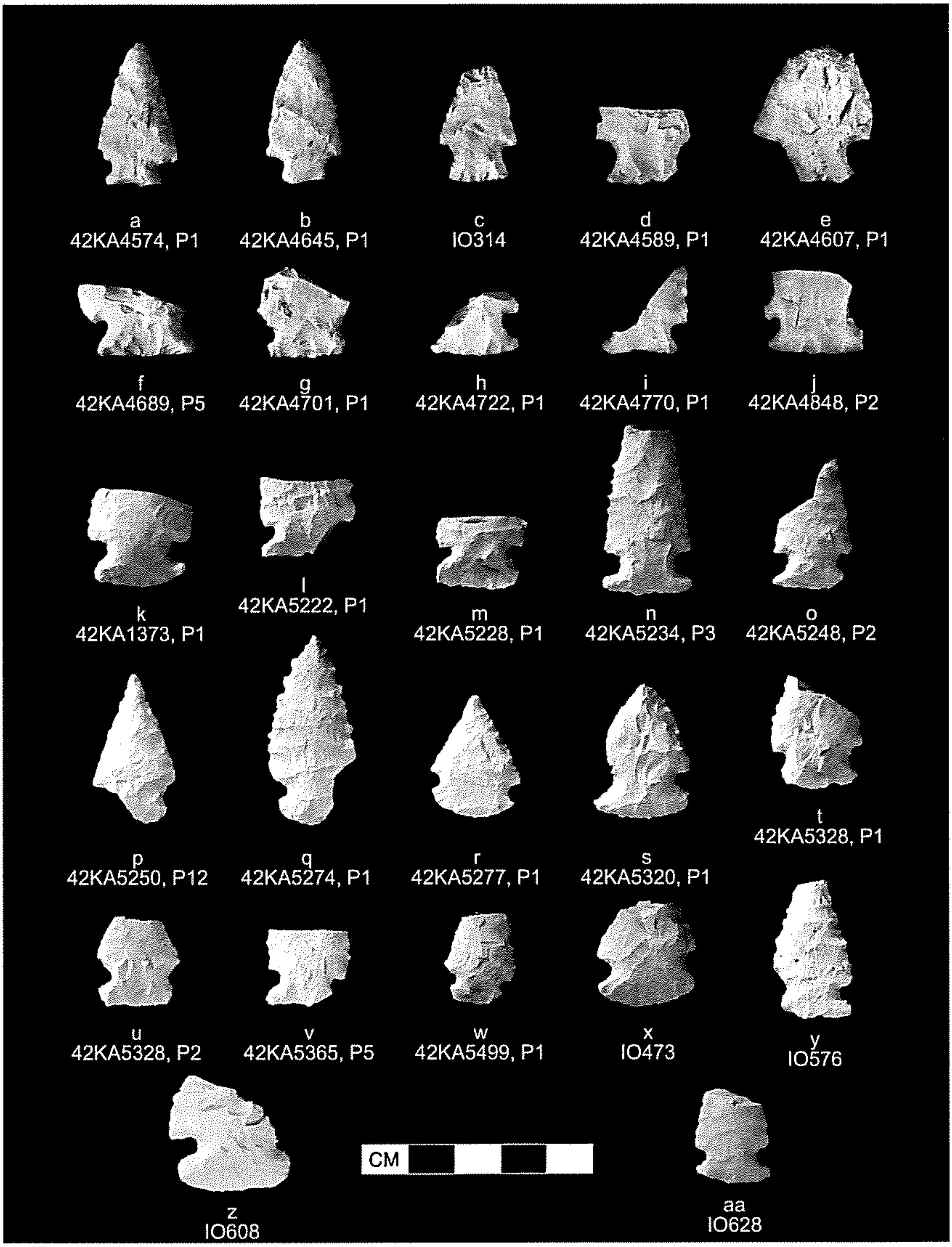


Figure 6.21b. Elko Corner-notched and Side-notched points from the Kaiparowits Plateau Survey.

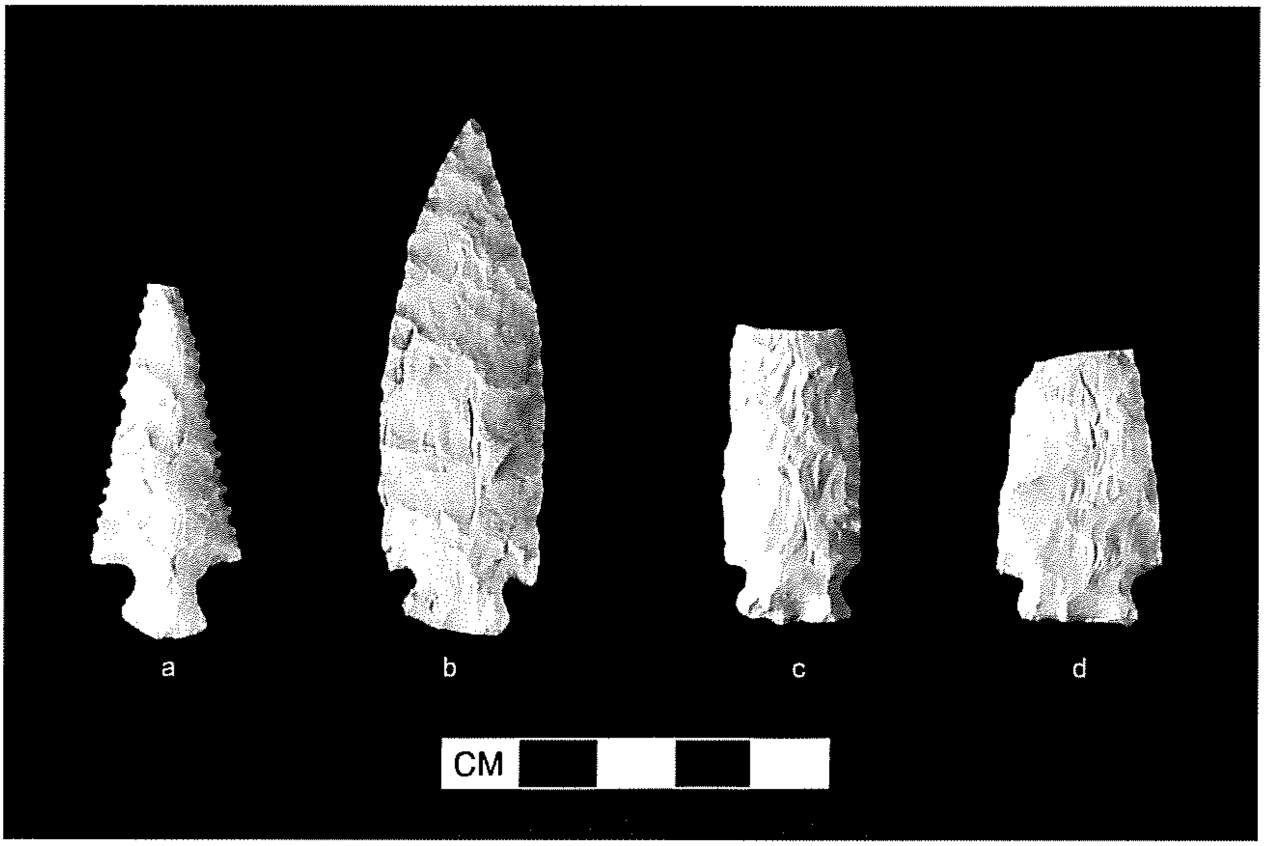


Figure 6.22. Elko series projectile points from the Kaiparowits Plateau Survey that are compared with western Basketmaker II points: a) 42KA4817, P1; b) 42KA4843, PI; c) IO146; d) IO225.

examples of side-notching with the force directed perpendicular to the long dimension are provided by several specimens in Figures 6.20 and 6.21.

In any event, we distinguished Elko Corner-notched from Elko Side-notched during the Kaiparowits Plateau Survey to the extent practical, giving the designation of simply Elko when no decision could be made as to angle of notching (i.e., the intergrade specimens). Of course, making this distinction does not help with temporal placement as far as we currently know. Elko Eared points are easily distinguished from the other Elko Series points; the one potential source of confusion with this style is with Pinto, as discussed earlier.

Holmer (1978:62) found that "Elko Series projectile points are the most plentiful but the least temporally diagnostic of the point types commonly found in the northern Colorado Plateau." With an approximate 7000-year duration (ca. 6000 B.C. to A.D. 1000), Elko Series points appear to provide rather imprecise temporal placement. In a later analysis of the problem Holmer (1986:101–102) found no way to partition the Elko temporal continuum into subtypes that might correspond to various intervals of the 7000 years of popularity. Given this situation, many researchers consider finding Elko points as really no better than not finding them when it comes to making temporal inferences. We have done the same on other projects, but on this survey we began to wonder whether the presence or absence of white patina on flakes and tools associated with Elko points might help to segregate assemblages into those that are likely Archaic and those that are likely post-Archaic. By about the end of the third session of Phase 1 fieldwork this seemed a reasonable possibility. In the spirit of making the most of the evidence at hand, we have used the occurrence of Elko Series points with patinated flakes to infer a minimal Archaic age. For the ESCA-Tech survey on the northern portion of the Kaiparowits Plateau and adjacent tracts, Kearns (1982) considered Elko points as Archaic diagnostics.

The 162 Elko points collected during survey are shown in Figures 6.18–6.22 according to the following types: eared, corner-notched, side-

notched, and corner/side-notched (many intergrade points are too damaged to distinguish). Of this entire collection the eared points are the most interesting and may have the most temporal information. Data on point patination presented in Chapter 7 reveal that as a group the eared points are more patinated (52%) than the other Elko types (29% C-N and 28% S-N). This seems to support the notion that production of Elko Eared may have been more temporally restricted, whereas production of the other two types persisted into the Formative period. A few of the Elko points are whole; thus length measurements are given in Table 6.3. These points commonly break across the notches, resulting in small base portions and larger blade portions. It seems to have been common to notch the large blade portions above the old break to create a new expedient but totally serviceable point. The snapped ends are usually left unmodified and are readily identifiable.

Basketmaker II Points?

Recognizing sites on the Kaiparowits Plateau that date to the Archaic-Formative transition is problematic. The points of early farmers such as the western Basketmakers are similar in some respects to those of the preceding Archaic hunter-gatherers. There are some potentially important morphological distinctions as outlined by Geib (1996:62–64), but it is often difficult to apply these criteria to the small broken fragments commonly found, especially during survey. Geib (2000b) has also outlined some technological distinctions owing to the use of mountain sheep horn flaking tools by western Basketmaker flintknappers (those of the Kayenta Anasazi region). Four of the collected Kaiparowits Plateau specimens were set aside during analysis from the rest of the Elko points as potential Basketmaker II points (Figure 6.22), but none of these specimens is an unequivocal good candidate. The notching on the point shown as (a) is similar to that seen on many western Basketmaker II points, but the blade is wrong because of its triangular shape and serrations. The serrations are from resharpening and likely have made the blade look more triangular than it was originally. The other example from a site (Figure 6.22b) has the right blade shape and length (it measures 67 mm long, 22 mm wide, and 5 mm thick) and is a spectacular point because of how the maker oriented the blade to correspond with natural banding within the rock (see cover photo). The notches, however, are not very typical for Basketmaker II because they are rather shallow and narrow (ca. 4 to 4.5 in maximum width). The same discussion applies to both of the points found as isolated occurrences (Figure 6.22 c, d): the blades look good but not the notches.

So is this evidence for Basketmaker II groups on the Kaiparowits Plateau? At this stage we have to conclude that the evidence is tenuous. None of the points are convincing—all might simply be Archaic Elko points. The one unusual aspect is that two of the four points occurred as isolated occurrences. Just as during the Formative period, it is likely that if preceramic farmers used this western portion of the Kaiparowits Plateau, it would have been for hunting or other foraging pursuits and not farming. Residential bases may have been located along Cottonwood Wash or in other settings suitable to farming, with use of the plateau primarily logistic in nature. As a result, we would not expect to see the same type of evidence for Basketmaker II occupation as occurs on nearby settings such as the Grand Staircase (McFadden 2000), Rainbow Plateau (Geib and Spurr 2000), and Cedar Mesa (Matson 1991).

Another factor that may be involved here is the possibility of a social boundary in the Glen Canyon region during the interval when farming was first becoming established. Geib (1996) presented evidence for White Dog Basketmaker II populations occupying a broad region south and east of the Colorado River with limited use extending into the Glen Canyon lowlands. Areas north and west of the Colorado River in Glen Canyon appear to have been occupied by preceramic Fremont populations during this same interval. If this argument is correct, the lack of obvious western Basketmaker II dart points on the Kaiparowits Plateau comes as no surprise; indeed, it would be expected.

Untyped and Other Dart Points

A moderate proportion of the collected dart points (16%) were left untyped; this excludes the three Paleoindian points, three unfinished dart points, and six hafted knives. Not typing these 63 items kept the identified point types less cluttered with odd point shapes. Some of the oddness is the result of breakage, which precluded accurate determination of original point morphology. Some points are, however, just plain unusual (Figure 6.23).

Formative Arrow Point Types

Rose Spring Corner-notched. The first arrow points known to be used in the region are identi-

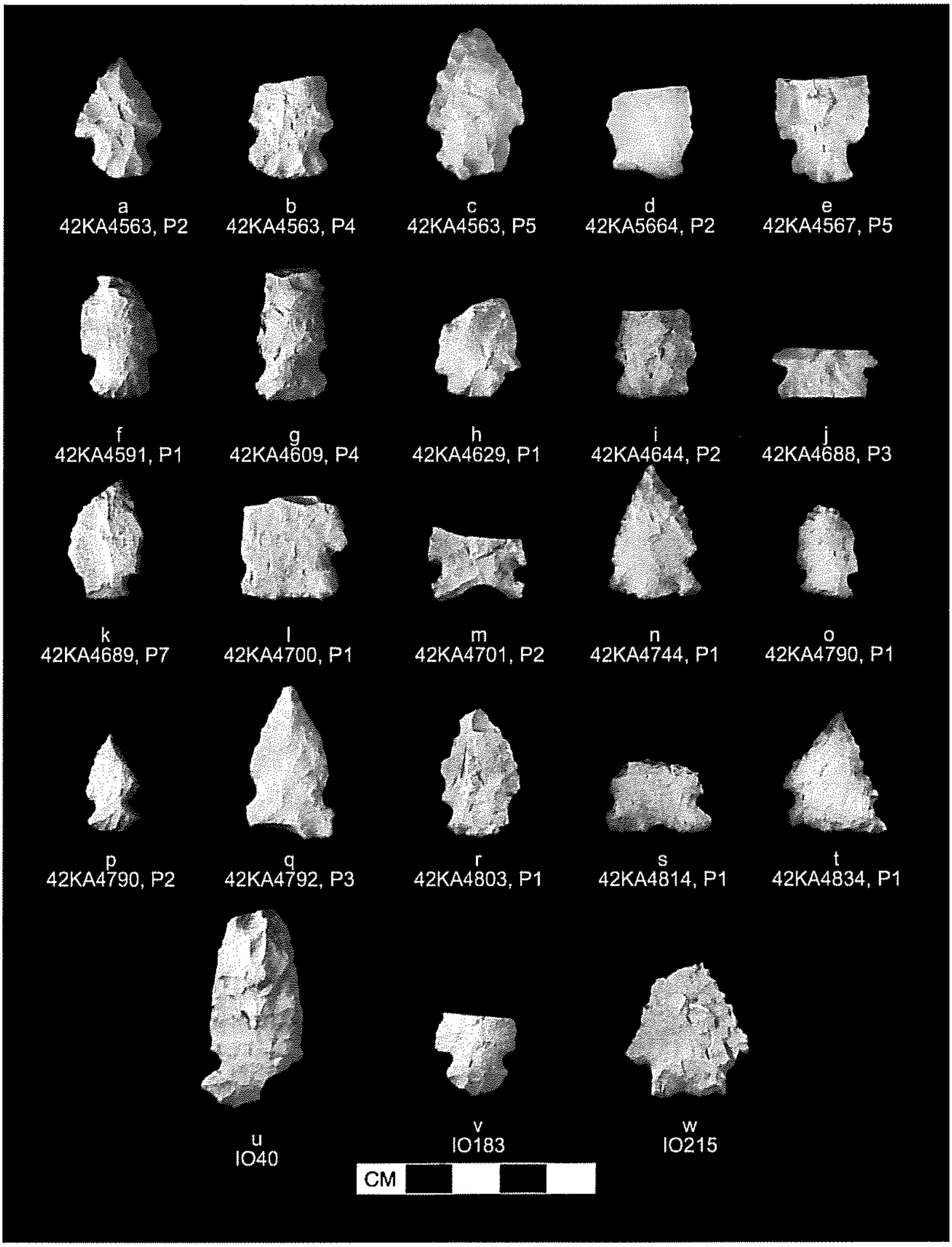


Figure 6.23. Various untyped points from the Kaiparowits Plateau Survey.

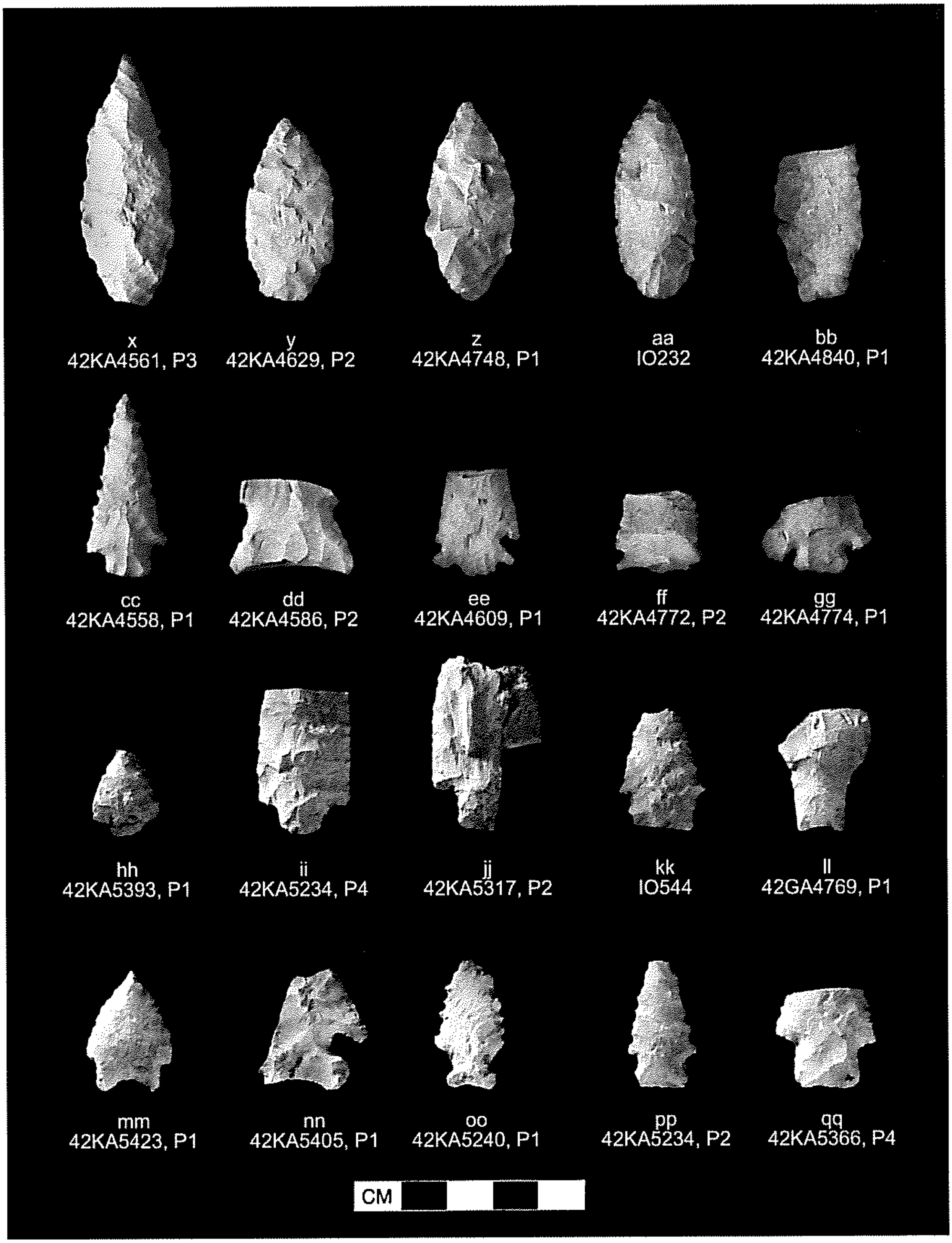


Figure 6.23b. Various untyped points from the Kaiparowits Plateau Survey.

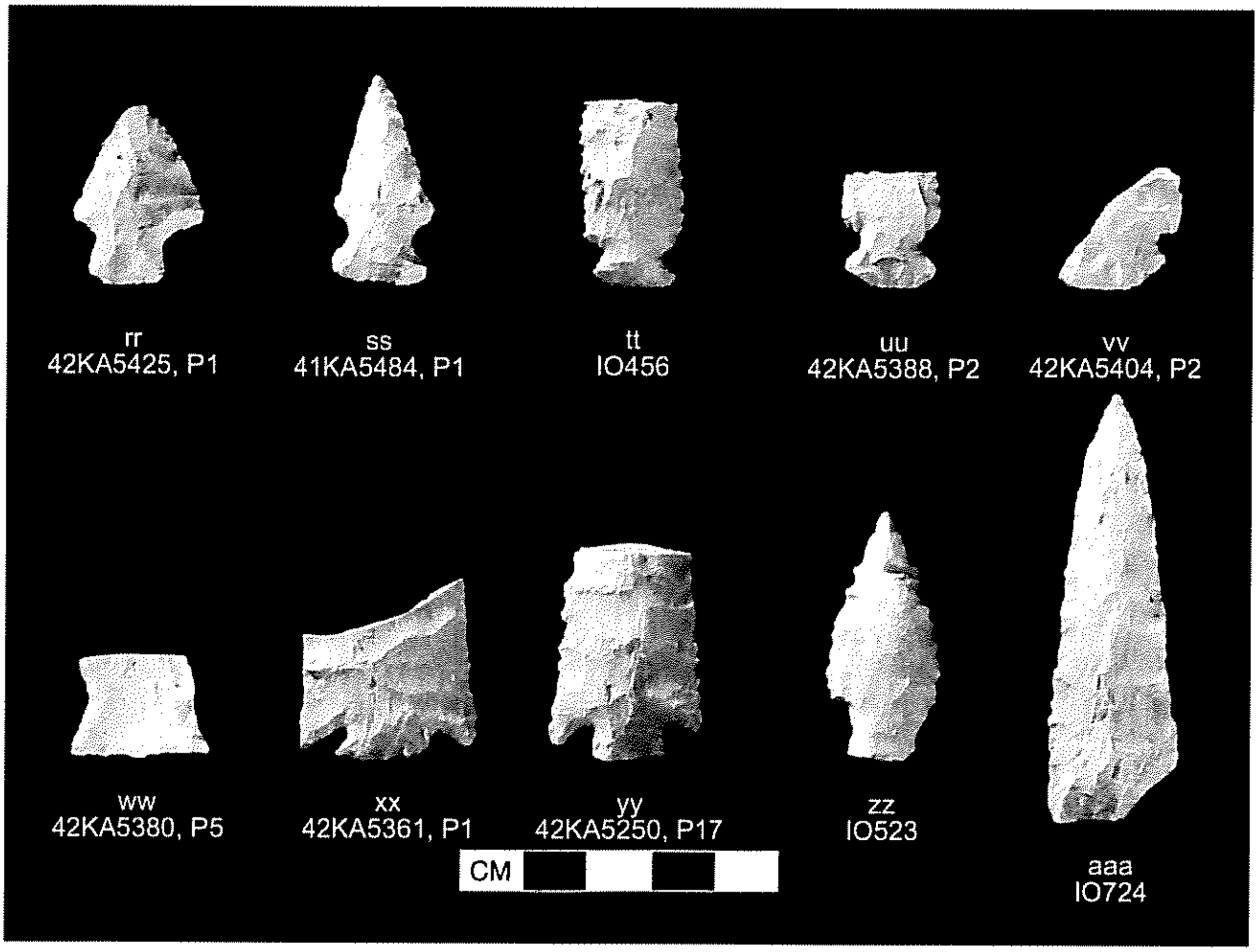


Figure 6.23c. Various untyped points from the Kaiparowits Plateau Survey.

fied as Rose Spring Corner-notched. This type, named from a western Great Basin site (Lanning 1963), is widespread and common on the northern Colorado Plateau, and appears to represent the transition to bow and arrow technology (Holmer and Weder 1980). These points commonly occur on early ceramic sites of the region but can also occur on preceramic sites and may date back to the start of the Christian era (see discussion in Geib 1996). As such, they are potential diagnostics of the preceramic farmers or terminal Archaic hunter-gatherers. Indeed, the limited testing of a site with a Rose Spring Corner-notched point but no sherds produced an associated ^{14}C date with a calibrated two-sigma age range of A.D. 255-435 (see Chapter 5). Unfortunately there is currently no way of knowing whether an aceramic site with Rose Spring points is actually preceramic in age or simply a ceramic period site without pottery. At present however, we consider the points diagnostic of the early Formative (ceramic) period.

Fifteen of the points collected on the Kaiparowits Plateau Survey are identified as Rose Spring Corner-notched (Figure 6.24). The Rose Spring points come from 13 sites and two isolated occurrences. A few sites had distal portions of possible Rose Spring points snapped across the notches. Two of the points classified as Rose Spring perhaps should have been included in the Anasazi stemmed category discussed next. They are exceedingly short and poorly made for Rose Spring and one occurred on a site with Virgin Anasazi pottery (42KA4578). This item is made of agatized wood, indicating a likely origin from the west. Other archaeologists have identified similar crudely fashioned and more straight-stemmed arrow points from Virgin Anasazi sites as Rose Spring (e.g., McFadden 2000:Figure 21; Walling et al. 1986:Figure 207h).

The Rose Spring point from IO123 is the largest and best made of the lot; it also has a light patina on one face. The tip is missing but its length

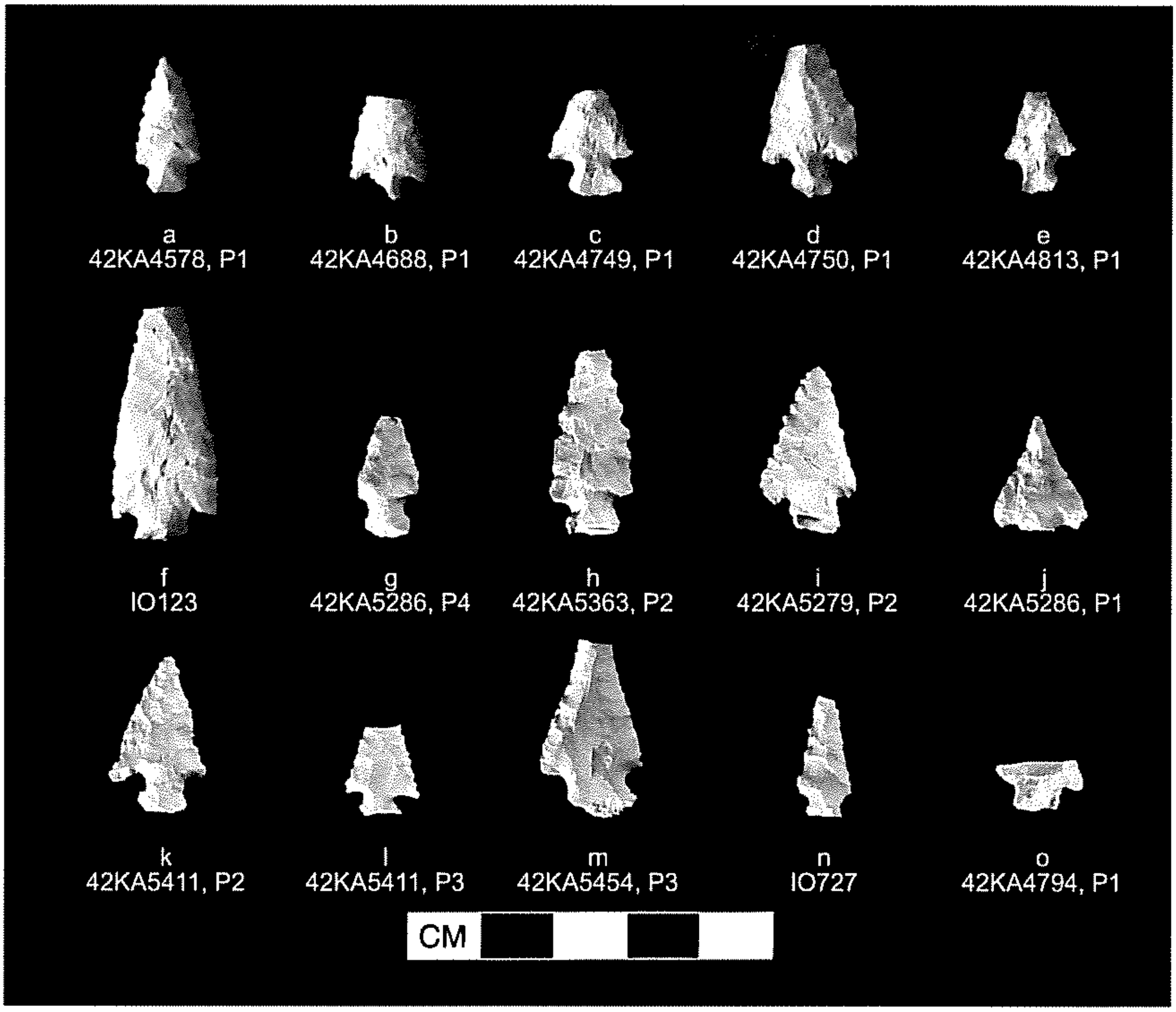


Figure 6.24. Rose Spring Corner-notched points from the Kaiparowits Plateau Survey.

can be estimated at about 38 mm; it is 15 mm wide and 3.5 mm thick. The point base in Figure 6.24o came from Rose Shelter, the small rockshelter on Jack Riggs Bench (42KA4794) with stratified cultural deposits (see testing results in Chapter 5). This base retains pitch from hafting but none of the other arrow point bases recovered from this site during testing retained evidence of pitch.

Parowan Basal-notched. A single point identified as Parowan Basal-notched (Figure 6.25a) is from site 42KA4756 on Paradise Bench along with an Anasazi short-stemmed point. This style is seen in low frequencies at Virgin Anasazi sites. The lithic materials at the Formative component of 42KA4756 suggest a possible western origin for its occupants (agatized wood was well represented).

Anasazi Stemmed. The four points identified as Anasazi stemmed are shown in Figure 6.25b–e. Points like this are common at Virgin Anasazi sites, where they have been called Abajo or even Parowan (e.g., Walling et al. 1986:Figures 207 and 208). There is clearly a large continuum of basal treatment in notched arrow points at Virgin Anasazi sites, ranging from Parowan-like basal notches with the stem flush with the barbs, to Rose Spring-like corner notches that leave a slightly flaring stem below the barbs, to notching that essentially results in a miniaturized Gypsum-like contracting stem. These points are perhaps mostly indicative of Pueblo II use of the Kaiparowits Plateau, but they might denote Pueblo I and Pueblo III use as well. Short-stemmed arrow points are

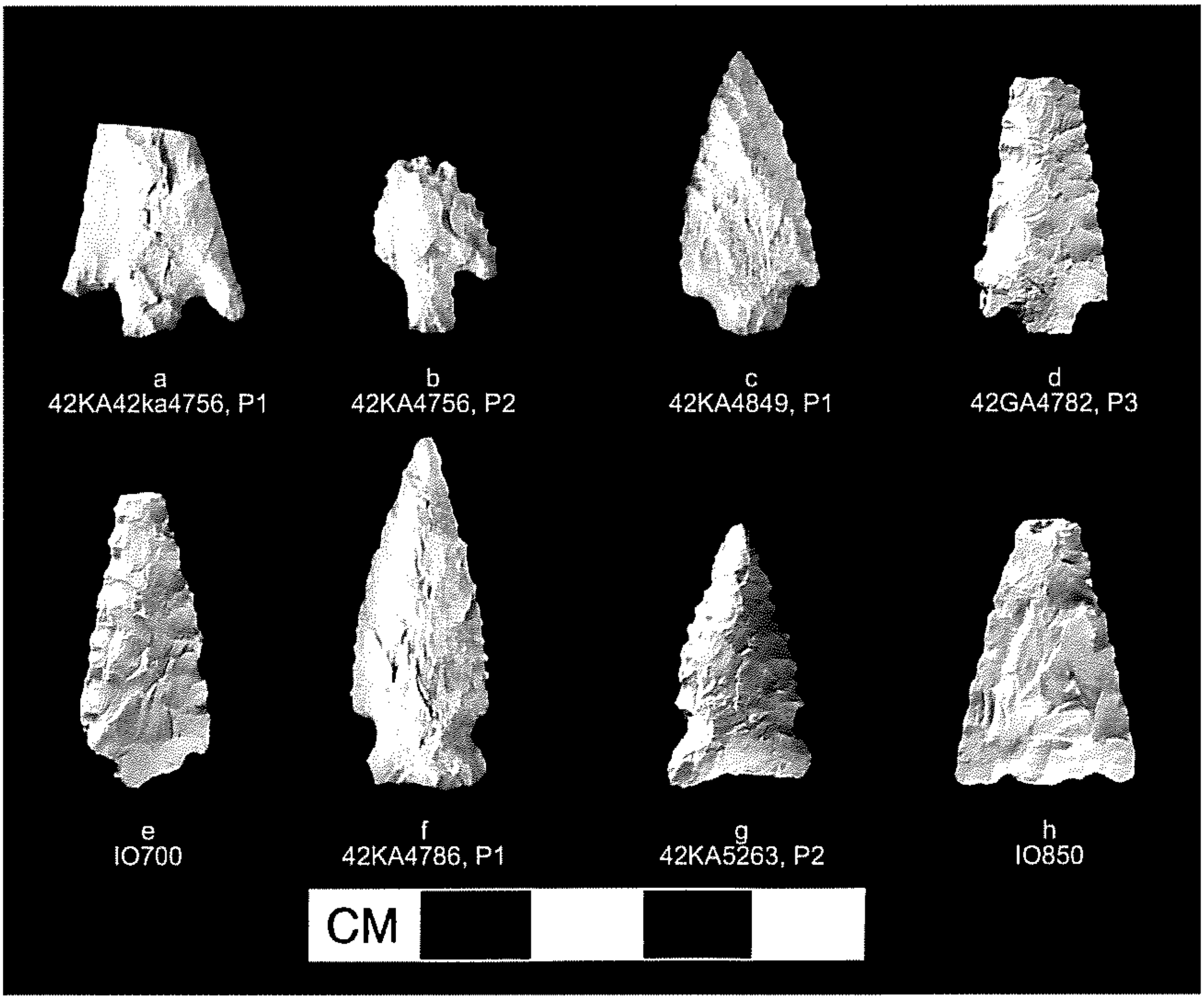


Figure 6.25. Several arrow point types from the Kaiparowits Plateau Survey: a, Parowan Basal-notched; b-e, Anasazi stemmed; f-g, Untyped side-notched; h, Untyped (stem missing).

generally not found on Kayenta sites east of the Colorado River, so, like pottery found on the Kaiparowits Plateau, they suggest a western origin for the Anasazi groups using portions of the plateau.

Untyped Side-notched. Two whole side-notched arrow points were found: one at site 42KA4786 on Long Flat and one of obsidian at 42KA5263 on Fourmile Bench. These points somewhat resemble Nawthis Side-notched (Holmer and Weder 1980) but it would be a stretch to type them as such. Moreover, differential weathering of the obsidian point (Figure 6.25g) reveals that the current form results from recycling an older point, which was probably dart sized; the notches and slight basal concavity were part of this original form. The flake scars forming the basal concavity and notches are heavily weathered and pitted; the more recently fashioned tip portion is also somewhat weathered, indicating that the reflaking was done some time ago. The other side-notched arrow point has a light patina on one face; it measures 31 mm long, 13 mm wide, and 4.5 mm thick.

Bull Creek. Weder and Sammons-Lohse (1981) named this type for points found at sites on the north side of the Henry Mountains. It is a common Pueblo II and Pueblo III projectile point found throughout southern Utah and northern Arizona at sites identified as Kayenta Anasazi, Virgin Anasazi, and Fremont. The Kaiparowits Plateau is almost central to the greater distribution of this type. Just a single Bull Creek point was found as an isolated occurrence on the Phase 1 survey. In contrast, the Phase 2 survey collected 12 examples

of this type, three as isolated finds and the rest from seven sites (Figure 6.26). Six additional sites contained examples of this type that were not collected, making the total number of sites with Bull Creek points 13. The increase in the number of Bull Creek points is a direct result of finding many more Anasazi habitations during the Phase 2 survey, virtually all of which occurred on Collet Top.

There is potential for confusion between Bull Creek and Cottonwood Triangular, principally because at single-component Anasazi habitations the degree of basal concavity on narrow isosceles triangle points can range widely, and usually includes flat-based forms as well. Where on the continuum of basal concavity does the point become Bull Creek? What we have done is relied on overall point shape rather than basal concavity, with the narrow isosceles form typed as Bull Creek and those with an essentially equilateral shape classified as Cottonwood Triangular. Note however that the point of Figure 6.26b is far more of an equilateral than an isosceles triangle—this specimen is perhaps a classic case of typing by association because it occurred in the midden of an Anasazi habitation along with the points of Figure 6.26c and d. Moreover, there is potential confusion with unfinished arrow point fragments that were broken in production and lack a final finished form. Indeed this is what most of the points typed as Cottonwood Triangular appear to be—some of these could have been destined to become Bull Creek but others were likely en route to be Desert Side-notched. There are, however, three instances where unfinished triangular points occurred on Formative period sites and in these cases the intended final point style was likely Bull Creek.

Post-Formative Arrow Point Types

For all intents and purposes there is only one truly diagnostic arrow point of the Post-Formative era—Desert Side-notched. Cottonwood Triangular might be an additional temporal diagnostic but we have reservations about this point type because of problems in distinguishing between finished and unfinished points and potential confusion with Anasazi triangular points.

Desert Side-notched. Desert Side-notched is a common horizon marker all across the desert West and into the plains. On the northern Colorado Plateau the appearance of this type is thought to mark the expansion of Numic populations. On the Kaiparowits Plateau, Desert Side-notched points are indicative of Post-Formative southern Paiute occupancy, anywhere from about A.D. 1300 to 1900. Eighteen examples of this point type were collected (Figure 6.27). Typical examples of Desert Side-notched have a basal notch or concavity and not just side-notches (Holmer and Weder 1980:60). Three of the Desert Side-notched points have basal concavities rather than basal notches; the rest have the pronounced basal notch. Even the fragment with snapped ears (6.27m) obviously had a pronounced basal notch; this is evident both by how the ears broke and by the remnant of the notch left at the base. It is clear from the size of the notches as well as the flake scar initiations that the pressure flaking tool routinely used to fashion points of this type had a tip diameter no bigger than 1 mm. Based on the nature of the notching flake scars, these points were notched using the "edge of tool" technique as described by Titmus (1985: 248–249). Two of the Desert Side-notched points are quite tiny, no larger than a dime (Figure 6.28). Pressure flaking tools used for these points must have had almost microscopic tips. Antler or bone worked down to such small diameters is quite fragile, which makes us wonder about the possibility that metal may have been used as pressure flakers for some of the points. Notches like this can also be made using an appropriate flake, so perhaps that is what was done.

Finding these points on sites often takes a concerted effort because of their small size, even when whole, let alone the tiny fragments such as shown in Figure 6.27k and l. Even the small portions are diagnostic, however, and can make all the difference in assigning a temporal affiliation with a high degree of confidence. Indeed this is precisely what happened at site 42KA4819 where the small fragment shown in (l) was found. The crew chief closely and carefully scrutinized the ground around the hearth at this site and finally found the item that confirmed his suspicion of a Post-Formative temporal affiliation.

Cottonwood Triangular/Unfinished Arrow Points. Figure 6.29 shows 12 items provisionally identified as Cottonwood Triangular. Most appear to be unfinished arrow points because they show signs of being broken during production rather than being finished items. Most, for example, have obvious perverse fractures initiated at a pressure flake scar. As unfinished items they lack a diagnostic basal morphology, thus typing them as Cottonwood Triangular might imply an unwarranted Post-Formative temporal affiliation. Unfinished arrow points indeed may have been headed for be-

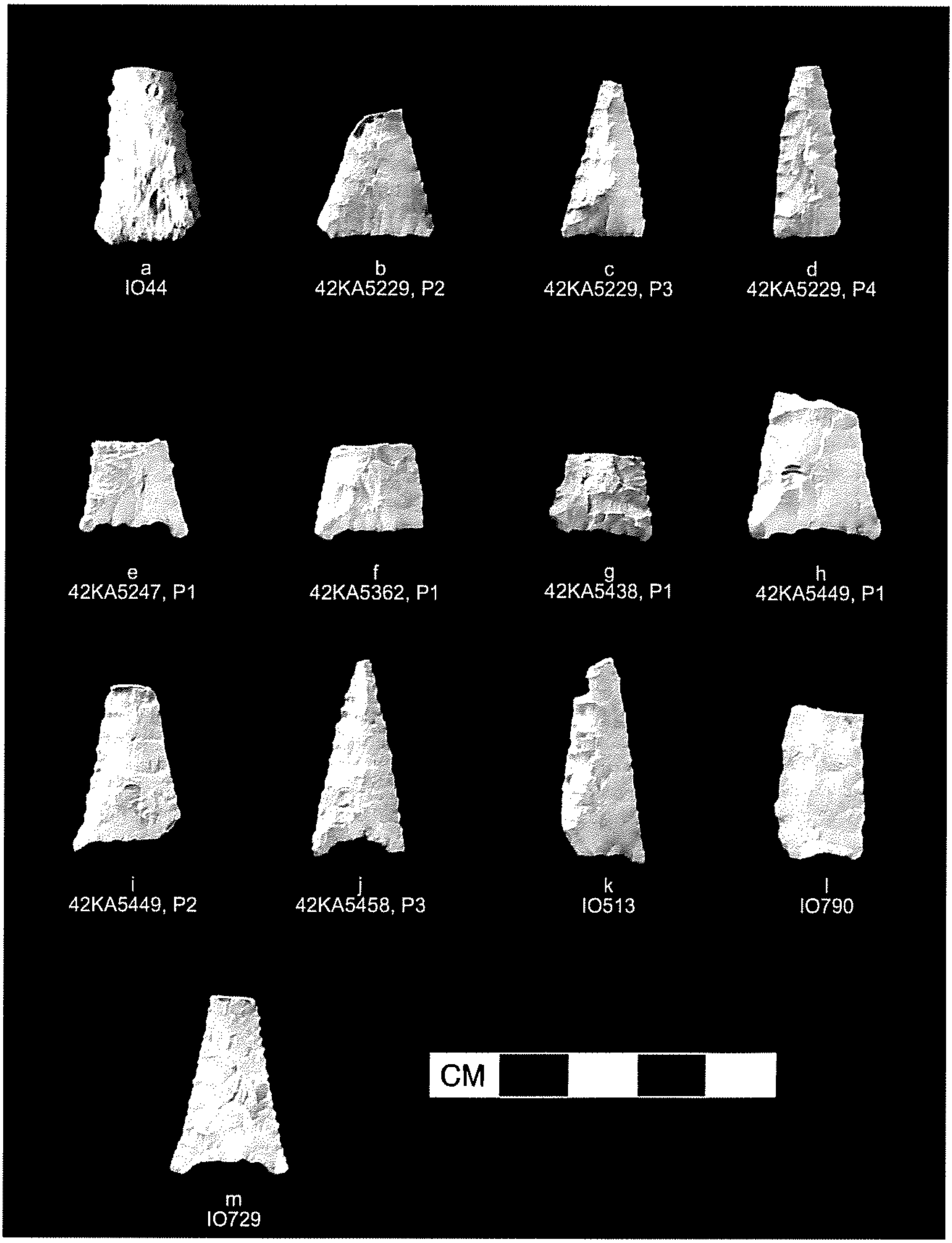


Figure 6.26. Bull Creek points from the Kaiparowits Plateau Survey.

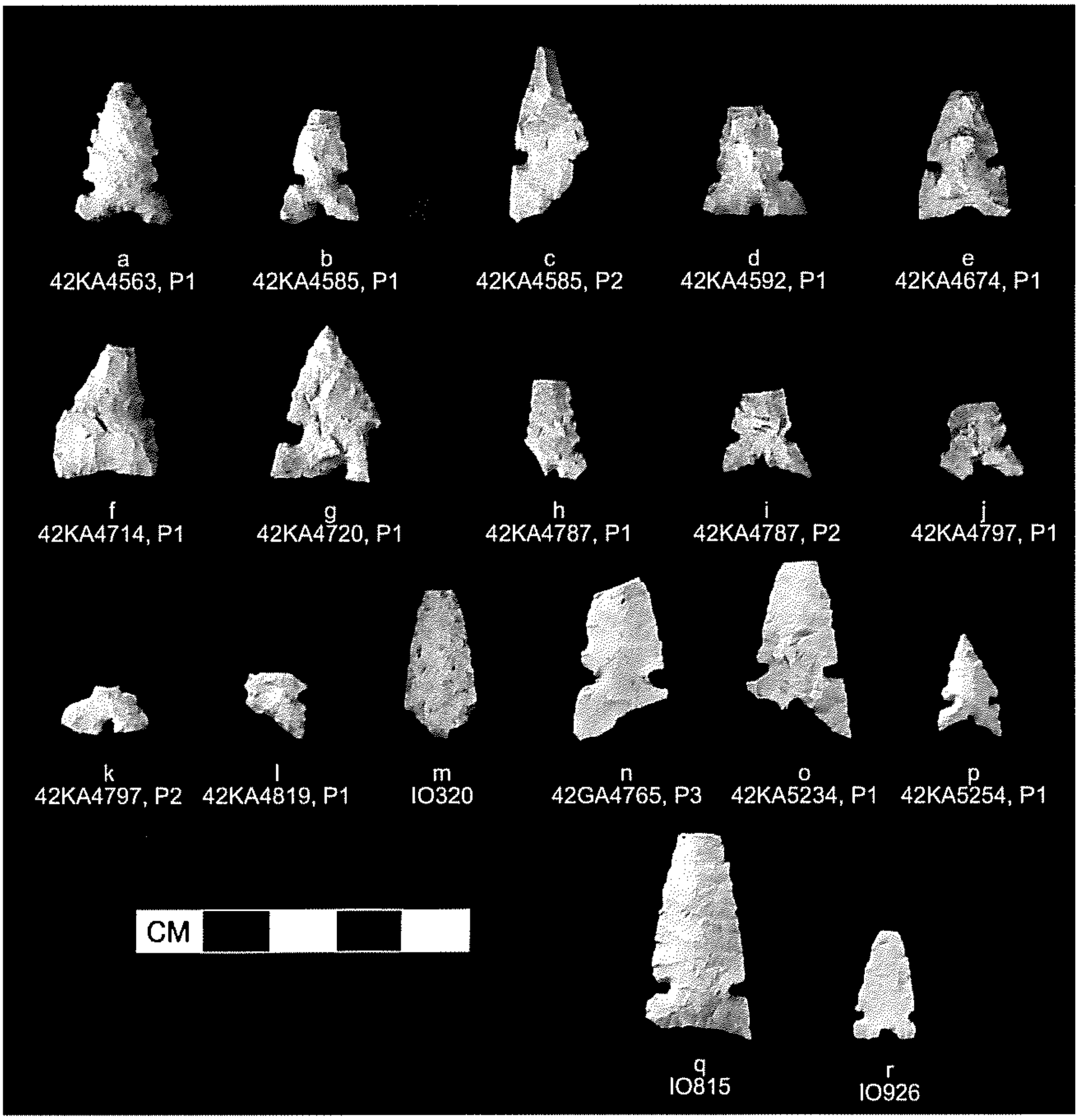


Figure 6.27. Desert Side-notched points from the Kaiparowits Plateau Survey.

Figure 6.28. Tiny examples of Desert Side-notched points.

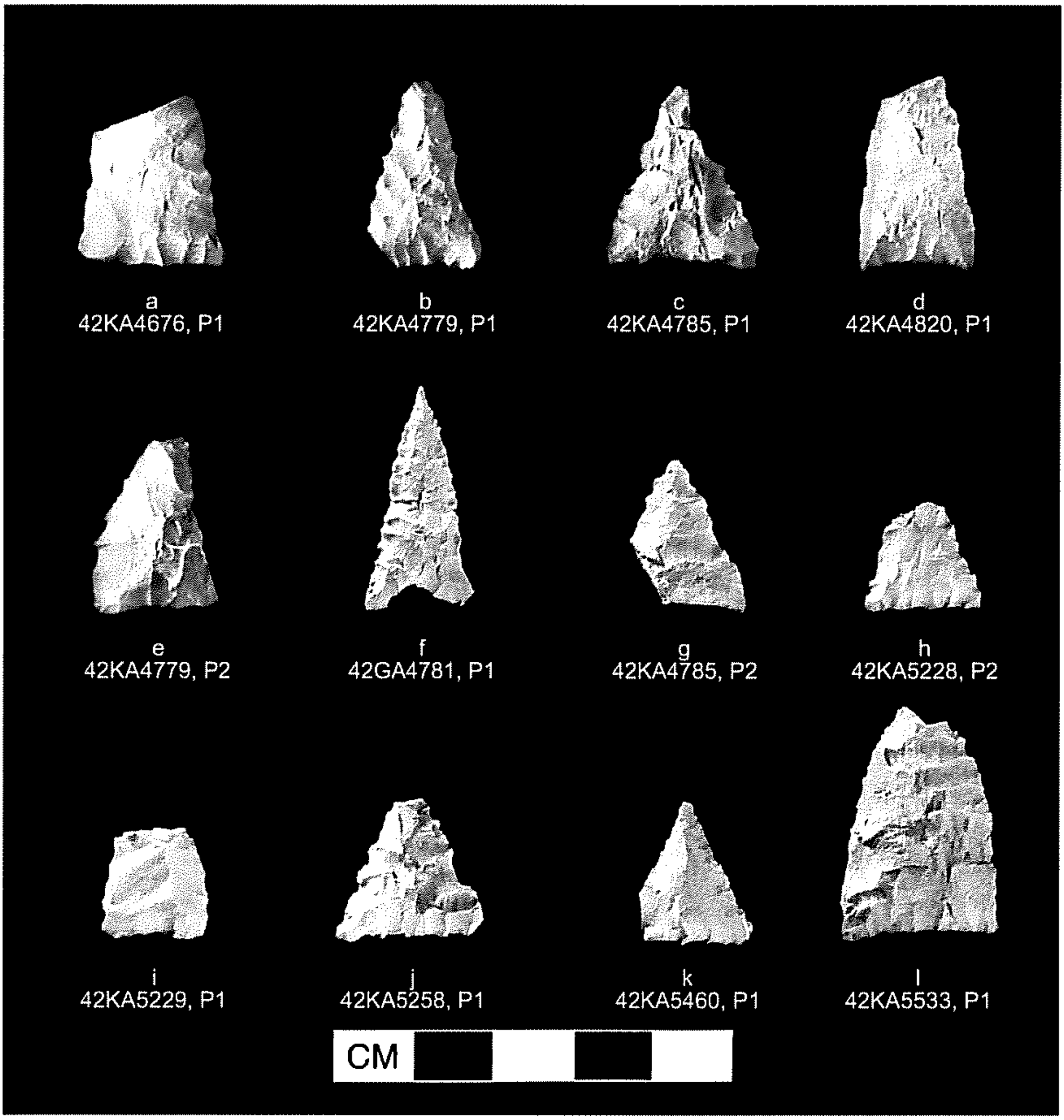


Figure 6.29. Cottonwood Triangular/unfinished arrow points from the Kaiparowits Plateau Survey.

coming Desert Side-notched, but they also might have been intended to be some other arrow point type such as Bull Creek. In one instance (Figure 6.29g) a Cottonwood Triangular occurred on a site along with a Desert Side-notched. Nonetheless, three of the Cottonwood Triangular points occurred on obvious Anasazi sites. Because arrow point preforms prior to notching can all look alike, we prefer to take the conservative route and assign Post-Formative occupancy based on Desert Side-notched points and not Cottonwood Triangular points. The point shown in Figure 6.29f (also see Figure 7.3) looks like a Bull Creek, but the basal concavity of this unfinished specimen is nearly all the result of a wide crescent-shaped bending flake that was likely detached during an attempt at basal notching. Based on the small size of this point it was likely intended to be a Desert Side-notched; no other remains from the site it was collected from (42GA4781) provide clues as to age.

Production Technology

Projectile point production can involve a bifacial percussion thinning stage; this is especially true of dart and spear points. Indeed, dart and spear points are often seen as the ultimate end products of the bifacial reduction process, though many different use and resharpening episodes may occur during the progression from unthinned flake blank or nodule to well-thinned bifacial tool. This model is not necessarily wrong, and indeed many large well-made projectile points such as those of the Paleoindian period had to be bifacially percussion thinned to achieve the desired result. Yet it is abundantly clear that many of the projectile points recorded in the field, or collected and analyzed in the laboratory, had been made without a bifacial percussion thinning stage (or stages). It goes beyond simply skipping a labor-intensive step in the production process, in that it appears that projectile points were generally conceived of as a separate production trajectory from bifacially percussion thinned tools. The trajectory often went directly from flake blank to point with no bifacial percussion thinning, just pressure flaking to produce the desired shape. Thinness for points was mainly achieved by detaching a thin flake blank. In that flake thickness determined final point thickness, thinness was selected for at the start of production by only using flakes of appropriate dimension. Between flake detachment and pressure flaking to finish a point, it was common to heat treat to improve the flaking quality of the raw material. This was readily observed on some points because the lack of a percussion thinning stage left traces of both ventral and dorsal surfaces of the original flake blank. These surfaces had a matte-like appearance, whereas the pressure flake scars were highly glossy. This differential luster is certain evidence for heat treatment, something that we verified for the common local cherts by the heat-treatment experiments discussed previously.

Of the 324 dart-sized projectile points collected during the Kaiparowits Plateau Survey, just under 50 percent had been made on flakes (Table 6.4). This includes 24 percent that retained evidence of ventral and dorsal surfaces on the original flake blanks and 24 percent where plano-convex cross-sections, often combined with longitudinal curvature, strongly indicate a flake blank. The flake scars and terminations often vary from one face to the other on these items because the edge from which the flakes were detached was not centered on the item—it was usually closer to or flush with the ventral surface. This tends to result in pressure

Table 6.4. Summary comparisons of blank morphology for collected projectile points.

	Flake, Certain[1]		Flake, Likely[2]		Flake or Nodule[3]		Total	
Projectile Point Groups	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Arrow Points	41	60.3	16	23.5	11	16.2	68	100.0
Dart Points	79	24.4	78	24.1	167	51.5	324	100.0
Total	120	30.6	94	24.0	178	45.4	392	100.0
Paleoindian	4	33.3	1	8.3	7	58.3	12	100.0
Archaic	24	25.8	25	26.9	44	47.3	93	100.0
Early Archaic	9	33.3	4	14.8	14	51.9	27	100.0
Middle Archaic	1	4.5	6	27.3	15	68.2	22	100.0
Late Archaic	14	31.8	15	34.1	15	34.1	44	100.0
Formative	16	44.4	10	27.8	10	27.8	36	100.0
Post-Formative	15	83.3	3	16.7	0	0.0	18	100.0
Total	59	37.1	39	24.5	61	38.4	159	100.0
Elko Series (C/S-notched)	2	18.2	1	9.1	8	72.7	11	100.0
Elko Corner-notched	18	24.0	19	25.3	38	50.7	75	100.0
Elko Side-notched	11	24.4	9	20.0	25	55.6	45	100.0
Elko Eared	8	25.8	9	29.0	14	45.2	31	100.0
Total	39	24.1	38	23.5	85	52.5	162	100.0

[1]Ventral and dorsal surfaces of the flake blank are obvious having not been removed by flaking.
[2]Longitudinal curvature or plano-convex cross section provides evidence that point was made from a flake.
[3]There is no evidence that indicates what the projectile point was made from—it could have been a flake or a nodule.

flake scars on the ventral surface that expand and end in step terminations. The other 52 percent of the dart points also may have been made on flakes, but the extent of flaking has removed all traces of the original blank characteristics. This can be achieved by pressure flaking alone, especially on arrow points, but for dart points, it can involve percussion flaking. Table 6.4 should be compared with Table 6.5, which tabulates the production method for the points collected during the Kaiparowits Plateau Survey. As can be seen, 23 percent of the dart points were made by pressure flaking alone; another 45 percent might have been made by pressure flaking alone, or the pressure flaking scars might have removed all traces of percussion flaking. We believe that most of these, however, were made by pressure flaking alone because they lack the long- and cross-section symmetry that one would expect with a point made on a percussion-thinned biface. Exceptions to this are the Paleoindian points because the finely controlled pressure flaking and excellent sectional symmetries that characterize many Paleoindian points could not have been achieved without prior, well-controlled percussion thinning. The 32 percent of the dart points in the last column retained obvious percussion flake scars, so some percussion facial thinning was done. Many of these may have been made on percussion-thinned bifaces that successfully passed through a long process of use and resharpening.

The arrow points are nearly all made on flakes; for 60 percent of the arrow points this is certainly true, and for another 24 percent it is probably true (Table 6.4). This is not simply because of their smaller size, though this has something to do with it, but because the noninvasive flaking used to fashion most arrow points commonly left traces of the flake blank. This is directly linked to point size because a thin flake blank can be made into an arrow point with marginal and less invasive flaking; to make a dart point from a flake blank usually required more invasive flaking. Consequently, arrow points have a better chance of retaining flake blank characteristics than dart points even if both were made by pressure flaking alone. As Table 6.5 shows, pressure only was used to fashion 99 percent of the arrow points and none of the arrow points showed definite evidence of having been percussion flaked; one arrow point might have been percussion flaked. One interesting difference in arrow points is that Formative arrow points, Bull Creek especially, were more extensively and invasively flaked than most Post-Formative arrow points. This is indicated in Table 6.4 by the almost 30 percent of the

Table 6.5. Summary comparisons of production method for collected projectile points. The middle category means that only pressure flake scars are evident but these may or may not have removed evidence of percussion flake scars.

	Pressure Only Evident		Pressure Evident, Percussion Possible		Pressure and Percussion Evident		Total	
Projectile Point Groups	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Arrow Points	67	98.5	1	1.5	0	0.0	68	100.0
Dart Points	74	22.8	145	44.8	105	32.4	324	100.0
Total	141	36.0	146	37.2	105	26.8	392	100.0
Paleoindian	2	16.7	5	41.7	5	41.7	12	100.0
Archaic	29	31.2	40	43.0	24	25.8	93	100.0
Early Archaic	9	33.3	14	51.9	4	14.8	27	100.0
Middle Archaic	2	9.1	10	45.5	10	45.5	22	100.0
Late Archaic	18	40.9	16	36.4	10	22.7	44	100.0
Formative	35	97.2	1	2.8	0	0.0	36	100.0
Post-Formative	18	100.0	0	0.0	0	0.0	18	100.0
Total	84	52.8	46	28.9	29	18.2	159	100.0
Elko Series (C/S-notched)	0	0.0	7	63.6	4	36.4	11	100.0
Elko Corner-notched	10	13.3	25	33.3	40	53.3	75	100.0
Elko Side-notched	10	22.2	28	62.2	7	15.6	45	100.0
Elko Eared	7	22.6	13	41.9	11	35.5	31	100.0
Total	27	16.7	73	45.1	62	38.3	162	100.0

Formative arrow points for which no evidence of flake blank morphology was evident (the third column). All of the Desert Side-notched points retained some evidence to suggest that the tool was made on a flake, and more than 80 percent retained obvious flake features. This compares with just 44 percent of the Formative arrow points.

Heat Treatment

Table 6.6 presents the results of heat treatment evaluation for the collected projectile points using the same series of point groupings presented earlier. Burned points are excluded because this does not allow an accurate evaluation of this attribute. Points were identified as heat treated based on luster; color change is another potential criterion (see Figure 6.5) if one has a good understanding of how raw material types occur naturally and how heating affects them. The most clear-cut case for heat treatment is when differential luster is evident (Figure 6.30). This occurs when production flaking does not remove the entire surface of the original heated tool blank. A chert or chalcedony flake blank will have a matte-like surface appearance prior to heating. After heat treatment the flake blank will look no different—still matte like, though there might be a color change—but all flakes subsequently removed will leave glossy and lustrous flake scars.

Making a determination of heat treatment when the entire tool is lustrous is more difficult. Polish from sand blasting or polish from gloss patina will both produce highly lustrous surfaces on artifacts that are not heat treated. An example of this is shown in Figure 6.31. To eliminate the possibility of wrongly classifying otherwise polished points as heat treated, tiny fresh flakes must be removed from inconspicuous portions to check for the underlying surface appearance of the material. If the fresh flake reveals a matte surface then the rock is likely not heat treated, but if a lustrous surface is revealed then heat treatment is highly probable if one has a good understanding of the raw material. The Gypsum point of Figure 6.30 lacks differential luster but is doubtless heat treated because its overall glossy appearance is also seen in a tiny fresh flake. This tool also exhibits the somewhat rough fracture that is seen when materials begin to be overheated. Our confidence in concluding that the tool is heat treated comes from extensive reduction experiments with the material that the point is made from—Paradise chert. We have never seen a raw example of this material as lustrous as the point. Some materials, however, have a natural high luster, such as some examples of Chinle chalcedony and a material common to the Kayenta Anasazi region known as Navajo chert. For these materials, differential luster is essential to be certain of heat treatment.

Table 6.6 reveals that both dart and arrow

Table 6.6. Summary comparisons of heat treatment of collected projectile points. Burned points are excluded because burning precludes accurate evaluation of heat treatment.

	Absent		Possible		Certain		Total	
Projectile Point Groups	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Arrow Points	12	18.2	41	62.1	13	19.7	66	100.0
Dart Points	54	18.6	178	61.2	59	20.3	291	100.0
Total	66	18.5	219	61.3	72	20.2	357	100.0
Paleoindian	3	25.0	8	66.7	1	8.3	12	100.0
Archaic	15	18.3	50	61.0	17	20.7	82	100.0
Early Archaic	4	19.0	13	61.9	4	19.0	21	100.0
Middle Archaic	2	9.5	14	66.7	5	23.8	21	100.0
Late Archaic	9	22.5	23	57.5	8	20.0	40	100.0
Formative	4	11.4	24	68.6	7	20.0	35	100.0
Post-Formative	6	35.3	9	52.9	2	11.8	17	100.0
Total	28	19.2	91	62.3	27	18.5	146	100.0
Elko Series (C/S-notched)	1	11.1	6	66.7	2	22.2	9	100.0
Elko Corner-notched	12	16.7	42	58.3	18	25.0	72	100.0
Elko Side-notched	10	25.0	22	55.0	8	20.0	40	100.0
Elko Eared	6	22.2	13	48.1	8	29.6	27	100.0
Total	29	19.6	83	56.1	36	24.3	148	100.0

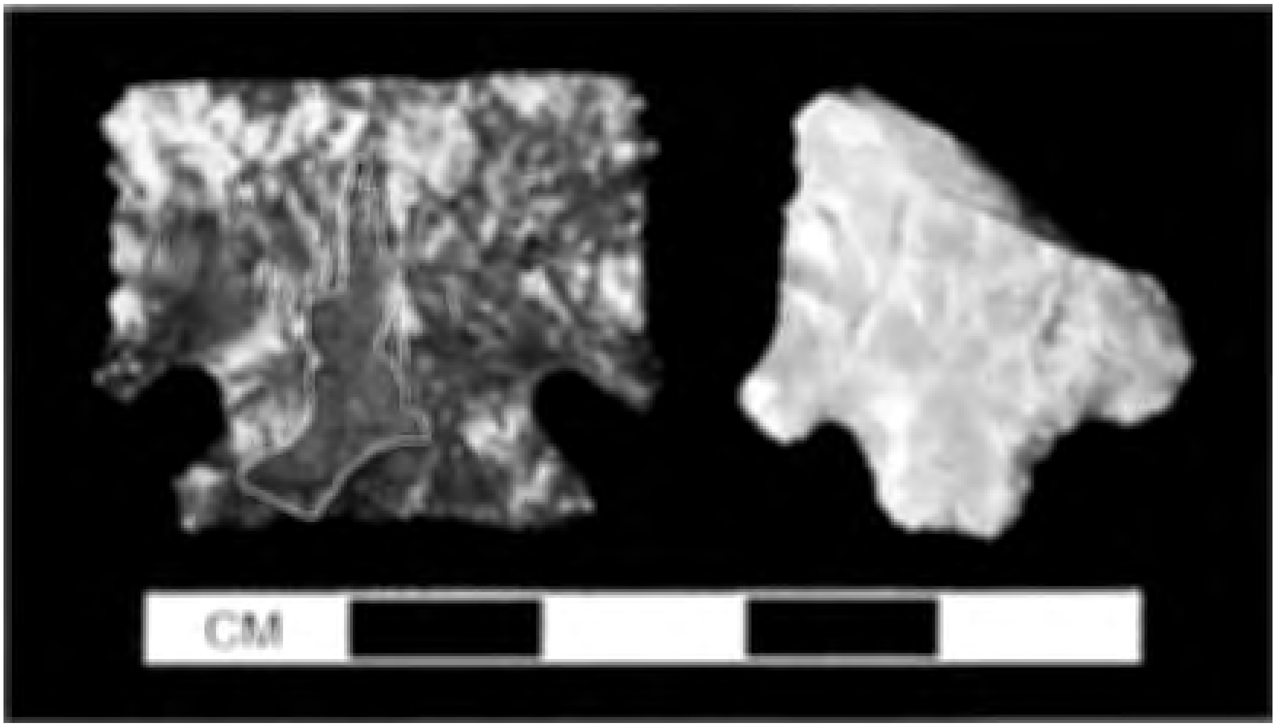


Figure 6.30. Examples of heat-treated projectile points from the Kaiparowits Plateau. An Elko Comer-notched (42KA4586, P1) illustrating differential luster; most flake scars are highly glossy but a percussion flake scar near the base has a matte surface appearance (outlined in white). This raw material has a pronounced color change in that it appears to be Paradise chert turned brown. The Gypsum point (42KA4658, P1) exhibits an overall high luster, but not from sand blasting or gloss patina because removal of a small flake reveals an underlying lustrous surface. The material for this point was overheated slightly, making it brittle and producing the somewhat rough fracture, especially noticeable on one face of the point.

Figure 6.31. An example of gloss patina on a flake (42KA4849, F1) of Paradise chert that can mimic heat-treatment luster. A flake (outlined in white) detached from this artifact reveals the underlying original matte surface appearance of the material. Had the flake been heat treated then the newly detached flake would have resulted in a flake scar as lustrous as the ventral surface of the original flake.

points exhibit nearly identical patterns of heat treatment and that this practice was prevalent for all groups occupying the Kaiparowits Plateau irrespective of temporal period. Just over 80 percent of both arrow and dart points exhibit evidence of heat treatment. The somewhat higher incidence of differential luster seen in arrow points relates to the often less invasive flaking of arrow points as discussed previously, which leaves original flake blank attributes. An excellent example of what was probably the common practice for making arrow points was documented at the small Post-Formative site 42KA4662. The flaking debris at this site is characterized by two distinct size classes from different reduction strategies: there are large simple core reduction flakes removed from at least one prepared nodule (i.e., they have no or little cortex), and tiny pressure flakes removed from bifaces. The core flakes are not heat treated, but all the pressure flakes are heat treated, with highly lustrous ventral surfaces and differential luster on many dorsal surfaces. Arrow point fragments broken during production are made on flakes that had been heat treated and then pressure flaked to fashion the points. The ventral surfaces of the flake blanks are still obvious and matte in appearance but the scars of the pressure flakes removed from them are lustrous. The flakes and point fragments are clustered around a small hearth. By considering all the evidence, it is apparent that simple core reduction was done to produce suitable flake blanks, with the selected few then heat treated and pressure flaked to make arrow points. Figure 7.6b shows an arrow point that was being made this way on a patinated flake when it was broken by perverse fracture.

This same production scenario, though scaled up in size, applies equally well to many dart points made during the Archaic period. The one collected example of this is shown in Figure 7.1c for the patina discussion. This probable dart point preform was snapped in production by an overshot pressure flaking mistake, which removed the upper third of the artifact. The ventral surface of the flake blank is plainly obvious on this artifact and has a matte surface appearance. All of the pressure flake scars on the artifact (production was by pressure flaking alone) are glossy, certain evidence of heat treatment. There is no doubt that this artifact was made just like the points at the Post-Formative site—a core flake is detached, heat treated, and then pressure flaked to make a dart point. Of course, in this instance the tool never made it to the finished stage.

Raw Material

Raw materials used in projectile point manufacture are identified in Table 6.7 using the point groups of Table 6.2. They are organized into those that are locally occurring within the survey area and those that occur outside the study area (nonlocal). The category for coarse materials includes quartzite, siltstone, and metasediment; the metasediment is certainly local but perhaps not the other two, so they are tabulated separately. One of our most basic assumptions concerning raw material selection is that it is largely conditioned by availability and proximity of residential bases. In other words, groups make do mainly with what is at hand. Of course, if groups are residentially mobile they may be cycling through many different raw material sources and their stone tool assemblages will become increasingly diverse with regard to raw materials. Groups out on logistic forays might also acquire raw materials at a long distance from home, especially if they live in a material-poor area.

At the most general level of comparison, raw material types for arrow and dart points show some slight differences. Paradise chert/chalcedony is used almost equally for both size classes of points, but Canaan Peak cobble chert more frequently for dart points. At this level of comparison it is hard to know why this might be the case, though it is far easier to pressure flake the Paradise chert/chalcedony than the cobble chert. This can make a difference when making small points because of the amount of pressure that must be exerted to remove a flake relative to how thin the flake blank is. In this regard, none of the arrow points were made of coarse materials. Of the nonlocal materials, petrified wood and various chert are similarly represented by arrow and dart points.

More interesting patterns are apparent when looking at point raw materials organized by time period. For example, the arrow point group, when separated into Formative and Post-Formative categories, shows important differences. Post-Formative arrow points are made of local Paradise chert/chalcedony almost exclusively, whereas this material accounts for a relatively minor proportion of the Formative arrow points. Most Formative arrow points are made of petrified wood or nonlocal chert. The one finished arrow point of obsidian (an untyped side-notched) is listed as Formative but it was made on a recycled older tool. The virtual lack of obsidian arrowheads at Post-Formative sites is a puzzle, given that obsidian is

Table 6.7. Summary comparisons of collected raw materials used for projectile points.

	Local Materials						Non-local Materials									
	Paradise Chert		Paradise Chalcedony		Canaan Pk Cobble Chert		Petrified Wood		Various Chert		Obsidian		Other Coarse		Total	
Projectile Point Groups	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Arrow Pts	15	22.1	14	20.6	3	4.4	17	25.0	16	23.5	3	4.4	0	0.0	68	100.0
Dart Points	86	26.5	53	16.4	34	10.5	69	21.3	72	22.2	6	1.9	4	1.2	324	100.0
Total	101	25.8	67	17.1	37	9.4	86	21.9	88	22.4	9	2.3	4	1.0	392	100.0
Paleoindian	1	8.3	1	8.3	1	8.3	3	25.0	4	33.3	1	8.3	1	8.3	12	100.0
Archaic	34	36.6	16	17.2	5	5.4	14	15.1	22	23.6	1	1.1	1	1.1	93	100.0
Early	9	33.3	6	22.2	2	7.4	5	18.5	4	14.8	1	3.7	0	0.0	27	100.0
Middle	10	45.5	3	13.6	1	4.5	1	4.5	7	31.8	0	0.0	0	0.0	22	100.0
Late	15	34.1	7	15.9	2	4.5	8	18.2	11	25.0	0	0.0	1	2.3	44	100.0
Formative	4	11.1	5	13.9	3	8.3	12	33.3	11	30.6	1	2.8	0	0.0	36	100.0
Post-Form.	8	44.4	7	38.9	0	0.0	1	5.6	2	11.1	0	0.0	0	0.0	18	100.0
Total	47	29.6	29	18.2	9	5.7	30	18.9	39	24.5	3	1.9	2	1.3	159	100.0
Elko Series (C/S)	3	27.3	1	9.1	1	9.1	5	45.5	1	9.1	0	0.0	0	0.0	11	100.0
Elko C-notch	12	16.0	10	13.3	13	17.3	18	24.0	21	28.0	0	0.0	1	1.3	75	100.0
Elko S-notch	15	33.3	6	13.3	8	17.8	8	17.8	6	13.3	2	4.4	0	0.0	45	100.0
Elko Eared	10	32.3	7	22.6	1	3.2	6	19.4	6	19.4	0	0.0	1	3.2	31	100.0
Total	40	24.7	24	14.8	23	14.2	37	22.8	34	21.0	2	1.2	2	1.2	162	100.0

present at many sites of this age.[6] Obsidian occurs at these sites principally as flakes, and judging from their attributes the flakes were detached from cores by simple hard hammer reduction. At only one site did field crews observe examples of obsidian pressure flakes, but they did not note whether the flakes came from arrow point manufacture. It seems that the Post-Formative occupants of the Kaiparowits Plateau did not directly procure obsidian but rather acquired it through exchange in the form of cores, perhaps large flakes, and in one instance, even nodules. Nevertheless, they rarely used this material for arrow point manufacture but instead relied almost exclusively on Paradise chert/chalcedony. Across the Colorado River on Cummings Mesa a Post-Formative site (NA 7961) yielded Desert Side-notched points made of obsidian (Ambler, Lindsay and Stein 1964:Table 27, listed as small triangular points with sides and base notched). Thus some nearby Post-Formative groups, perhaps with different trade relations and materials from different sources, used obsidian in point manufacture.

Table 6.8 presents a condensation of the data in Table 6.7 to look at local and nonlocal material usage. Formative arrow points are mainly made of nonlocal materials (67%) compared to Post-Formative arrow points, which are nearly all made of local materials (83%). The high incidence of nonlocal materials for Formative arrowheads is partially a result, we believe, of some Formative populations residing outside the study area but using it logistically for hunting. Formative use of the western portion of the Kaiparowits Plateau seems to have been mainly for hunting and likely collecting wild plants. They came to the plateau armed for hunting with arrow tips prepared at their homes, made of materials proximate to where they lived for most of the year. They likely exploited the local chert and chalcedony on the Kaiparowits Plateau to replenish broken items, but not to the extent that would have been the case for a population resident on the plateau. The Post-Formative record provides an example of the materials used for arrow points by probable resident groups on the Kaiparowits Plateau. Formative groups likely used local materials to replace broken points at the time of returning home—re-arming before departure. As such, these points would have ended up back at residential bases or other camps outside the study area.

[6]An arrow point tip of obsidian occurs at 42KA4612; it was principally on this basis that the site was assigned a Post-Formative age, but because this assignment is tentative, there is still no certain evidence of obsidian use for Desert Side-notched points.

Table 6.8. Condensation of the raw material projectile point data presented in Table 6.7.

	Local Materials		Non-local Materials		Other		Total	
Projectile Point Groups	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Arrow Points	32	47.1	36	52.9	0	0.0	68	100.0
Dart Points	173	53.4	147	45.4	4	1.2	324	100.0
Total	205	52.3	183	46.7	4	1.0	392	100.0
Paleoindian	3	25.0	8	66.7	1	8.3	12	100.0
Archaic	55	59.1	37	39.8	1	1.1	93	100.0
Early Archaic	17	63.0	10	37.0	0	0.0	27	100.0
Middle Archaic	14	63.6	8	36.4	0	0.0	22	100.0
Late Archaic	24	54.5	19	43.2	1	2.3	44	100.0
Formative	12	33.3	24	66.7	0	0.0	36	100.0
Post-Formative	15	83.3	3	16.7	0	0.0	18	100.0
Total	85	53.5	72	45.3	2	1.3	159	100.0
Elko Series (C/S-notched)	5	45.5	6	54.5	0	0.0	11	100.0
Elko Corner-notched	35	46.7	39	52.0	1	1.3	75	100.0
Elko Side-notched	29	64.4	16	35.6	0	0.0	45	100.0
Elko Eared	18	58.1	12	38.7	1	3.2	31	100.0
Total	87	53.7	73	45.1	2	1.2	162	100.0

This said, there also appears to be considerable use of nonlocal materials by the Anasazi groups resident on Collet Top. This was not so much evident in the materials used for the arrow points collected from the habitation sites as it was in the debitage at these sites. There are no local sources of siliceous stone on Collet Top because Paradise chert/chalcedony and Canaan Peak cobble chert do not occur this far east. Consequently, even the material "local" to the Kaiparowits Plateau had to be procured from a distance. In this case, the Anasazi residents of Collet Top procured by some means nonlocal material such as agatized wood and Boulder jasper. Direct procurement by traveling to the lowlands of the Escalante River is one possible means by which the Anasazi occupants of Collet Top obtained agatized wood and Boulder jasper. There was clearly some interaction with Anasazi populations at the Coombs site because limited amounts of Coombs variety Anasazi pottery occur at Collet Top sites. Travel to this site from Collet Top would bring you close to the Boulder jasper source and no doubt agatized wood could be procured from river gravels of the Escalante River on the same trip—the excellent Morrison Formation silicified wood outside the town of Escalante erodes into this drainage. The finding of Anasazi pottery at sites of the upper Escalante River and tributaries (e.g., Keller 2000) also suggests Anasazi use of canyons where the materials can be obtained.

Exchange might be another possibility, but if so then it commonly involved flake blanks and roughed-out forms of raw material rather than finished tools. This conclusion is based on the evidence for heat treatment and bifacial thinning at Collet Top habitations (see earlier discussion under Boulder jasper and Figure 6.8). Exchange of raw material might be one of the physical manifestations of interaction between the Collet Top Anasazi and the Fremont. Fremont habitations are well represented in and around the source of the excellent silicified wood, both within Escalante State Park (Latady 1999) and outside, such as at Rattlesnake Point (Gunnerson 1959b). If these Fremont habitations were contemporaneous with the Anasazi habitations on Collet Top, then the Fremont were encamped virtually on top of a premier source of agatized wood and exchange would have been likely.

Comparing point materials used by foragers at the two different ends of the temporal spectrum is also interesting. At the most recent end are the Post-Formative Southern Paiute, who occupied the area into the late 1800s and about whom we have some limited ethnographic information (Kelly 1964). Archaic hunter-gatherers represent the early end of the spectrum. The ethnographic record of the Southern Paiute and other Numic groups is often used as a model or a point of departure for

understanding Archaic foragers. Differences between these early and late foragers in the proportion of local and nonlocal materials used for point production may imply some important distinctions between these groups. In particular, settlement-subsistence strategies or settlement territories (size of annual range) may have differed. Based on Kelly's (1964:149–150) report and accompanying map, it is evident that the Kwaguiuavi (seed valley) economic unit occupied the study area and evidently restricted most of their subsistence travels to other portions of the Kaiparowits Plateau. This would have limited direct access of raw materials to the local resources enumerated earlier, with the Paradise chert/chalcedony being the best among these for arrow point manufacture (easiest to pressure flake). The finding that more than 80 percent of the Post-Formative arrowheads are made of the Paradise chert/chalcedony is a likely expectation of groups resident within the study area. Archaic dart points overall and within general subperiods show a heavy reliance on local materials (55% or greater), but also use of materials from outside the study area (36–43%). This difference may be reflective of annual settlement ranges during the Archaic that were more extensive than those documented ethnohistorically. Or perhaps settlement territories were configured differently to include more environmental diversity, such that groups who used the study area also took regular trips to the Escalante River basin, the Colorado River, or the Vermilion Cliffs.

Distribution

NNAD archaeologists found 978 projectile points on 389 of the 689 (56%) Kaiparowits Plateau sites with Native American components. In addition, projectile points were found as isolated occurrences in 169 instances. Information about the occurrence and distribution of projectile points at sites is given in Table 6.9. Distribution information about projectile points found as isolated occurrences is presented later in this chapter. Although just over half of the sites contain projectile points on the surface, the mean number of points per site in the survey is 2.5. This is because 80 of the sites contain two points and 128 sites have more than this, with the maximum value of 40 points at a single site. This last value is an extreme outlier, with 17 being the next most frequent count of points at a single site. The outlying value comes from 42KA4567, a site that we doubtless should have partitioned into several smaller entities (see discussion of site definition problems in Chapter 1). Nevertheless, the occurrence of so many points on this one ridge at the south end of Horse Flat is doubtless an indication of long-term use of this location for brief hunting camps.

Table 6.9. Data about the occurrence and distribution of projectile points on prehistoric sites: (a) descriptive statistics based on 689 sites with prehistoric components; (b) percentage of sites within each sampling stratum containing projectile points, based on 689 sites with prehistoric components; (c) percentage of sites within each temporal interval containing projectile points, based on 634 single-component sites; and (d) percentage of sites within each temporal interval containing projectile points, based on 634 single-component sites.

(a) Variables	Values
Sum of artifact type	978
Number of sites with artifact type	389
Percent present	56.4
Maximum count per site	40
Mean	2.5
Standard deviation	2.8
(b) Sampling Stratum	Percent of Sites with Proj. Points
Collet Top (n = 146)	53.4
Horse Mountain (n = 97)	71.1
Long Flat (n = 121)	51.2
Horse Flat (n = 33)	60.6
Fourmile Bench (n = 135)	57.8
Smoky Mountain (n = 76)	68.4
Brigham Plains (n = 40)	40.0
Nipple Bench (n = 35)	37.1
East Clark Bench (n = 6)	16.7
(c) Temporal Affiliation	
Unknown (n = 221)	23.5
Archaic general (n = 195)	72.8
Early Archaic (n = 21)	100.0
Middle Archaic (n = 20)	100.0
Late Archaic (n = 31)	93.5
Formative (n = 92)	50.0
Formative/Post-Formative (n = 25)	41.9
Post-Formative (n = 29)	72.4
(d) Site Type	
Semi-permanent habitation (n = 13)	66.7
Residential camp (n = 70)	77.5
Processing camp (n = 147)	35.4
Hunting camp (n = 165)	77.6
Reduction locus (n = 105)	38.1
Storage–cache (n = 9)	0.0
Other (n = 3)	66.7
Unknown (n = 122)	45.9

Table 6.9 shows that sites containing points are most frequently found on Horse Mountain with the fewest occurring on East Clark Bench and Nipple Bench. This may result from more frequent replacement of broken points at camp sites in close proximity to raw materials rather than any neces-

sary implication toward preferred hunting areas. On Horse Mountain the Paradise chert/chalcedony and Canaan Peak cobble chert is abundant, so here hunters may have more commonly discarded broken and worn stone tools because replacement could be made with materials readily at hand. On East Clark Bench and Nipple Bench, however, the lack of locally occurring raw materials might have made hunters more conservative, tending to recycle and make do with what they had without readily discarding points or other tools. It appears true, however, that these two lowest elevation benches seem least desirable for hunting of the nine sampling strata.

Tabulating the presence of sites with projectile points by temporal periods is not informative because projectile points provide the principal means for assigning sites to the Archaic period, and the only means for assigning sites to the Archaic subperiods. Accordingly, all early and middle Archaic sites have 100 percent presence of points because no site was assigned to these subperiods unless it had a point. Two sites were assigned to the late Archaic based on feature type although they lack points; thus the proportion is less than 100 percent. The frequency of sites with points in the Formative and Post-Formative periods is only somewhat more meaningful.

Sites identified as residential camps and hunting camps have the highest occurrence rates of projectile points, likely because most repair and maintenance of hunting equipment occurred at either residential sites or at hunting camps. Both site types contain more projectile points than ever occur on other types of sites: 12 percent of the hunting camps have six or more projectile points and 11 percent of residential camps contain this many. As discussed in the site type section, the incidence of projectile points at reduction loci does not necessarily mean point bases. The database used does not differentiate this information, but it makes an important difference functionally, because bases should be rare at reduction locations. This follows from the assumption (based on ethnographic observations) that most tool maintenance and repair occurs at residential sites or hunting camps.

Bifaces

Definition and Production

Tools in this class were made by controlled and often sequenced bifacial percussion flaking designed to produce thin, symmetrical artifacts, usually with biconvex or flattened cross-sections. Callahan (1979) provided a detailed discussion of this technology as applied to fluted point production in the eastern United States, but his general model and initial reduction stages are applicable to most types of biface production. Callahan's biface reduction Stages 2 through 5 are defined in Table 6.10; these stages were used in the field to

Table 6.10. Definitions of technological categories used for field classification of bifaces (after Callahan 1979).

Stage 2, Edging: Items in this stage might be flattened nodules or large core flakes that have been percussion flaked on both faces, usually in an alternate manner, to remove square edges and establish appropriate platforms for driving off initial thinning flakes. Readily available cortex or single-flake scar platforms were used to detach the flakes by Hertzian cone initiations probably mostly using hard hammers. Margins are usually sinuous, with high edge angles, and cross sections and plan outlines exhibit major irregularities. Thinning is preliminary so items are thick relative to their width and cortex is usually present on at least one face. Tools of this stage were identified as 'primary blanks' during the Glen Canyon survey (Geib et al. 1986:25–27) and as Stage 1, Edged Blanks by Whittaker (1994:201–202).

Stage 3, Initial Thinning: Tools of this stage have major cross section irregularities removed. Faces are noticeably smoother and flatter than Stage 2 bifaces. Most cortex is removed. Thinning flakes were detached from prepared platforms involving edge beveling and abrasion. Flake scars usually extend past the midsection. Average thickness is roughly three to four times less than average width. Bifaces of this stage were identified as "secondary blanks" during the Glen Canyon survey (Geib et al. 1986:25–27) and as Stage 2, Preforms by Whittaker (1994:202).

Stage 4, Secondary Thinning: Tools of this stage have essentially been maximally thinned with an average width five times or more the average thickness. Flake scars commonly extend past the midsection. Plan and section symmetry is well established. Edges might be beveled and abraded to facilitate the removal of flakes principally by percussion, but pressure flaking might have been used to isolate platforms. The "preform" category used during the Glen Canyon survey (Geib et al. 1986:25–27) includes bifaces of this stage and the next. Whittaker (1994:202) designates these items as Stage 3, Refined Bifaces.

Stage 5, Final Thinning and Shaping: Faces are smooth and quite flat, and cross sections are thin and regular, with an average width five times or more the average thickness. Some flake scars invade past the midsections, but shorter scars are more numerous, and may be detached by both pressure and percussion. Edges have been maximally regularized and sharpened by removing platform remnants and irregular edges. Distal and proximal portions are usually discernible. Whittaker (1994:202) designates these items as Stage 4, Finished Bifaces, though he also includes items modified for hafting that we have included in the Projectile Point class.

classify bifaces found at sites, and the information is presented in this manner on the site forms under tool descriptions. In Callahan's system, a Stage 1 biface might be simply a nodule of raw material or a flake blank. No examples of these were identified during the Kaiparowits Plateau Survey because of potential confusion over whether or not an item was actually intended to be bifacially thinned. After Stage 5, items are modified for hafting, principally by notching. We have classified all such tools as projectile points with the realization that the largest examples were probably never intended for this purpose (they are notched knives) and that even those tools used as projectile points may have been used for other tasks as well.

Percussion bifacial thinning is commonly done with the goal of producing projectile points and hafted and unhafted knives or cutting tools. Thus, there is a tendency to view the various stages prior to Stage 5 as simply preliminary steps culminating in a final finished tool. After examining 1455 bifaces at 477 sites, as well as a vast amount of reduction debris, we believe that the biface industry on the Kaiparowits Plateau was largely designed to provide multiple-purpose portable tools that could be resharpened numerous times. This falls under Kelly's (1988:718–719) second reason for biface production. Projectile points were not necessarily the desired products of this process. Indeed, as discussed previously, many of the projectile points recorded in the field had a separate production sequence, one that did not involve percussion bifacial thinning. On the Kaiparowits Plateau there was no evident hurry to percussion-flake bifaces just to produce thin, formal-looking tools. Part of the evidence for this is that many percussion-thinning flakes had been detached from used tools for the purpose of edge resharpening, as indicated by the use-wear polish and rounding commonly seen, even without the aid of a microscope, on bifacial thinning flake platforms (see Frison 1968). This kind of wear occurs on early through late stage biface thinning flakes, indicating that bifaces of all stages were heavily used. In such a strategy, percussion flakes are removed to resharpen worn bifacial tool edges and in the process, the tools are made thinner, but the flakes are not being removed for the sole purpose of creating a thin tool. Thinning is a byproduct of tool resharpening but thinning is not necessarily an end goal; rather tool use and resharpening seems to have been the focus. As the tools became thinner their functions likely changed somewhat toward more light-duty cutting tasks, but not exclusively as exemplified by a deeply serrated Stage 5 biface (item 3.2.1) from the tested site 42KA4549. In gross morphology this tool would be classified as a cutting tool or knife, but it evidently functioned as a scraper, based on use-wear (see Chapter 5).

The bifacial tool fragments observed at sites provide the related evidence that they were intended for a variety of uses beginning with the initial edging stage. Of the 1455 bifaces recorded at sites, most are fragments broken by reduction mistakes, usually bending fractures from end shock, or perverse fractures for the thinner tools. Use-wear was evident on well over half of these tools, and this is based on field assessment of wear traces that are macroscopically obvious in the sunlight. Doubtless, had we been able to examine the bifaces under a low-power binocular microscope, the incidence of use-wear traces would have been greater. Given the high frequency of biface resharpening flakes, it is reasonable that a majority of bifaces would exhibit evidence of use. Most important, use-wear is not restricted to late stage, well-thinned bifaces, but occurs nearly equally on bifaces of all reduction stages. As soon as a biface was initially roughed out (Stage 2), it was likely used for some task. Two examples of bifaces collected for laboratory study are shown in Figures 6.32 and 6.33.

Another reason for an emphasis on bifaces is their use for flake production, as suggested by Goodyear (1979) and Kelly (1988). Bifaces essentially serve as prepared cores from which numerous sharp thin flakes can be detached. Potentially supporting this probability is that some used flakes and thin unifacial tools are made on biface thinning flakes. Conversely, many used flakes and many of the unifacial tools recorded during the Kaiparowits Plateau Survey are made on simple unpatterned core flakes of high-quality silicate and coarse alluvial cobble material (quartzite, metasediment, and igneous rock).

Heat treatment was an important part of the biface reduction strategy. Field crews observed direct evidence for this in the form of differential luster on many sites of the project area. The biface shown in Figure 6.32b exhibits differential luster; all flake scars, except for a single percussion flake scar on one face, are highly lustrous. The one exception has a matte appearance. Based on our experiments with heat treating the local chalcedony, this item had nearly been overheated. As mentioned on the site forms, survey crews observed evidence for heat treatment on flakes or tools at 324 of the 689 prehistoric sites (47%).

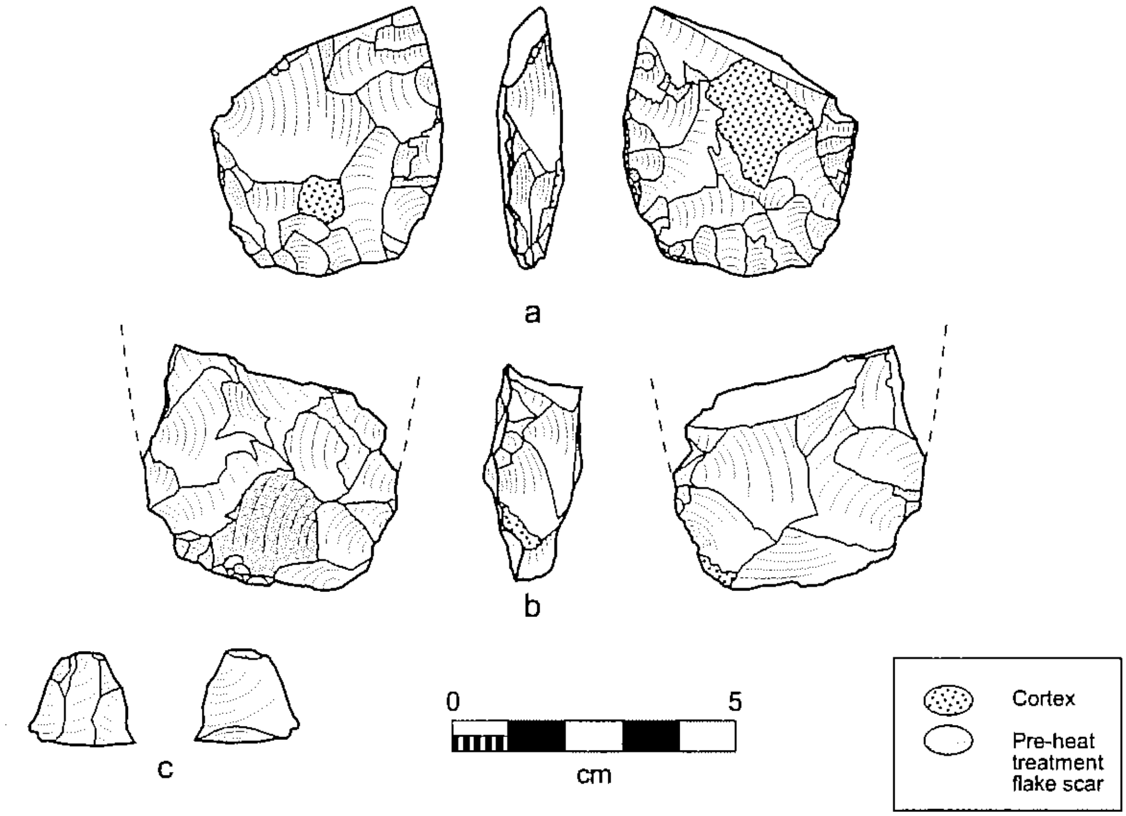


Figure 6.32. Two biface fragments collected for laboratory study: a) a Stage 4 biface (IO28) of local white chert broken by perverse fracture; b) a Stage 3 biface of heat-treated local chalcedony (42KA4804) that exhibits differential luster; c) the platform end of a percussion flake removed from the biface.

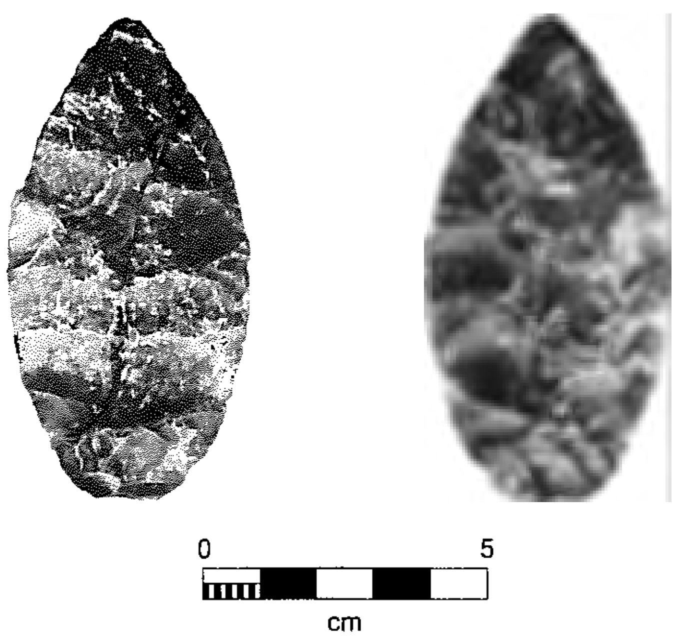


Figure 6.33. A whole Stage 5 biface of agatized wood (IO623) slightly patinated on one face, exhibits microflaking, abrasion and slight polish on edges, especially towards tip.

Distribution

The most common type of flaked stone tool on the Kaiparowits Plateau was the thinned biface, occurring at almost 70 percent (477 of 689) of all Native American sites (Table 6.11). We documented 1455 bifaces overall with an average of 3 per prehistoric site. Although common to all time periods, there is a significant difference in the occurrence of bifaces between Archaic and Post-Formative sites. As with projectile points, this comparison is only informative based on single-component sites. Because the data are coded on a site rather than component basis, there is no way to know on multiple-component sites which tools relate to which component. To partially overcome this problem we have selected only sites on which surveyors found no convincing evidence for multiple occupancy. As discussed in Chapter 7, some of these doubtless consist of more than one component, so there is still some uncertainty in these figures. Nevertheless, Archaic sites are almost twice as likely to contain bifaces as Post-Formative sites. This trend appears to be mirrored in the debitage assemblages from these two time periods, with biface reduction debris preponderant at Archaic sites, but simple core reduction debris most common at Post-Formative sites.

Tabulating biface occurrence by site type reveals that these tools most commonly occur at sites identified as residential camps and semi-permanent habitations. This is probably a reflection of where this tool type was commonly produced and resharpened, which greatly increases the chance for production breaks and discard.

Table 6.11. Data about the occurrence and distribution of bifaces on prehistoric sites: (a) descriptive statistics based on 689 sites with prehistoric components; (b) percentage of sites within each sampling stratum containing bifaces, based on 689 sites with prehistoric components; (c) percentage of sites within each temporal interval containing bifaces, based on 634 single-component sites; and (d) percentage of sites within each temporal interval containing bifaces, based on 634 single-component sites.

(a) Variables	Values
Sum of artifact type	1455
Number of sites with artifact type	477
Percent present	69.2
Maximum count per site	20
Mean	3.1
Standard deviation	2.7
(b) Sampling Stratum	
Collet Top (n = 146)	75.3
Horse Mountain (n = 97)	85.6
Long Flat (n = 121)	61.9
Horse Flat (n = 33)	63.6
Fourmile Bench (n = 135)	69.6
Smoky Mountain (n = 76)	67.1
Brigham Plains (n = 40)	45.0
Nipple Bench (n = 35)	57.1
East Clark Bench (n = 6)	83.3
(c) Temporal Affiliation	
Unknown (n = 221)	58.8
Archaic general (n = 195)	79.0
Early Archaic (n = 21)	71.4
Middle Archaic (n = 20)	80.0
Late Archaic (n = 31)	77.4
Formative (n = 92)	67.4
Formative/Post-Formative (n = 25)	61.3
Post-Formative (n = 90)	48.3
(d) Site Type	
Semi-permanent habitation (n = 13)	92.3
Residential camp (n = 70)	85.7
Processing camp (n = 147)	61.2
Hunting camp (n = 165)	78.8
Reduction locus (n = 105)	58.1
Storage–cache (n = 9)	11.1
Other (n = 3)	33.3
Unknown (n = 122)	61.5

Other Facial Flaked Tools

A great variety of other facial flaked tools such as unifaces, drills, used flakes, and the like occur at Kaiparowits Plateau sites. Table 6.12 presents definitions for these various tool types, most of which are not individually discussed or described below due to their low frequencies. Surveyors observed unifaces and used flakes at many sites, but most other tool types are less common and were perhaps inconsistently observed. At small sites surveyors could exhaustively document all surface tools, but this was not possible at large sites with hundreds or thousands of artifacts. Consequently, the number and type of other flaked stone tools observed at large sites likely vastly underrepresents their actual number and diversity. Excluding unifaces, all of the other flaked stone tools are lumped together within the database used to generate the summary information for this chapter because of low or sporadic occurrence. Detailed tool descriptions are presented on the individual site forms. A few of the tool types deserve individual discussion, which follows.

Thick Bifacial Tools

One kind of flaked stone tool found at some Kaiparowits Plateau sites and on occasion as isolated finds we designated as thick bifacial tools. These items are flaked bifacially but not in an

Table 6.12. Definitions for field classification of various other facial flaked stone tools.

Thick Bifacial Tool: These are described in the text.

Uniface: This technological category incorporates flakes that have a unifacially (or unidirectionally) produced edge(s) on margins, ends, or both. They may or may not demonstrate certain kinds of use wear. Unifaces are commonly assumed to have functioned as scrapers, which is what they are usually called in morpho-functional classifications. In the majority of cases use-wear traces support the scraping assumption. Unifaces with invasive flake scars have acute edges well suited for cutting tasks (unifacial knives). Most unifaces, however, have rather high angled (>50) edges that are too great to be useful for cutting. There are numerous ways to subdivide tools of this class—according to whether the flaking occurs on flake margins or ends (side or end scrapers), whether the tool has thick or thin working edges , whether it has a denticulate edge, whether the worked edges are straight, concave, or convex in plan view. Aside from gross morphology, use-wear traces provide the best evidence for functional classification but field observation of these is limited.

Drill: A drill is identified by a purposely produced narrow projection on a flake or recycled biface, usually a projectile point. The bit end can be short or long depending on the task at hand. The item may or may not demonstrate some kind of hafting mechanism such as notches; notched drills are often recycled projectile points. The tip end usually displays 'rotary' type abrasion and striations, but some bits may be microflaked or even just lightly polished—this all depends on contact material.

Graver, Perforator: These are functionally specialized items, although they may be technologically simple and generalized. They are characterized by a small, short projection produced by unidirectional or bidirectional flaking, often on a small, thin flake or biface. These items are suitable for incising or perforating materials considerably softer than stone, primarily hide, wood, or bone.

Retouched Flake: These are flakes that have been retouched but not with constant directionality and often alternating from both faces. The retouch is usually just short noninvasive flakes. The produced edges commonly exhibit wear. Some of these tools may have functioned as saws or as general cutting tools though an unretouched edge is better suited for cutting. A flake that is alternately pressure retouched on both faces is an excellent tool for sawing bone and wood (cut-and-snap method). Some retouched flakes may been from the early stage of producing projectile points (especially arrow points) from thin flakes.

Used Flake: An unmodified flake put to use and exhibiting obvious use-wear. Wear traces consist of edge microflaking, abrasion, rounding, polish, and striations; these traces can also extend onto flake surfaces, particularly flake arrises. Observation of wear traces is best done in the laboratory with various types of microscopic magnification, but limited field observations are possible, especially in bright sunlight; wear traces can also have a tactile expression.

effort to achieve thinness; thus they seem to be outside the biface thinning strategy. The flakes removed from both faces were not invasive, so they did not thin the items, resulting in tools with progressively lower width to thickness ratios (i.e., the tools become narrower but no less thin). The flaking on these tools was evidently for resharpening purposes. The flakes removed are generally so small that they would have had little utility. Morphologically and perhaps functionally, these tools are similar to what are known as "tula slugs" in Australia (Horne and Aiston 1924; Mulvaney 1969; Gould, Koster and Sontz 1971). Most examples of these items are quite narrow and thick with a width to thickness ratio of about 2:1. Only a few whole examples were found, including an isolated occurrence shown in Figure 6.34. This example is actually less bifacially flaked than most, as the attributes of the original flake blank are still obvious. For most of these tools it is not so obvious whether they were made on flakes or from entire nodules. The illustrated example is also actually thinner than other examples of this tool type, perhaps because it is made on a thin flake. This tool has use-wear traces along the edge occurring on high points between flake initiations, revealing that flakes were removed for resharpening purposes. It is difficult to make an accurate determination of tool use, but scraping or planing tasks seem probable given the high edge angles. Use-wear was sometimes evident on these tools in the field, but there were also examples lacking obvious wear traces (at least without the aid of a microscope).

Many examples of this tool type observed at sites might best be termed "slugs," in that they appear to be the discarded exhausted remnants of tools at the end of their use lives. The tools mostly occur as fragments that evidently broke from bending fractures. Of the several whole examples found, most are very narrow relative to thickness and likewise seem nearly exhausted. In a few rare cases, surveyors found whole examples of this tool that appeared to retain plenty of use life (far from exhausted). Site 42KA4831 on Long Flat had two of the largest examples of thick bifacial tools. Both of these exhibit heavy use-wear, one with microflaking and abrasion on one end and the other with microflaking of one end and margin. Again, the use-wear and overall morphology of these tools seems most consistent with some sort of scraping task.

Thick bifacial tools appear to mostly occur on Archaic age sites, but this is just an impression. It

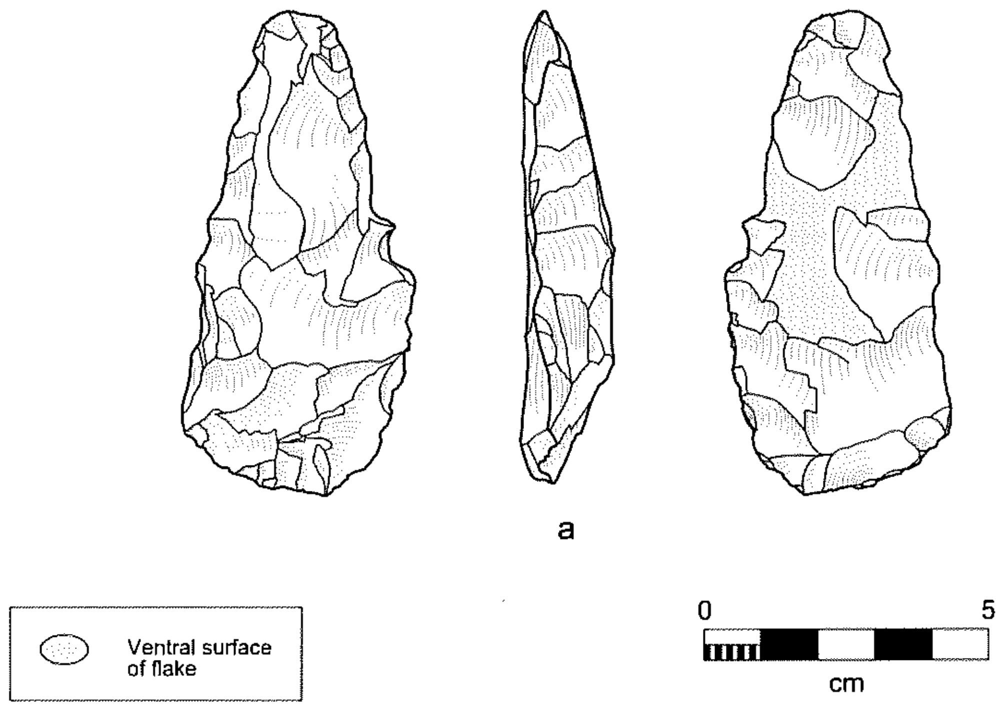


Figure 6.34. An example of a thick bifacial tool of local white chert found as an isolated occurrence (IO277) toward the north end of Paradise Bench. Use-wear traces occur mostly on the end of this tool. It is actually thinner than other examples of this tool type, perhaps because it is made on a thin flake.

will take more consistent recording of this tool class to determine its temporal associations. The tools also seem to occur mainly on sites inferred to have served as temporary residential camps or processing camps. They were seldom observed on sites classified as hunting camps.

Denticulate Scrapers

The most interesting and distinctive unifacial tools, and ones that might be somewhat temporally diagnostic, are those identified as denticulate end scrapers (Figure 6.35). These tools have a series of sharp teeth carefully produced by unidirectional pressure flaking. Most are made on flakes, often a bifacial thinning flake, with the retouch on the distal end. The retouch leaves the edge with an even rounded profile bristled with small projections. These delicate tools with their tiny teeth seem poorly suited to working hard materials, and indeed the few that we have had the chance to examine under a microscope exhibit polish of the teeth, suggesting that they had been used on a soft material. Some aspect of hide preparation seems a likely function for such tools, either in flesh and fat removal or perhaps hair removal, tasks where the small teeth would have been well suited. Given the small size of these tools it is possible that they were used principally on small hides such as those from rabbits and hares. They also could have worked well on hides of larger game, especially the denticulate scrapers in the larger size range. One of the largest examples of these tools was made on a long dart point tip fragment by reworking the broken end (Figure 6.35a). Two other collected examples help to illustrate the size range (Figure 6.35b, c).

Morss (1931:58, Plate 33a, table on p. 56) briefly characterized items that he calls "sawtoothed scrapers," which are identical to the tools considered here. It is not clear from his report from what cultural/temporal context such artifacts are derived. This aspect is equally unclear from the Kaiparowits Plateau Survey, but it seems probable that such distinctive tools might be temporally restricted.

Used Flakes

The observation of used flakes in survey situations is difficult because many use-wear traces are subtle, and even low-power microscopic observation does not necessarily identify wear traces on flakes that were used. Identification is also depen-

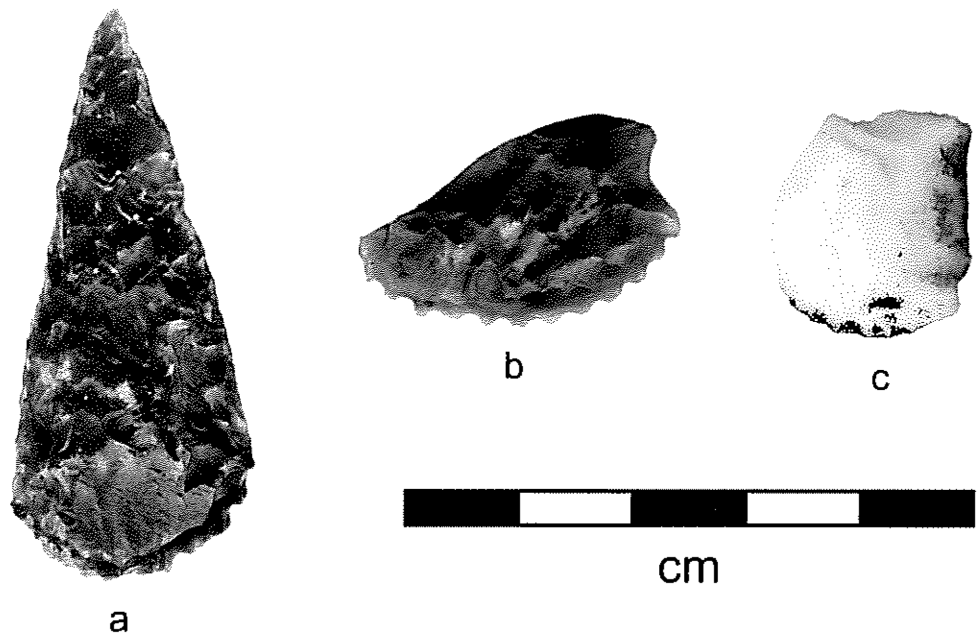


Figure 6.35. Denticulate end scrapers: a) example made on a large tip fragment of a projectile point from site 42KA5354; b) fragment from 42KA5444; c) small example from site 42KA5525.

dent upon examining each flake, something that can rarely be accomplished in routine inventory work, except at the smallest sites. In effect, if used flakes are listed on a site form they provide some additional functional information, but an absence is not necessarily significant because it might simply be an observation problem. Nevertheless, used flakes were recorded frequently at Kaiparowits Plateau sites. These flakes exhibit obvious use-wear traces consisting of edge microflaking, abrasion, rounding, and polish (see Ahler 1979). The wear traces indicate use in a variety of transverse (scraping or planing) and longitudinal motions (cutting or sawing). Examples of used flakes collected for laboratory analysis and illustration are shown in Figure 6.36.

Distribution

In Table 6.13 unifaces have been separated from the other types of facially flaked tools in an attempt to see if there are any interesting patterns. Interpretation of the data is complicated by the extent to which examples of this tool type were overlooked during site recording. Because the other flaked tools are such a lumped group, the distribution data are not very informative. We provide the numbers for those who may be interested and for equal treatment of each stone tool category discussed in this report.

Flaked Cobble Tools

Definition and Production

Heavy-duty flaked cobble tools of various function are ubiquitous stone artifacts on the Kaiparowits Plateau. These tools are made from well-rounded alluvial cobbles of coarse material, which are common as lag deposits across portions of the study area and within major washes such as Wahweap; the cobbles originate from the basal unit of the Canaan Peak Formation. Flaked cobble tools are made from such tough materials as quartzite, metasediment, and diverse grainy igneous rocks; cobbles of these materials are naturally most abundant in the local gravel deposits, with quartzite most common. The cobbles selected for these tools tend to be oval or circular in plan and somewhat flattened in section.

The usual production method is to unidirectionally flake one end of a cobble to create a working edge, leaving the other end unaltered to form a comfortable natural grip (Figure 6.37). Kearns (1982:126) described this sort of tool during the Escalante Project as cobble unifaces. In rare cases, the entire circumference of a cobble is unidirectionally flaked and in even rarer instances, cobbles are bidirectionally flaked. The latter is not to be confused with bifacial flaking, which is designed to thin a tool form. The flakes removed from

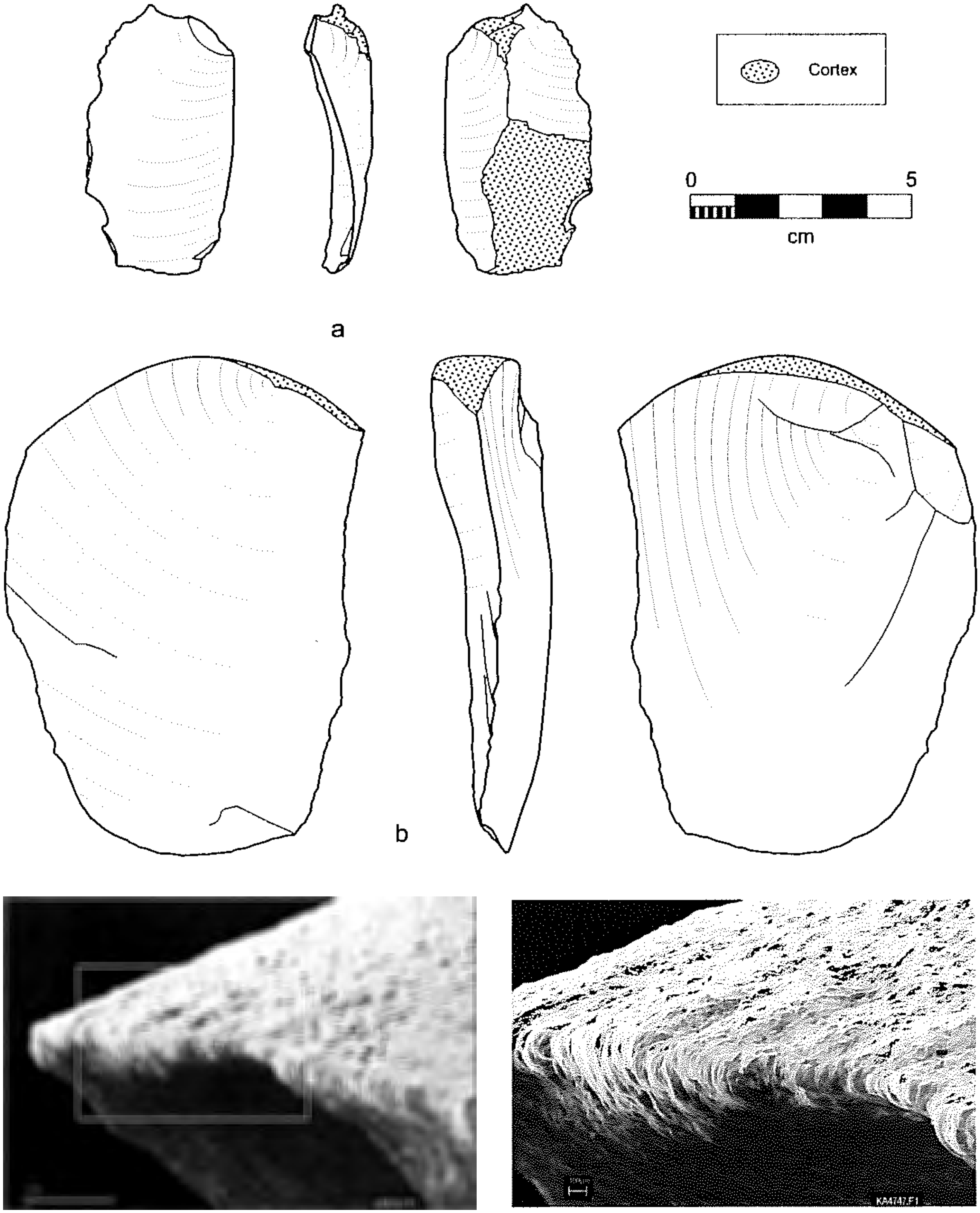


Figure 6.36. Two examples of used flakes collected during the Kaiparowits Plateau Survey: a) an early stage biface thinning flake of local white chert used extensively on one edge for cutting (42KA4848, F1); b) a quartzite cobble flake (42KA4747, F1) used on distal end. Electron micrographs of the distal end of the quartzite flake show edge smoothing and striations from use of the tool in a scraping fashion.

Figure 6.37. Replicated quartzite cobble choppers: a) cobbles initially reduced by unidirectional flaking to produce acute functional edges and the detached preparation flakes showing dorsal and ventral surfaces; b) cobbles with functional edge regularized by removing core overhangs and the detached edge trimming flakes showing dorsal surfaces.

Table 6.13. Data about the occurrence and distribution of unifaces and other facial flaked stone tools on prehistoric sites: (a) descriptive statistics based on 689 sites with prehistoric components; (b) percentage of sites within each sampling stratum containing unifaces and other facial flaked tools, based on 689 sites with prehistoric components; (c) percentage of sites within each temporal interval containing unifaces and other facial flaked tools, based on 634 single-component sites; and (d) percentage of sites within each temporal interval containing unifaces and other facial flaked tools, based on 634 single-component sites.

(a) Variables	Unifaces	Other Flaked Tools
Sum of artifact type	196	549
Number of sites with artifact type	137	301
Percent present	19.9	43.7
Maximum count per site	9	11
Mean	1.4	1.8
Standard deviation	1.0	1.4
(b) Sampling Stratum	Percent of Sites w/ Unifaces	Percent of Sites w/ Other Facial Flaked Tools
Collet Top (n = 146)	17.1	48.6
Horse Mountain (n = 97)	33.0	53.6
Long Flat (n = 121)	21.5	33.1
Horse Flat (n = 33)	33.3	48.5
Fourmile Bench (n = 135)	15.6	40.0
Smoky Mountain (n = 76)	10.5	44.7
Brigham Plains (n = 40)	12.5	50.0
Nipple Bench (n = 35)	20.0	31.4
East Clark Bench (n = 6)	33.3	50.0
(c) Temporal Affiliation		
Unknown (n = 221)	13.1	43.4
Archaic general (n = 195)	22.1	43.6
Early Archaic (n = 21)	9.5	42.9
Middle Archaic (n = 20)	35.0	40.0
Late Archaic (n = 31)	29.0	48.4
Formative (n = 92)	16.3	34.9
Formative/Post-Form. (n = 25)	22.6	35.5
Post-Formative (n = 29)	24.1	44.8
(d) Site Type		
Semi-permanent habitations (n = 13)	16.7	46.2
Residential camp (n = 70)	22.5	60.0
Processing camp (n = 147)	17.7	43.5
Hunting camp (n = 165)	22.4	47.3
Reduction locus (n = 105)	13.3	22.9
Storage–cache (n = 9)	0.0	0.0
Other (n = 3)	0.0	0.0
Unknown (n = 122)	18.9	43.4

opposite faces of cobbles are noninvasive and do not thin the tool but simply prepare an edge. Kearns's (1982:126) designation of these items as cobble bifaces is potentially confusing in this regard. There are also cobbles flaked on opposite faces from different ends, tools that Kearns called cobble multifaces. Some of the flaked cobble tools are made on large flakes, usually ones with abundant cortex. These usually were flaked to make a suitable working edge but sometimes the massive flakes had been used directly without further modification. Although flaked cobble tools can be subdivided based on whether they are made on entire cobbles (core tools) or made on flakes (flake tools), this distinction appears to lack functional significance in most cases and seems to have little interpretive value. The direction of edge preparation and the number of prepared edges likewise appear to have little interpretive value principally because these attributes seem to have been irrelevant to the producers.

Preparation flakes are those initially detached from the cobbles to create the working edge (Figure 6.37a). These are always the largest ones and have a high incidence of cortex cover, usually from 50 to 100 percent. Commonly only two to four large flakes need to be removed to produce a suitable edge. The preparation flakes with their large bulbs of percussion leave an irregular working edge with core overhangs. The edge can be regularized and core overhangs removed by detaching a series of small edge-trimming flakes (Figure 6.37b). After edge trimming, the tool is ready for use in any number of heavy-duty tasks. As the edges become worn, they are easily refurbished by detaching a series of resharpening flakes. These are customarily struck off in the same direction as the preparation flakes and therefore have use-wear traces on the platform edge. An example of this is shown in Figure 6.38. This resharpening flake can be as large as the preparation flakes, though usually with little or no cortex, or they can be quite small. Resharpening flakes are ubiquitous at many prehistoric sites of the Kaiparowits Plateau. An alternative resharpening method is by tranchet blow (Crabtree 1972:95), where a worn cobble is struck obliquely on one side to remove a flake crosswise and at right angles to the main axis of the tool, carrying away the worn edge along one margin of the flake. We observed examples of this type of resharpening flake on sites, but in general, this technique seems to have been little used.

Another common method to make flaked cobble tools involves detaching a large flake from a cobble and either flaking one margin to make a suitable edge or using the flake directly without further modification. In many cases, these cobble flake tools are made on primary flakes, but some are made on interior flakes, including large edge-

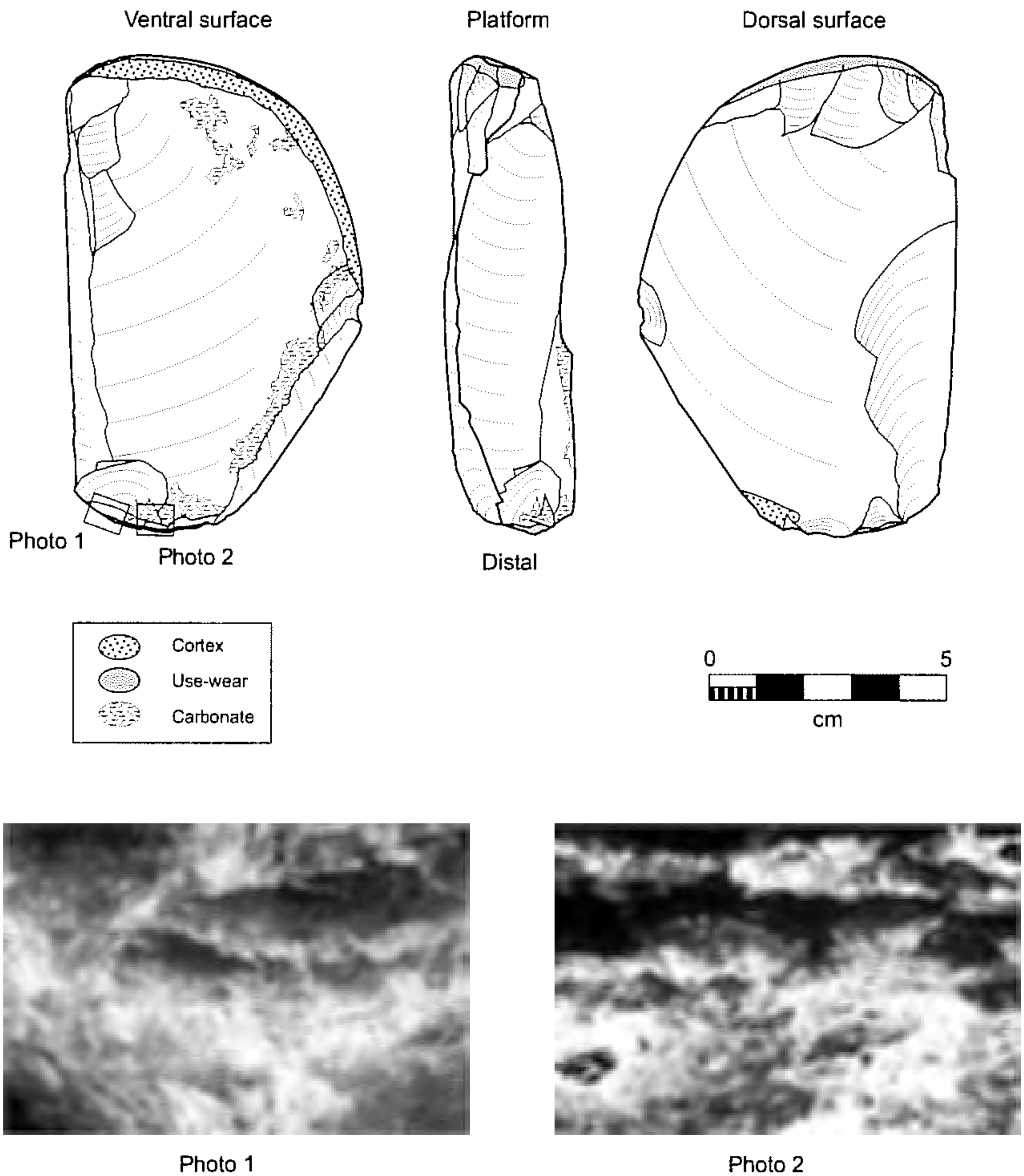


Figure 6.38. A quartzite cobble flake (42KA4845, F1) that was detached to resharpen a cobble pounder; flake was subsequently used as a chopper on its distal end. Flaked surfaces are partially encrusted with carbonate. Light micrographs taken at 16x show crushing and fracturing of distal edge.

resharpening flakes. Figure 6.38 (see also 7.6a) illustrates a flaked cobble pounder resharpening flake that was subsequently used as a chopper without further edge preparation (i.e., a used flake). It is possible that the incidence of cobble flake tools, especially those used as scraper planes without further retouch, has been underrepresented. Lacking obvious retouch or use flaking and other wear traces, such flake tools may simply have been overlooked as production debris.

Common use-wear traces on tool edges include microflaking from both faces, with the flakes commonly ending in step fractures (Figures 6.38–6.40). This can be accompanied by edge abrasion and rounding. These wear traces are interpreted as resulting from use of the tools as choppers, a task for which the flaked cobbles would be well suited. The edges of some flaked cobbles have heavily battered, dulled, and rounded margins with a thickness of 5 mm or more. This extensive form of battering use-wear suggests that these flaked cobbles were used in a percussive fashion on some far more unyielding substance than the choppers with microflaking use-wear. For the sake of providing a category distinct from cobble choppers, we referred to these tools as cobble pounders. In some respects the flaked cobble pounders appear similar to tools at Puebloan habitation sites, termed pecking stones (Woodbury 1954:86), that were used in the production and maintenance of manos and metates. Similar tools are common at grinding tool production sites such as those along the lower Colorado River (Geib 1986; Huckell 1986). On the Kaiparowits Plateau, flaked cobble pounders typically occurred on sites that lacked either grinding tools or the sorts of grinding tools that were heavily maintained and required extensive production effort. Thus, the cobble pounders must have been put to some other tasks that we have yet to specifically identify. Other flaked cobble tools with an edge prepared by flaking lacked microflaking use-wear, but instead had an edge rounded from being used in a scraper or plane-like fashion.

Some of the flaked cobble tools seen on sites have abrasive edge rounding but not polish, and may have been used to work wood or some other material (Figure 6.39). They seem to have been used more as scraper planes than as choppers, because they lack large step-fracture use flaking. Others have extensive rounding and polish of the edge, often resulting in a distinct wear facet, perhaps from having been used to work hides. Figure 6.41 shows an example of a quartzite flaked cobble tool with a polished wear facet and striations perpendicular to the edge. This type of use-wear is similar to that seen on end-scrapers used in the final stage of working hides (see Hayden 1979; Ahler 1979) where the goal was softening and a sharp edge was not required. Stanley Ahler (personal communication 2000) examined this tool under a microscope and concurred that the wear traces are consistent with a hide softening function.

For this survey, NNAD field crews recognized three functional classes of flaked cobble tools—choppers, scraper planes, and pounders. A functional classification, even if rather nonspecific and perhaps somewhat subjective, seemed more informative than one based on production technology. After all, it is clear that tools of vastly different function were similarly produced—for example, unidirectionally flaked cobbles have wear traces indicative of uses ranging from heavy pounding on hard materials such as stone to hide scraping. Indeed, how an edge on a cobble tool was produced—whether unidirectional or bidirectional—seems largely irrelevant. Sometimes a single cobble appeared to have been used for two tasks on different prepared edges. There is likely quite a bit of functional variability lumped together in our three general functional classes of cobble tools, variability that will take laboratory analysis in conjunction with experimental studies to unravel. Ultimately, it will be of value to obtain a better understanding of cobble tool functions. These tools were important for most groups using the Kaiparowits Plateau and form a significant part of its archaeological record. Discerning the functions of flaked cobble tools will allow a better evaluation of the settlement-subsistence roles of sites, which in turn should lead to a better understanding of various adaptations to the region.

Given that flaked cobble tools are technologically simple, informal, and made on abundant locally occurring materials, they might be considered expedient—tools produced in immediate response to some specific task (Binford 1979). This is likely to have been the case in some instances, but there are several lines of evidence suggesting that flaked cobble tools commonly were made in anticipation of use, maintained by resharpening, transported from one location to another, and even recycled. Resharpening seems to have been common, because much of the cobble tool flaking debris occurring on sites is derived from this activity. These flakes exhibit use-wear traces at the juncture of the platform and dorsal surface, or more rarely,

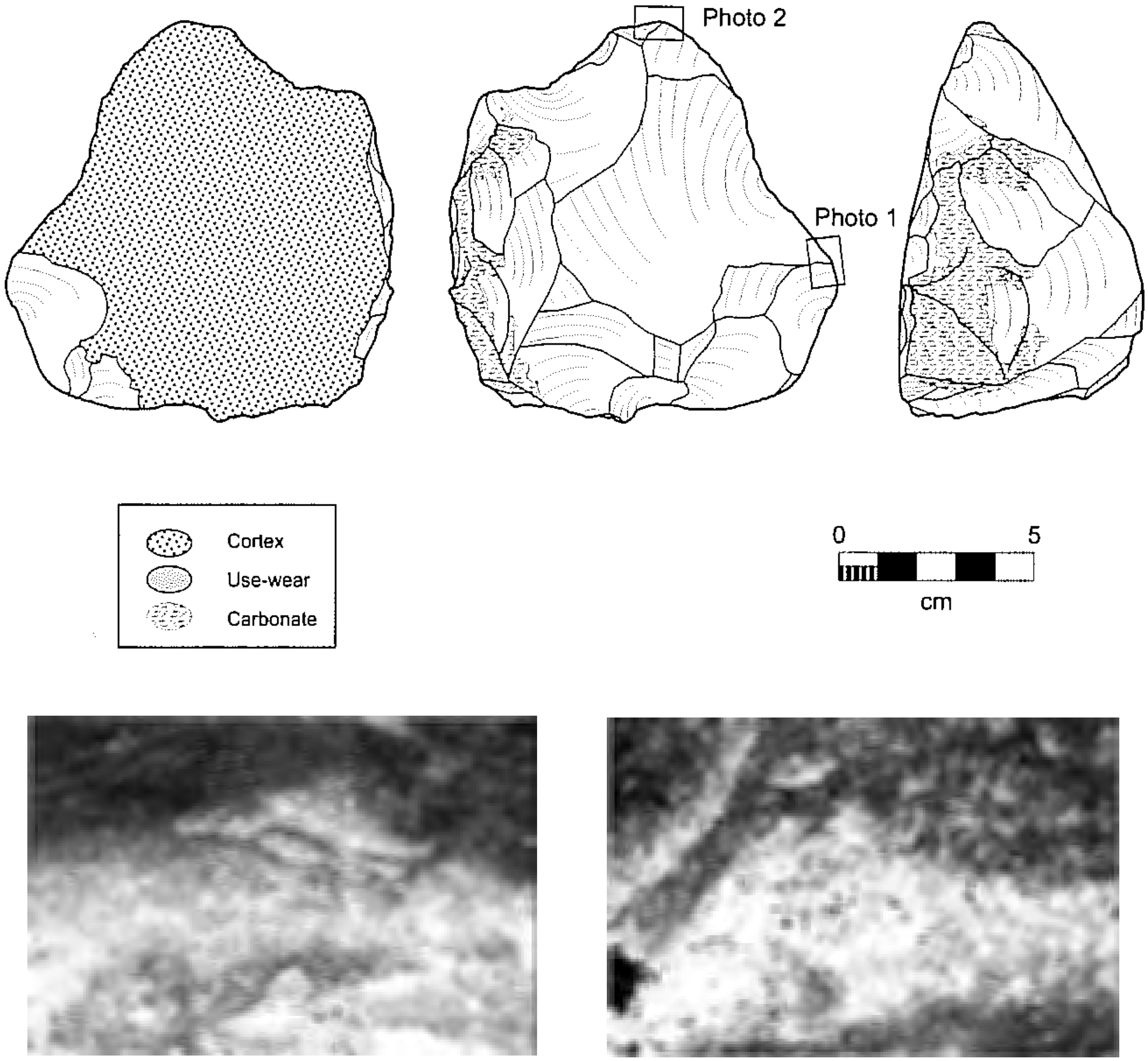


Photo 1 Photo 2

Figure 6.39. A flaked cobble scraper plane/chopper (42KA4747, Ct1). Light micrographs taken at 16x show the percussive crushing and abrasive rounding of tool edges.

along one margin (tranchet flakes). Even at sites where alluvial cobbles occur naturally on the site or immediately adjacent, cobble tool resharpening debris is abundant. Flaked cobble tools are also common occurrences at these sites, having been discarded or purposefully left for future reuse. In settings where the cobbles do not occur naturally, such as Horse Flat, Brigham Plains, and Jack Riggs Bench, cobble tool resharpening debris is abundant but not the tools or production debris. This indicates that the tools were made elsewhere and brought to sites ready for use or in already used condition, where they were also resharpened. Comparatively few tools were discarded or purposefully left at the sites on these topographic features; the occupants evidently removed them upon abandonment or perhaps cached them elsewhere. One site on Horse Flat (42KA4649) is a likely cache of both flaked cobble tools and manos. The cobble tools on sites distant from natural cobble deposits are usually exhausted, worked down to small end remnants. That flaked cobble tools were produced and brought to locations where chert/chalcedony is available, such as on the north

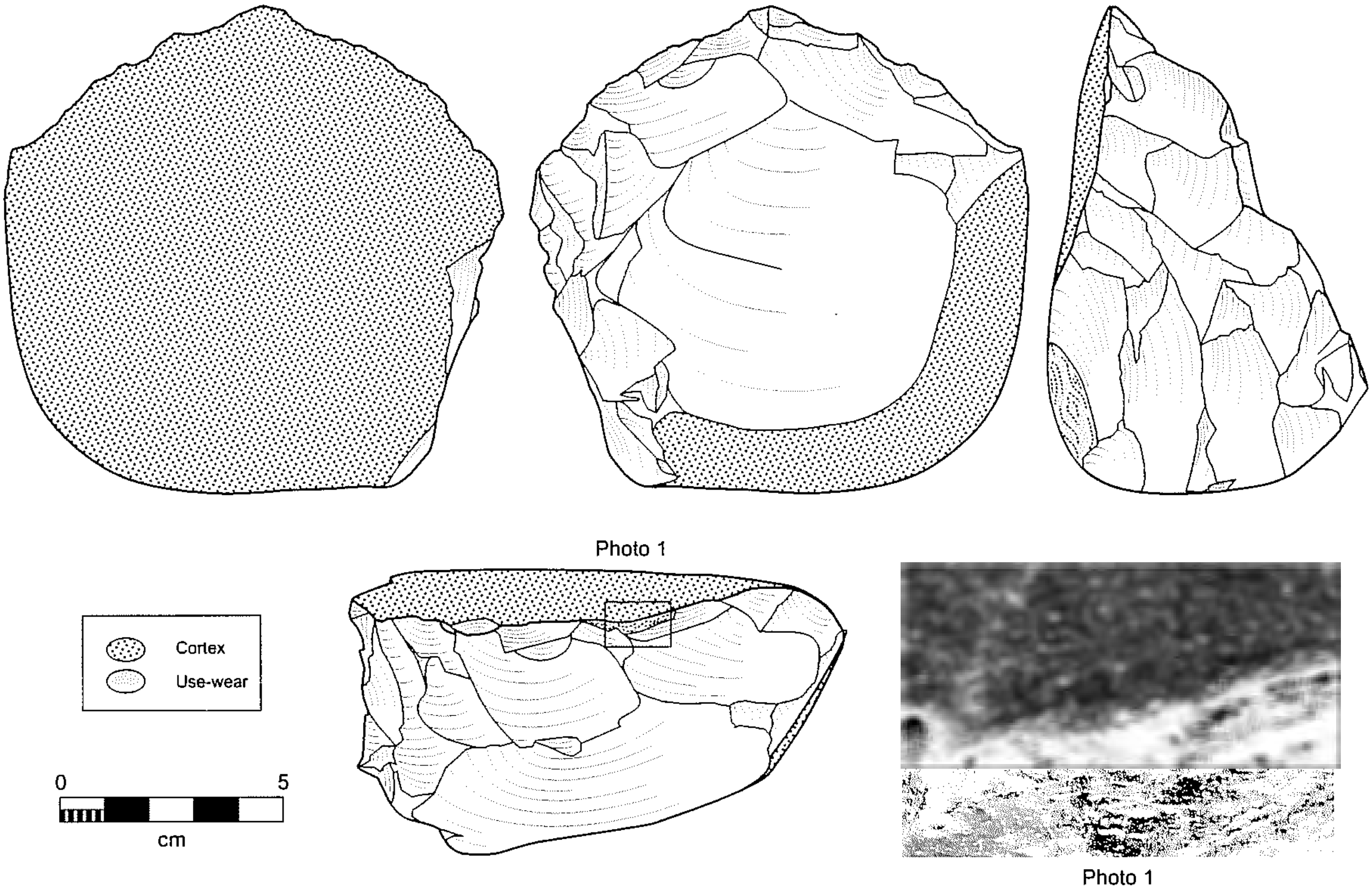


Figure 6.40. A flaked cobble chopper found as an isolated occurrence (IO327); most use-wear has been removed by resharpening but traces remain on one portion including microflaking and polish. Light micrograph taken at 16x shows microflaking; edge is also polished but does not show well in this image.

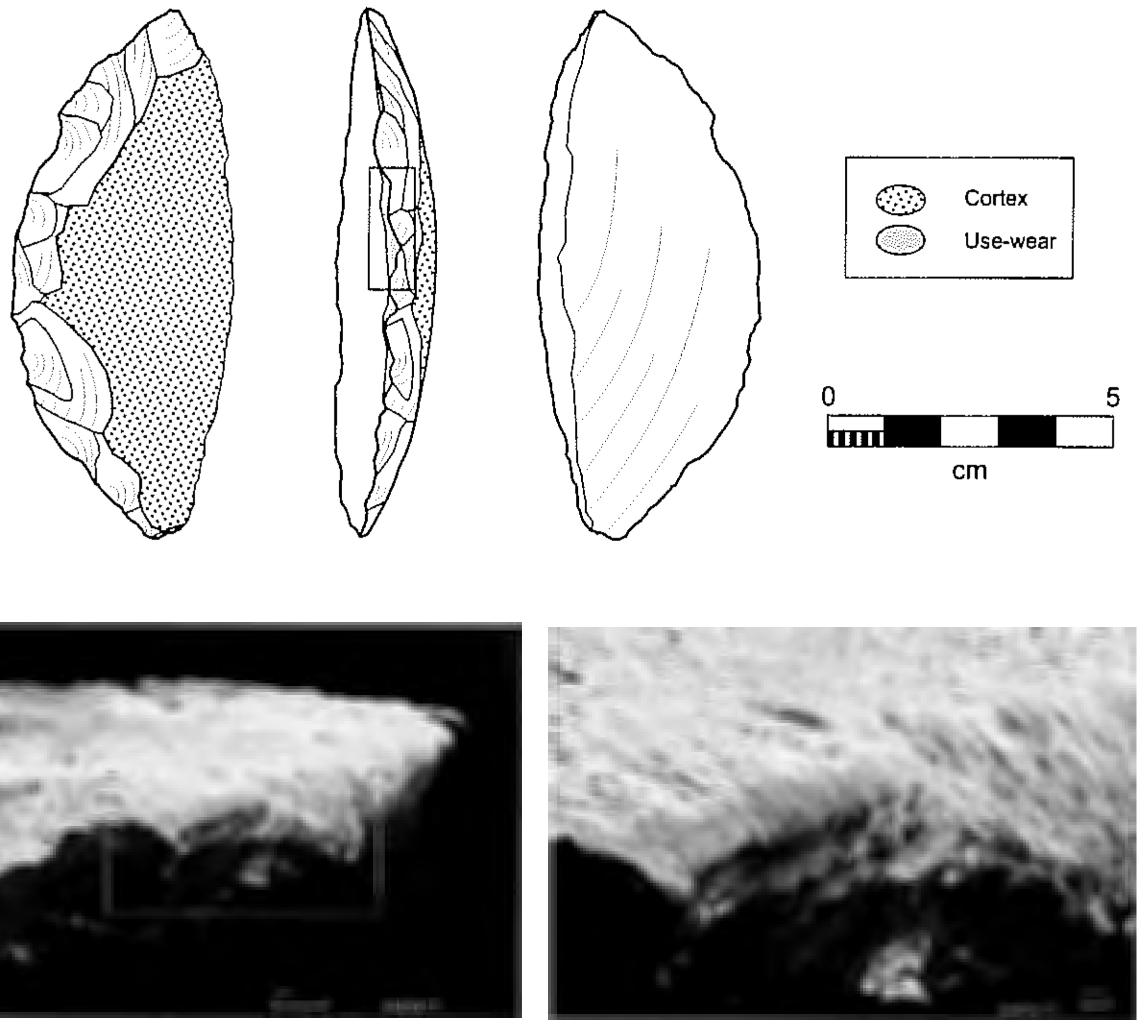


Figure 6.41. Quartzite cobble flake (42KA4754, Ct1) retouched on end and then used extensively in a scraping-like fashion resulting in a pronounced wear facet (as shown in the photomicrograph). Electron micrographs illustrate the wear facet and its striated surface with ventral surface facing up.

edge of Paradise Bench, suggests that these tools fulfilled tasks for which fine silicates were poorly suited. Using the coarse-grained cobbles did not result from being caught short and making do with what was at hand but from selecting the best material for the task at hand and preparing the tool ahead of time to conduct that task.

Distribution

Thirty-four percent of the sites that NNAD recorded have discarded examples of flaked cobble tools (Table 6.14). Many more sites have the flaking debris from the preparation or, more commonly, resharpening of these tools—501 of the 689 sites (73%). This supports what was said above about these being curated and maintained, at least in settings where the tough alluvial cobbles do not naturally occur, which includes many of NNAD's sampling strata. Flaked cobble tools seem to have been employed by most groups using the Kaiparowits Plateau, but perhaps less by the early and middle Archaic foragers than by later occupants of the region. These tools occur at 31 percent of the Post-Formative sites, but more than 47 percent of Formative sites have this tool class. The occurrence at Archaic sites varies from a low of 15 percent for middle Archaic sites to a high of 38 percent for sites with a general Archaic designation.

In contrast to the previous classes of flaked stone tools, this class shows some marked differences between site types. More than half of all residential sites and processing camps have these tools, but few hunting camps and even fewer reduction loci. This could be an indication that this

Table 6.14. Data about the occurrence and distribution of flaked cobble tools on prehistoric sites: (a) descriptive statistics based on 689 sites with prehistoric components; (b) percentage of sites within each sampling stratum containing flaked cobble tools, based on 689 sites with prehistoric components; (c) percentage of sites within each temporal interval containing flaked cobble tools, based on 634 single-component sites; and (d) percentage of sites within each temporal interval containing flaked cobble tools, based on 634 single-component sites.

(a) Variables	Values
Sum of artifact type	564
Number of sites with artifact type	234
Percent present	34.0
Maximum count per site	23
Mean	2.4
Standard deviation	2.9
(b) Sampling Stratum	Percent of Sites with Flaked Cobble Tools
Collet Top (n = 146)	38.2
Horse Mountain (n = 97)	32.0
Long Flat (n = 121)	48.8
Horse Flat (n = 33)	36.4
Fourmile Bench (n = 135)	29.1
Smoky Mountain (n = 76)	31.6
Brigham Plains (n = 40)	25.0
Nipple Bench (n = 35)	11.4
East Clark Bench (n = 6)	0.0
(c) Temporal Affiliation	
Unknown (n = 221)	27.1
Archaic general (n = 195)	37.9
Early Archaic (n = 21)	19.0
Middle Archaic (n = 20)	15.0
Late Archaic (n = 31)	35.5
Formative (n = 92)	47.7
Formative / Post-Formative (n = 31)	29.0
Post-Formative (n = 29)	31.0
(d) Site Type	
Semi-permanent habitation (n = 13)	53.8
Residential camp (n = 70)	67.1
Processing camp (n = 147)	58.5
Hunting camp (n = 165)	17.6
Reduction locus (n = 105)	11.4
Storage-cache (n = 9)	22.2
Other (n = 3)	0.0
Unknown (n = 122)	23.0

type of tool is not closely associated with the actual hunting and field processing of game. If pounders were used to smash long bones for marrow or bone grease extraction, it seem likely that these labor-intensive forms of game processing usually would have been done at residential sites (and perhaps by females) rather than at logistical hunting camps. Cobble choppers might be useful for separating a deer carcass into transportable sections, but this is also easily accomplished with just a flake by cutting through the muscle to the joint of separation and then twisting. Another labor-intensive game processing activity that flaked cobble tools appear to have been used for is hide preparation. A number of the cobble tools have distinct and pronounced use-wear facets with macroscopically obvious striations perpendicular to the use edge. These sorts of striated use-wear facets resemble those documented on ethnographic hide scrapers (e.g., Hayden 1979, especially Figure 7-10; also Ahler 1979:Figures 3 and 4), ones used in hide softening when the goal is to stretch the hide as it dries to leave the fiber network free moving (see Richards 1997:18–19, 73). Again, more likely than not this activity would have taken place at residential camps, when sufficient time was available for the various processing steps (fleshing, soaking, graining) prior to hide softening.

Grinding Tools

Metates

Metates (a.k.a. grinding slabs) are defined as stone slabs (all made of sandstone on the Kaiparowits Plateau) that may or may not have been shaped and then used as the passive stone for grinding seeds. Their counterparts, manos, or the active tools, are discussed next. Some of the grinding slabs on the Kaiparowits Plateau were selected for use without production investment, and others were spalled to shape, usually unidirectionally from the surface that would be used. There is no necessary cultural preference involved in whether slabs are shaped or not because both shaped and unshaped tools occurred together on obvious single-component sites. Shaping was probably contingent upon the slab selected for use—too big and heavy and it would be shaped.

As discussed and illustrated in Chapter 7 (see Figure 7.8), examples of this tool class on the Kaiparowits Plateau are in the process of leaving the archaeological record. Indeed, it is likely that grinding tools are underrepresented on Archaic sites simply because the local sandstones are highly susceptible to various forms of degradation: fragmentation (breaking across bedding planes), exfoliation (splitting along bedding planes), and surface weathering (chemical and physical weakening of cement resulting in loss of surface rock). Sites with the most severely fragmented grinding slabs commonly had other evidence suggesting an Archaic age. In contrast, sites with the best-preserved slabs often had other

evidence suggesting a Post-Formative age. In some cases, the excellent preservation alone of grinding slabs was cause enough to tentatively suggest a Post-Formative temporal affiliation, a finding supported by the testing project (see Chapter 5).

Four of the best-preserved grinding slabs found during the Kaiparowits Plateau Survey occur at two probable Post-Formative sites: 42KA 4732 and 42GA4743. The pair of slabs at each of these two sites are likely representative of what most slabs were like in the area throughout time. The well-preserved early Archaic examples from Dust Devil Cave are essentially no different. One of the slabs from 42GA4743 (GS1) was unidirectionally flaked around its entire circumference into a sub-rectangular shape measuring 54 by 37 and 10 cm thick. There is a central pecked and ground depression that measures about 25 by 20 cm, and is about 2 mm deep. The second grinding slab has a natural sub-rectangular shape (no production investment); it measures 46 by 31 and is 5 cm thick. At its center is an unpecked grinding slick that measures about 19 by 12 cm (it might have once been larger but lichen and moss growth has covered much of the surface). These two tools are almost identical to the two at site 42KA4732, where one of the slabs was unidirectional flaked into an elongated pentangle measuring 56 by 40 cm and 8 cm thick. It was used on one face toward the center of the slab in an area measuring about 30 by 20 cm; the face was pecked. The second grinding slab was not produced but has the approximate shape of the previous example; it measures 50 by 31 cm and 8 cm thick. This tool was also used on a single face with its grinding slick measuring about 30 by 20 cm; its face is not pecked. Site 42KA4732 contains at least one hearth (see testing results in Chapter 5), whereas 42GA 4743 consisted only of the two grinding slabs, no other artifacts or other cultural remains. Another interesting example of a whole metate is one that we found cached in a juniper tree on Fourmile Bench (IO854). This item is discussed in detail later in the discussion of isolated occurrences.

Table 6.15. Data about the occurrence and distribution of metates and manos at prehistoric sites: (a) descriptive statistics based on 689 sites with prehistoric components; (b) percentage of sites within each sampling stratum containing metates and manos, based on 689 sites with prehistoric components; (c) percentage of sites within each temporal interval containing metates and manos, based on 634 single-component sites; and (d) percentage of sites within each temporal interval containing metates and manos, based on 634 single-component sites.

(a) Variables	Metates	Manos
Sum of artifact type	280	228
Number of sites w/ artifact type	168	146
Percent present	24.4	21.2
Maximum count per site	9	8
Mean	1.7	1.6
Standard deviation	1.2	1.0
(b) Sampling Stratum	Percent of Sites with Metates	Percent of Sites with Manos
Collet Top (n = 146)	26.7	24.0
Horse Mountain (n = 97)	23.7	23.7
Long Flat (n = 121)	30.6	28.9
Horse Flat (n = 33)	23.3	24.2
Fourmile Bench (n = 135)	20.0	17.8
Smoky Mountain (n = 76)	19.7	9.2
Brigham Plains (n = 40)	17.5	15.0
Nipple Bench (n = 35)	31.4	20.0
East Clark Bench (n = 6)	0.0	16.7
(c) Temporal Affiliation		
Unknown (n = 221)	15.4	13.1
Archaic general (n = 195)	23.6	25.6
Early Archaic (n = 21)	14.3	4.8
Middle Archaic (n = 20)	25.0	30.0
Late Archaic (n = 31)	25.8	32.3
Formative (n = 92)	37.2	18.6
Formative/Post-Form. (n = 25)	25.8	25.8
Post-Formative (n = 29)	37.9	20.7
(d) Site Type		
Semi-perm. habitation (n = 13)	58.3	38.5
Residential camp (n = 70)	53.5	44.3
Processing camp (n = 147)	49.7	42.9
Hunting camp (n = 165)	8.9	6.7
Reduction locus (n = 105)	3.8	5.7
Storage–cache (n = 9)	33.3	33.3
Other (n = 3)	0.0	4.9
Unknown (n = 122)	6.6	33.3

Almost one quarter of the recorded sites have examples of grinding slabs in various states of preservation (168 of 689 sites; Table 6.15). In some cases the evidence is on the verge of disappearing and it seems likely that we did not observe grinding slabs at some sites because they had become part of the site matrix. The higher incidence of grinding slabs on Formative and Post-Formative sites over Archaic sites is most likely the result of preservation bias rather than evidence for more intensive seed processing later in time. As with the flaked cobble choppers, grinding slabs show some marked differences in representation among site types. This is expectable, as the occurrence of seed processing tools is thought to be an important indicator of site function (see Site Type discussion). That 9 percent of the hunting loci have grinding slabs, as do 4 percent of the reduction loci, is likely a result of

unrecognized multi component sites or changing settlement functions where the residential aspect was less evident. The high number of residential sites with grinding slabs but no manos is perhaps because the former were mainly site furniture whereas manos would be moved from one location to another, or at least cached. It could also result because manos are more likely to be recycled by later occupants of the area—usually made of dense sandstone, they are preserved better than grinding slabs of friable sandstone.

Simms (1983:Table 1) presented data on grinding tool occurrence at Archaic and Post-Formative sites from western Utah, showing that grinding tools are present at only 19 percent of Archaic sites, but 33 percent of Post-Formative sites. If these data had come from the Kaiparowits Plateau, we would conclude that the significant trend of greater grinding tool representation at Post-Formative sites could be entirely accounted for by differential preservation bias. That is, earlier sites have less grinding tools than recent sites simply because of tool fragmentation, exfoliation, surface weathering, and caliche encrustation. Indeed, it seems likely that even the earliest arrivals of those who would become members of the Kaiparowits Band of the Southern Paiute rarely found grinding slabs at open Archaic sites on the Kaiparowits Plateau that were of any utility. All had already been reduced to useless fragments.

Manos

Manos are hand-held tabular or cobble-shaped pieces of stone used against grinding slabs or metates for processing seeds and other plant products. We follow the common Southwestern practice of recognizing one-hand and two-hand forms, but note that virtually all examples observed on the Kaiparowits Plateau Survey are one-hand varieties. In most cases the Kaiparowits Plateau manos lack any signs of production—they usually consist of a natural sandstone stream cobble that was put to use without modification. Some of these have well-developed "rocker" bevels from extensive use. We usually identified this sort of mano as Archaic style but recognize that they may have been recycled by later groups. Also occurring on the plateau are manos with a more standardized oval to rectangular shape and with essentially parallel use faces that lack rocker bevels. The shorthand field designation for these was Basketmaker-style manos, but we recognize that this name is problematic. This sort of mano is common at Fremont and Anasazi sites that date well after the Basketmaker period. They are, however, distinctive from the two-hand rectangular manos with parallel or faceted use surfaces that are characteristic of Kayenta Anasazi habitations. No examples of these latter sorts of manos were found in the project area.

The overall representation of manos is no different than that of grinding slabs (Table 6.15). Site representation by sampling strata, temporal affiliation, and site type is likewise little different from grinding slabs. The one trend for less manos than grinding slabs to occur at residential sites was just discussed. Smoky Mountain has far fewer sites with manos than any of the other strata, but a reason for this is not immediately apparent.

Other Stone Artifacts

Shaft Abraders

Field crews found three examples of shaft abraders, one as an isolated find (IO267) and one each at sites 42KA4731 and 5396 (Figure 6.42). These artifacts have characteristics that match tools used by various tribes to abrade arrow shafts, as reported in ethnographies (see Flenniken and Ozbun 1988). The isolated occurrence is whole, although slightly damaged on one corner and the opposite end. The tool measures 76 mm long, 31 mm in maximum width (it tapers to about 25 mm at the distal end), 14 mm thick toward the distal end, and 12 mm thick at the proximal end. Made of medium-grained sandstone, the tool was carefully ground to shape on faces, edges, and ends. The flattest face (the other one is somewhat rounded) was used to abrade shafts. Up its center on a slight angle to the long axis of the tool runs an abrasion groove. The groove runs the full length of the tool, but it decreases in depth toward the proximal end to the point of being almost nonexistent. The groove has a maximum width of 8 mm and a depth of about 2 mm and has a U-shaped section.

The example from 42KA5396 is a fragment larger than the whole item above. Broken on one end, this tool does not appear to have been used after breaking because the broken edge does not appear use-rounded or abraded. Use of the tool after breaking would have been especially visible where the worn groove intersects the broken edge. The tool measures 96 mm long, 44 mm in maximum width, and 18 mm thick (it is essentially uniform in width and thickness along its entire length). Made of medium-grained sandstone, the tool was carefully ground to shape on faces, edges, and ends. The flattest face was used to abrade shafts, whereas the other face had just traces of

use—more like the start of an abrasion groove, but one clearly not used very much. The groove extends the full length of the tool running straight up the center paralleling the long axis. It is essentially constant in width and depth for the entire length of the tool, having a maximum width of 5 mm and a depth of about 2 mm. The groove has a truncated U-shaped section that appears to represent about a third of a round shaft. Given the diameter of the groove, it seems likely that arrow shafts were abraded with this tool. Unfortunately the site of this find had few remains and no clear indication as to temporal affiliation

The other shaft abrader is an interior fragment with both ends missing; the fine-grained sandstone is also somewhat eroded and friable. It too was formed by abrading the edges and faces. The fragment measures 34 mm in maximum width (a taper is also evident) and 13 mm thick. This tool was used on both faces; one groove is approximately 5 mm deep and the other is 3 mm deep, leaving just 5 mm between the grooves.

Morss (1931:55, Plate 31c) described a pair of sandstone shaft abraders similar to those reported here from his Site 34 in the San Rafael Swell. These examples bear witness to the idea that these items were commonly used in pairs. Morss (1931:55) observed that the tools occurred in a cave without other remains, thus he was uncertain whether "they are to be assigned to the Fremont culture." Because these tools occurred with a cache of deer bone within juniper bark, radiocarbon dating is possible so that a temporal assignment could be made. Occurring as a pair it seems certain that the two stones were used together, as described and illustrated by Flenniken and Ozbun (1988:37–41, Figure 8).

Bead Blank/Gaming Piece?

An unusual artifact is a flake of Paradise chert that had been chipped into a circular form and then abraded on its margin and the dorsal surface of the original flake (Figure 6.43). It measures 17 mm in diameter and 4.5 mm in maximum thickness. This item was found as an isolated occurrence (IO15) on Long Flat near site 42KA4546 and might be related to it. What this artifact was intended for is difficult to say. Stone beads made of chert of approximately this size or smaller are known from the Colorado Plateau (e.g., Guernsey and Kidder 1921:48). Items of this approximate size and sometimes made of stone have been described as compound dice (Guernsey and Kidder 1921:106–107, Plate 43). Joel Janetski (personal communication 2000) recovered several comparably sized, flaked and abraded stone disks of white chert and obsidian from a Fremont site known as Mickey's Place at Fish Lake. The site is dated to around A.D. 1000.

CERAMICS

Few sites of the Kaiparowits Plateau Survey have ceramics except for those in a portion of the Collet Top stratum. Just 12 percent of the Native American sites recorded during the entire survey (79 of 689) contained sherds. However, the distribution of sites with pottery by survey stratum shows a marked difference. Thirty-eight percent of the sites on Collet Top have ceramics, but for all other strata this value is 11 percent or less. The apparent principal reason for this difference is that portions of the Collet Top survey stratum offered environmental settings more conducive to rather intensive Anasazi settlement, ones perhaps somewhat comparable to those on Fiftymile Mountain. Within several of the survey units on Collet Top, namesake for the sampling stratum, NNAD archaeologists recorded Anasazi structural habitations ranging in size from single rooms to eight or so rooms. Each of these contained various quantities of ceramics, some in moderate abundance and diversity. The presence of these habitations probably also added to the incidence of nonhabitation sites containing pottery in the general region on and around Collet Top.

It is worth pointing out that the low frequency of sites with pottery in most of our sampling strata paralleled the results of ESCA-Tech's sample survey on the northwest portion of the Kaiparowits Plateau. Of the 146 sites recorded in Tract II of that project (120 in sample units and 26 outside sample units), just 11 had ceramics (7.5%; Kearns 1982: Table 24) and only two of these had more than a single sherd. This helps to further illustrate that the Collet Top portion of the Collet Top sample frame is anomalous with regard to the rest of the Kaiparowits Plateau except for Fiftymile Mountain.

Table 6.16 lists the pottery types identified based on field and laboratory observations. The total number of sherds found is over 2000, with most of these coming from the 14 sites that had more than 50 surface sherds. This table also presents the estimated quantity of sherds at each site according to four groupings: <10, 11–50, 51–100, and >101. Six sites had more than 100 surface sherds. Ceramic collection was allowed under the contract to enable laboratory analysis and positive

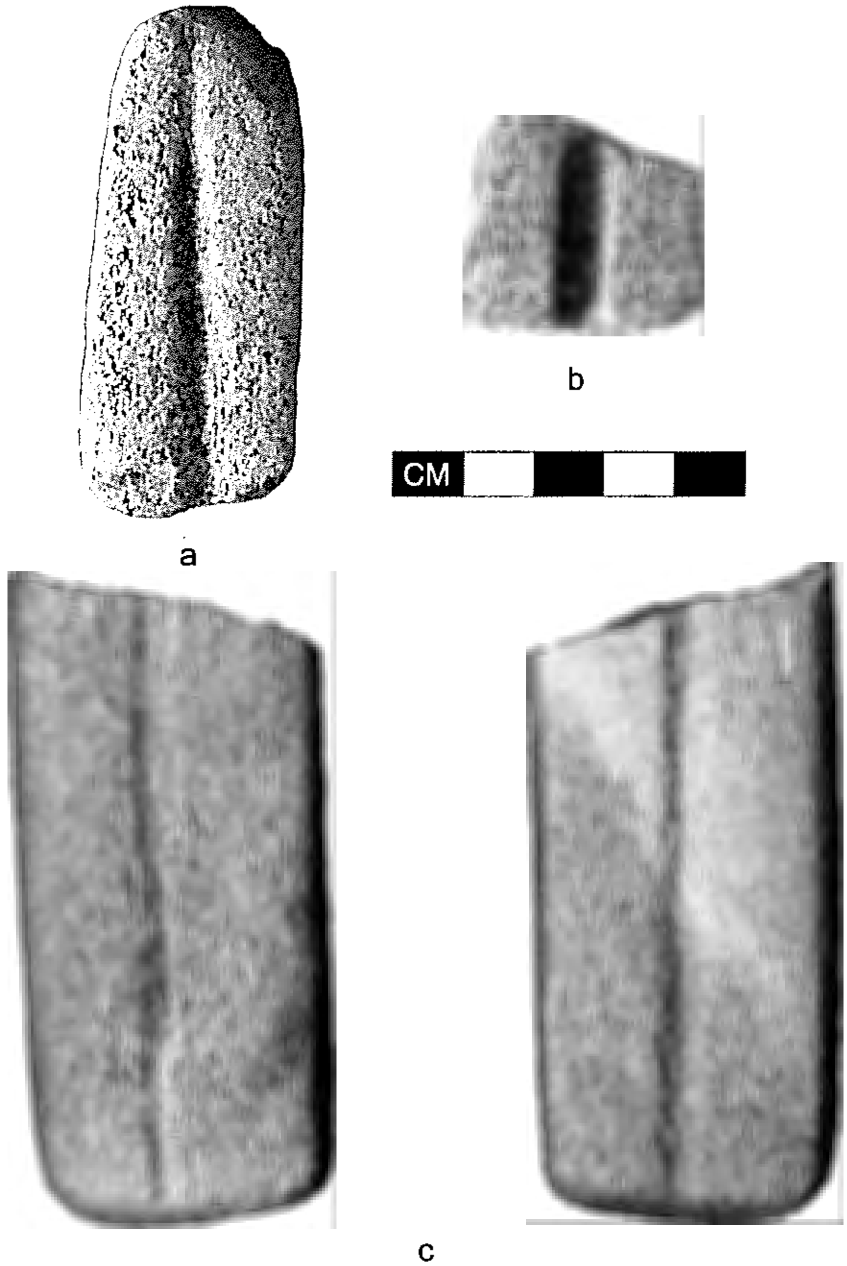


Figure 6.42 Shaft abraders found on the Kaiparowits Plateau Survey: a) IO267, b) site 42KA4731, c) site 42KA5396.

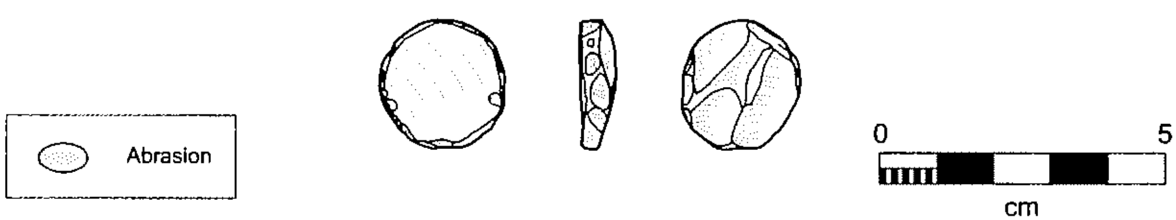


Figure 6.43. Bead blank or gaming piece (IO15) made on a flake of local white chert, chipped to shape then abraded on margin and dorsal flake surface.

Table 6.16. Ceramic types identified at prehistoric sites recorded during the Kaiparowits Plateau Survey. Identifications based on field and laboratory observations.

Ceramic Type	KA 2253	KA 4546	KA 4563	KA 4572	KA 4576	KA 4578	KA 4614	KA 4617	KA 4675	KA 4676	KA 4733	KA 4750	KA 4757	KA 4769	KA 4778	KA 4795
Estimated Quantity	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	11–50	<10	11–50	<10	<10	<10
Awatovi B/y																
Awatovi/Jeddito B/y				X												
Black Mesa B/w																
Citadel Polychrome																
Coombs Variety Corrugated																
Coombs Variety whiteware																
Deadmans B/r																
Emery Gray	X				X			X				X			X	X
Hildale B/g											X					
Kanab B/r																
Kanab Polychrome																
Kanab Red											X					
Moenkopi-like																
North Creek B/g		X				X										
North Creek Corrugated									X							
North Creek Gray									X	X						
Shinarump B/w																
Shinarump Corrugated						X				X	X		X			
Shinarump Plain						X					X					
Shinarump White Ware																
Snake Valley B/g						X			X							
Snake Valley Gray																
Sosi B/w																
St. George B/g																
Tsegi Orange Ware																
Tsegi B/o														X		
Tusayan Corrugated																
Virgin B/w																
Virgin Series Whiteware																
Virgin B/w-Hildale style							X									
Virgin B/w-North Creek style											X		X			
Virgin B/w-St. George style																
Untyped B/g																
Untyped corrugated																
Untyped utility			X													
Untyped vessel handle																
Untyped redware																
Untyped whiteware																

Table 6.16 (cont.)

Ceramic Type	KA 4797	KA 4812	KA 4827	KA 5223	KA 5225	KA 5228	KA 5229	KA 5254	GA 4782	GA 4783	GA 4790	KA 5265	KA 5279	KA 5281	KA 5286	KA 5286
Estimated Quantity	<10	<10	11–50	<10	<10	<10	51-100	<10	<10	<10	<10	<10	11–50	<10	<10	<10
Awatovi B/y			X													
Awatovi/Jeddito B/y																
Black Mesa B/w																
Citadel Polychrome																
Coombs Variety Corrugated																
Coombs Variety White W																
Deadmans B/r																
Emery Gray				X					X	X	X	X	X			
Hildale B/g																
Kanab B/r							X									
Kanab Polychrome							X									
Kanab Red					X	X	X	X								
Moenkopi-like					X		X									
North Creek B/g							X									
North Creek Corrugated	X		X													
North Creek Gray																
Shinarump B/w						X										
Shinarump Corrugated					X	X	X				X			X		
Shinarump Plain							X					X			X	X
Shinarump White Ware						X						X		X		
Snake Valley B/g																
Snake Valley Gray																
Sosi B/w																
St. George B/g	X															
Tsegi Orange Ware																
Tsegi B/o																
Tusayan Corrugated																
Virgin B/w							X									
Virgin B/w-Hildale style																
Virgin B/w-North Creek style																
Virgin B/w-St. George style																
Virgin Series Whiteware																
Untyped B/g																
Untyped corrugated																
Untyped utility	X	X										X	X			
Untyped vessel handle																
Untyped redware	X															
Untyped whiteware																

Table 6.16. (cont.)

Ceramic Type	KA 5288	KA 5293	KA 5311	KA 5318	KA 5330	KA 5332	KA 5344	KA 5351	KA 5362	KA 5376	KA 5377	KA 5378	KA 5391	KA 5392	KA 5393	KA 5411
Estimated Quantity	<10	<10	<10	<10	11-50	<10	<10	<10	<10	11–50	<10	51-100	>101	>101	51-100	11–50
Awatovi B/y																
Awatovi/Jeddito B/y																
Black Mesa B/w																
Citadel Polychrome																
Coombs Variety Corrugated																
Coombs Variety whiteware																
Deadmans B/r																
Emery Gray																X
Hildale B/g																
Kanab B/r		X														
Kanab Polychrome												X				
Kanab Red										X			X	X	X	
Moenkopi-like																
North Creek B/g																
North Creek Corrugated	X			X						X	X	X	X	X	X	
North Creek Gray				X						X		X	X	X	X	
Shinarump B/w																
Shinarump Corrugated						X		X	X				X			
Shinarump Plain					X	X							X		X	
Shinarump White Ware			X								X					
Snake Valley B/g																
Snake Valley Gray																X
Sosi B/w				X												
St. George B/g																
Tsegi Orange Ware																
Tsegi B/o																
Tusayan Corrugated										X						
Virgin B/w											X			X		
Virgin B/w-Hildale style																
Virgin B/w-North Creek style																
Virgin B/w-St. George style																
Virgin Series Whiteware																
Untyped B/g																
Untyped corrugated							X									
Untyped utility																
Untyped vessel handle																
Untyped redware																
Untyped whiteware							X									

Table 6.16. (cont.)

Ceramic Type	KA 5418	KA 5419	KA 5434	KA 5435	KA 5436	KA 5437	KA 5438	KA 5439	KA 5440	KA 5442	KA 5443	KA 5445	KA 5446	KA 5447	KA 5448	KA 5449
Estimated Quantity	51–100	>101	>101	11–50	11–50	51–100	11–50	<10	11–50	11–50	11–50	<10	51–100	51–100	11–50	>101
Awatovi B/y																
Awatovi/Jeddito B/y																
Black Mesa B/w																
Citadel Polychrome									X							
Coombs Variety Corrugated								X								
Coombs Variety whiteware				X										X		
Deadmans B/r																
Emery Gray					X											
Hildale B/g			X		X											
Kanab B/r				X	X	X			X							X
Kanab Polychrome			X	X	X	X			X							
Kanab Red		X	X	X	X	X			X		X					X
Moenkopi-like			X													
North Creek B/g				X	X	X					X					
North Creek Corrugated	X	X	X	X	X	X	X		X	X	X		X		X	X
North Creek Gray	X	X	X	X	X	X										
Shinarump B/w																
Shinarump Corrugated	X	X	X	X	X	X	X	X	X		X	X		X		X
Shinarump Plain			X	X	X	X	X	X	X					X		X
Shinarump White Ware	X			X			X	X			X					
Snake Valley B/g																
Snake Valley Gray																
Sosi B/w										X						
St. George B/g			X		X											
Tsegi Orange Ware											X					
Tsegi B/o																
Tusayan Corrugated																
Virgin B/w		X	X		X	X	X							X	X	X
Virgin B/w-Hildale style																
Virgin B/w-North Creek style						X										
Virgin B/w-St. George style		X														
Virgin Series whiteware				X				X						X		
Untyped B/g																
Untyped corrugated				X												
Untyped utility				X												
Untyped vessel handle															X	
Untyped redware																
Untyped whiteware																

Table 6.16. (cont.)

Ceramic Type	KA 5450	KA 5451	KA 5452	KA 5453	KA 5454	KA 5455	KA 5456	KA 5457	KA 5458	KA 5459	KA 5460	KA 5462	KA 5463	KA 5465	KA 5486	KA 5543	KA 5555
Estimated Quantity	51–100	11–50	<10	11–50	<10	11–50	11–50	11–50	>101	<10	11–50	<10	<10	11–50	11–50	<10	<10
Awatovi B/y																	
Awatovi/Jeddito B/y																	
Black Mesa B/w																	
Citadel Polychrome									X								
Coombs Variety Corrugated																	
Coombs Variety witeware																	
Deadmans B/r			X														
Emery Gray																	
Hildale B/g																	
Kanab B/r	X					X			X								
Kanab Polychrome																	
Kanab Red					X				X								
Moenkopi-like																	
North Creek B/g																	
North Creek Corrugated	X	X	X	X	X	X	X	X	X	X	X	X					
North Creek Gray	X	X		X		X		X	X				X				
Shinarump B/w																	
Shinarump Corrugated	X	X	X	X	X	X		X	X		X		X	X			
Shinarump Plain					X		X				X						
Shinarump White Ware																	X
Snake Valley B/g																	
Snake Valley Gray																	
Sosi B/w																	
St. George B/g																	
Tsegi Orange Ware																	X
Tsegi B/o																	
Tusayan Corrugated																	
Virgin B/w	X	X	X		X	X	X		X								
Virgin B/w-Hildale style																	
Virgin B/w-North Creek style																	
Virgin B/w-St. George style				X													
Virgin Series Whiteware						X											
Untyped B/g																X	
Untyped corrugated																	
Untyped utility								X							X		
Untyped vessel handle			X														
Untyped redware																	
Untyped whiteware																	X

identification of types and wares (or at least more informed speculation). We collected 123 sherds (probably less than 4% of the total number seen), 38 of which are merely small nips rather than whole items, leaving the greater part of the sherds on site. Because of limitations with the amount of information that sherd nips can provide, entire sherds were collected from some sites; this was especially done for several habitations that had previously been chained and lay close to a main thoroughfare. At most sites where we collected entire sherds, ceramic fragments were relatively numerous. The entire sherds were often vessel rims or body sherds with designs; utility ware jar body sherds were collected to gain a representation of what looked like the range of variability for these vessel types.

The collected sherds are described individually in Table 6.17 with select items illustrated in Figures 6.44 to 6.46. They were analyzed by examining fresh breaks under a 40x binocular microscope to identify temper particles and describe paste color and composition. Laboratory analysis confirmed the tentative field identifications in many cases. The main exceptions were with separating sherds of Virgin Series Tusayan White and Gray Ware from sherds of Shinarump White and Gray Ware (this is discussed below).

The association of pottery with the rest of the prehistoric remains at a few sites is questionable and it appears that the sherds represent pot drops on or near older scatters of flaked stone artifacts: 42KA5330 with about 20 sherds of a Shinarump Plain jar and 42KA5486 with about 30 sherds of an untyped plain jar. At both sites, there are flaked stone artifacts that are patinated or otherwise appear older than the vessel portions. These vessels may be in some sort of primary use context, such as having been dropped while carrying water or moving between camps, but they might not have anything to do with the other nearby cultural remains. The association of pottery with the rest of the prehistoric remains at two sites—42KA4546 with a single sherd and 42KA4757 with sherds of two types—appears to be the result of historic collection. Both sites contain corrals and cowboy camps, but lack features or other remains clearly associated with the pottery. Moreover, in both instances, these were the only sites with sherds found in each of their respective survey units. This might simply be a remarkable coincidence, but in both cases the surveyors were convinced that the sherds had been collected by the historic occupants from somewhere else and deposited in their current location. This interpretation seems all the more likely for the single sherd found at 42KA4546 because it is a large rim fragment of a North Creek Black-on-gray bowl, an exceptional find in this region of sparse, small, and poorly preserved sherds. The collection of pottery at 42KA4757 consists of about 12 pieces apparently from a single Shinarump Corrugated jar and a Virgin Black-on-white bowl sherd. This might seem like an unusual cowboy collection but the indiscriminant packrat mentality of modern collectors is often astonishing. These sherds also occur immediately next to the corral along with a scatter of cans.

Untyped Sherds

Utility Sherds with Clay/Shale Platelets

The most interesting utility sherds that could not be typed occur at sites 42KA5279 and 5486; at the latter there were about 25–30 fragments from a single jar, one of which was collected; at the former there were about 10 sherds from a single jar (with a nip taken from one of these). The common feature of both fragmented utility jars is their dark gray to brown paste with abundant clay/shale plates with sharp angular edges. These clearly are not crushed sherds. The shale/clay plates appear to be from inadequate grinding of a mud- or shalestone that was poorly suited to pottery production. These plates are different in degree from the unground clay chunks frequently seen in some Virgin ceramic types (e.g., Lyneis 1998:11), including some of the sherds reported here. In most vessels unground clay chunks have rounded corners and lenticular subrounded shapes, indicating that the clay more readily absorbed moisture and slaked better than did the clay/shale chunks reported here. These plates are easily seen with the unaided eye, especially in the vessel fragments at 42KA5486. The plates in this vessel were up to 5 mm long and 2 mm thick; the plates of the other vessel were much smaller with a maximum length of about 2 mm and a maximum thickness less than 0.5 mm. The smaller plates of the 42KA5279 vessel are nonetheless quite conspicuous because their black to dark gray color contrasts with the gray paste. Under a dissecting microscope it is evident that the plates within this vessel are vitrified and several of the thicker chunks have a reddish brown core. In some respects this vessel has the appearance of what a Shinarump Utility (Gray) Ware might look like if the potter had prepared the clay inadequately. The 42KA5486 vessel seems less like this, although it too could be so construed.

Sherds with shale/clay platelets are occasion-

Figure 6.44. Select Anasazi Black-on-white sherds collected from sites of the Kaiparowits Plateau Survey: a) Black Mesa B/W, b) Sosi B/W, c-d) Coombs Variety whiteware, e-f) Hildale B/G, g-l) North Creek B/G, and m-t) Virgin Black-on-white.

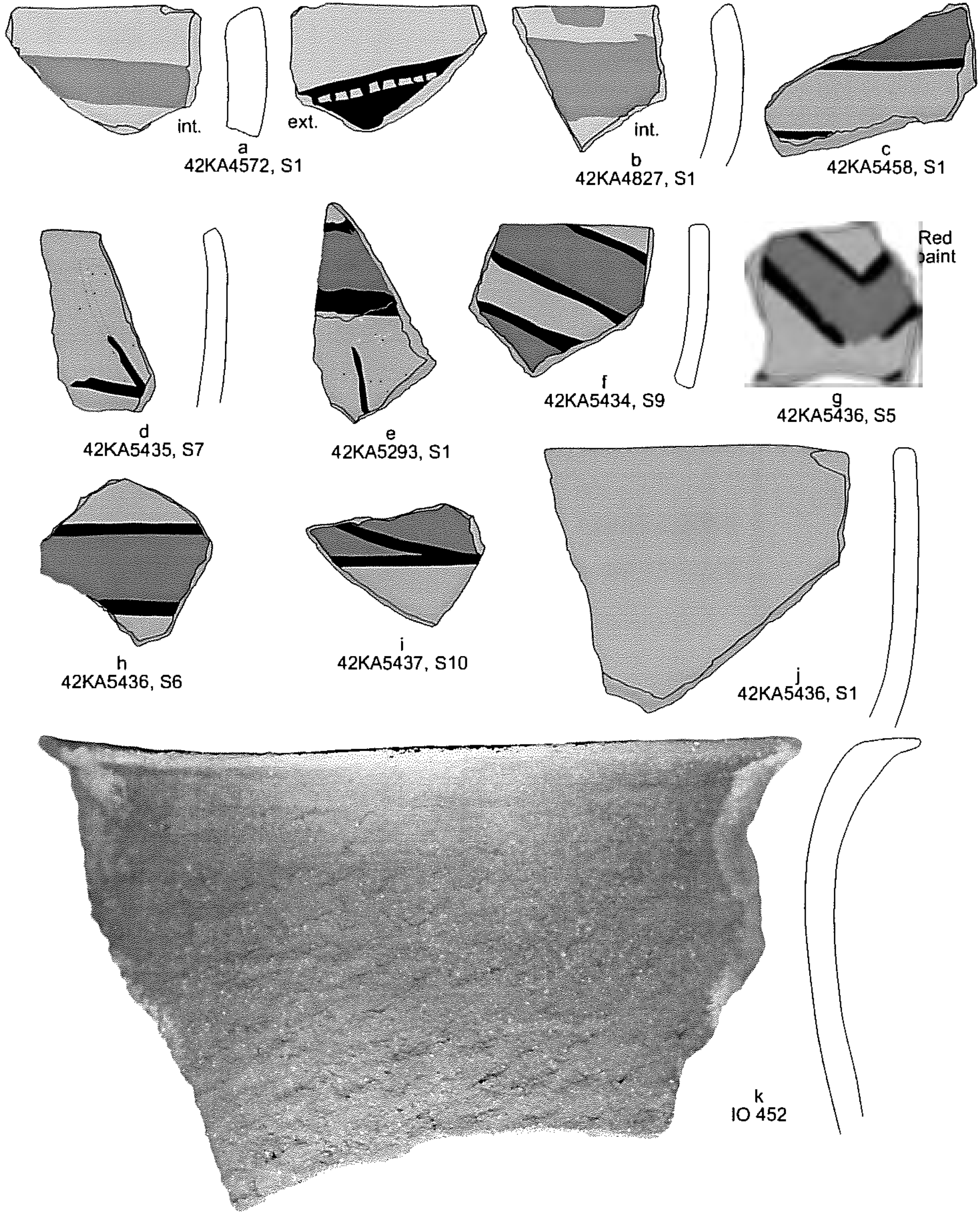


Figure 6.45. Select Anasazi sherds collected from sites of the Kaiparowits Plateau Survey: a) Awatovi or Jeddito Black-on-yellow, b) Awatovi Black-on-yellow, c) Citadel Polychrome, d) Kanab Black-on-red, e-i) Kanab Polychrome, j) an untyped redware, and k) Shinarump Corrugated.

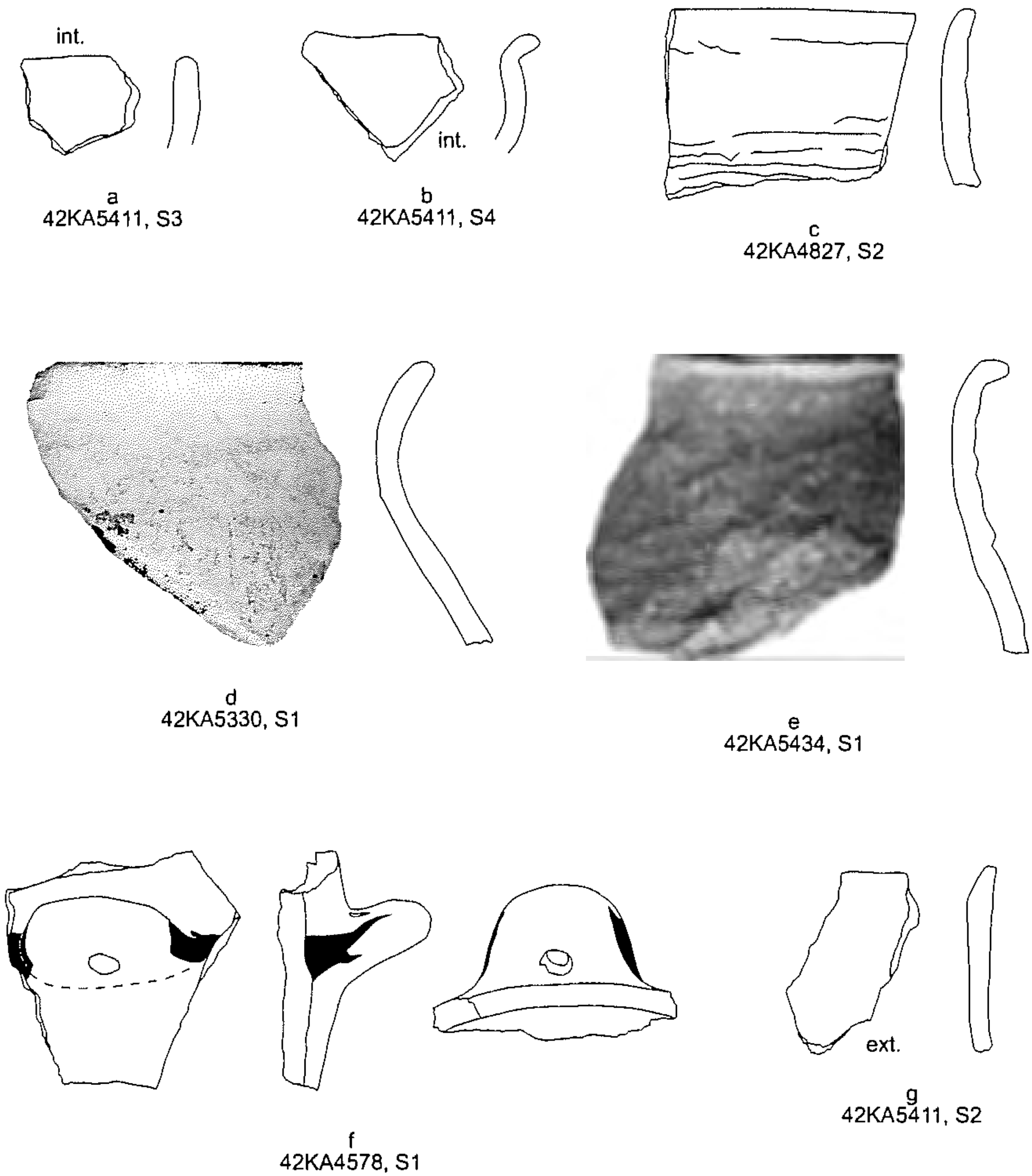


Figure 6.46. Select Fremont and Anasazi sherds collected from sites of the Kaiparowits Plateau Survey: a-b) Emery Gray, c) North Creek Corrugated, d-e) Shinarump Plain, f) Snake Valley B/G, and g) Snake Valley Gray.

Table 6.17. Descriptive details on sherds and sherd nips collected during the Kaiparowits Plateau Survey.

Site No.	Sherd No.	Nip	Type	Vessel Form	Description
42KA2253	1		Emery Gray	jar body	Jar with fugitive red slip, exterior is also polished, white firing paste with semi-coarse basaltic andesite.
42KA4546	1	x	North Creek B/G	bowl rim	Rim with 3 encircling bands; temper is subangular to subrounded quartz sand with accessory minerals and clay pellets; paste is light gray (essentially white) with no carbon streak; float on interior (not a true slip), which is also polished.
42KA4563	1		Untyped Utility	jar body	Tiny sherd with scrape marks on interior; exterior somewhat smoothed over; many fine aplastic inclusions, but does not appear purposefully tempered; grayish colored paste is gritty containing large to small lumps of uncrushed clay; looks like expedient technology.
42KA4572	1		Awatovi B/Y or Jeddito B/Y	bowl rim	Rim style is consistent with either type, at least the early portion of Jeddito; faded reddish encircling band on interior below rim and design in dark brownish red mineral paint on exterior (Figure 6.45a); abundant fine aplastics within light yellow paste, some resembling volcanic ash; much more abundant aplastic component than is normal, especially for Jeddito. Probably produced in mid A.D. 1300s.
42KA4576	1–2	x	Emery Gray	jar body	Two nips from a probable single jar; one sherd has a lighter gray core than the other but this range is common in single Emery vessels; temper is typical basaltic andesite common to the Escalante River basin and derived from Boulder Mt.; light exterior polish, especially on the darker core sherd.
42KA4578	1		Snake Valley B/G	jar handle	Perforated flat lug handle with faded black carbon band painted across jar body and along edge of handle (Figure 6.46f); typical light gray paste with abundant clear angular quartz and black biotite plates.
42KA4578	2	x	Shinarump Corrugated	jar body	Semi-vitrified gray paste tempered with angular quartz with adhering white matrix.
42KA4578	3	x	North Creek Corrugated		Dark gray paste (carbonaceous) tempered with subangular quartz and other minerals with clay pellets.
42KA4614	1	x	Virgin B/W?	bowl body	Cross-hatchure design on interior (Figure 6.44o); a purplish but unvitrified paste; not typical Shinarump paste or temper; temper consists of well rounded quartz sand grains; thick white slip applied to interior, none on exterior; carbon paint is semi-watery and faded to dull black.
42KA4614	2	x	Virgin B/W	bowl body	Hildale-like design; more typical temper and paste than S1, though unvitrified; angular and subangular quartz sand with white matrix, also feldspars and other minerals; no slip; gray surface color and core, no carbon streak.
42KA4675	1–9	x	North Creek Gray	jar body	Nine nips apparently from a single vessel; all identical in temper, paste, wall thickness, exterior color and core color; temper is rounded to subrounded quartz with some white matrix and staining of grains; fairly clean, light gray paste; a Lino-like exterior surface finish with temper drag marks. Surveyors identified one of these as corrugated but this was not apparent from the nips.
42KA4676	1		North Creek Gray	jar body	Lino-like surface finish (temper drag marks); very clean paste with no carbon streak oxidized to a light pink (post firing burning?); fairly large and moderately sparse subangular quartz temper.
42KA4676	3		North Creek B/G	bowl body	North Creek-like design of 7–8 mm wide line; carbon paint faded; very gritty light gray paste abundantly tempered with very fine rounded to subangular quartz sand, also many unmixed pieces of clay; interior slipped, polished and somewhat cracked; no exterior slip or polish.

(Table 6.17 cont.)

Site No.	Sherd No.	Nip	Type	Vessel Form	Description
42KA4676	4		Shinarump Corrugated	jar body	Excellent example of Shinarump Corrugated—brownish red cast to exterior, hard vitrified slate gray paste with shrinkage voids, temper of angular quartz with white matrix and sparse other minerals.
42KA4733	1	x	Hildale B/G	bowl body	Light gray paste tempered with subrounded quartz and pinkish sand grains with a few other minerals; faded ghost-like carbon paint on a light gray slip.
42KA4750	1	x	Emery Gray	jar body	More or less typical basaltic andesite temper within a somewhat gritty and crumbly medium dark gray paste; paste more gritty than is commonly seen in the Escalante River basin (compare with Emery Gray sherds form site 42KA4795.
42KA4795	1		Emery Gray	jar body	Small sherd from neck area at juncture with body; very clean, hard, light paste (essentially white) tempered with typical crushed basaltic andesite ranging from coarse to fine; exterior polished.
42KA4797	1		North Creek B/G	bowl body	Very faded design; polished interior, exterior smoothed but less well finished; light gray paste with subangular to subrounded quartz sand temper; design style cannot be discerned.
42KA4797	2		Untyped Red Ware	unknown	Tiny and badly weathered red ware sherd; tempered with crushed sherd and other material, but crushed sherds are not those typical of Tsegi Orange Ware from the Kayenta Region proper; paste also differs from Tsegi Orange Ware, being gritty with lots of small inclusions, some being poorly crushed and mixed clay; probably a local copy of Tsegi Orange Ware.
42KA4797	3	x	Untyped Utility	jar body	Plain utility jar; dark paste tempered with abundant moderately coarsely crushed white sherds, also some large to small, dark shale-like pieces.
42KA4797	4	x	North Creek Corrugated	jar body	Medium gray, semi-gritty paste tempered with subangular to subrounded quartz and some other mineral grains (especially in the fine size range), also clay pellets.
42KA4812	1		Untyped Utility (Obelisk?)	jar body	Resembles early Basketmaker III utilitarian pottery; brownish exterior (7.5YR6/4, light brown); smoothed but not polished; large temper particles 'peek' out from the paste; interior is rough and temper particles protrude; many casts from where temper grains have fallen out; no interior temper drag marks; temper is medium to coarse, rounded to subrounded quartz sand in a clean dark gray paste; vessel wall is thin (ca. 4 mm) but uneven.
42KA4827	1		Awatovi B/Y	dipper rim	Vessel form based on tight circumference and exterior abrasive wear on outer rim edge extending down side; lip is slightly thickened, suggesting manufacture somewhat toward the end of the type (ca. more towards A.D. 1350 than 1300); rim is ticked and there is a wide encircling band just below rim on the interior (Figure 6.45b); paste is typical light yellow with fine quartz and reddish aplastic natural inclusions as well as other detrital minerals.
42KA4827	2 & 3		North Creek Corrugated	jar rim & body	Sherds clearly from the same jar; clean, hard, light gray paste with a light carbon streak; tempered with moderately coarse subangular quartz; also lots of clay pellets; very tiny, shallow and somewhat smoothed over corrugations; coils are narrow, just 2 mm wide; ca. 5 mm between indentations; rim has a Pueblo II profile (Figure 6.46c).
42KA5223	1		Emery Gray	bowl body	Bowl with polished interior and exterior; crushed igneous rock but not the 'typical' basaltic andesite of Boulder Mountain; light firing paste but with carbon discoloration.

(Table 6.17 cont.)

Site No.	Sherd No.	Nip	Type	Vessel Form	Description
42KA5254	1	x	Kanab Red	bowl body?	Badly weathered sherd, but appears to have faded trace of interior slip; sand/crushed sandstone temper in a vitrified reddish paste with dark core.
42KA5265	1		Untyped Utility	jar body	Quartz sand temper in clean paste with carbon discoloration; exterior exhibits fingernail indentations; initially thought to have been a possible Southern Paiute sherd but this seems doubtful based on laboratory analysis; likely a local Anasazi sherd.
42KA5265	2	x	Shinarump White Ware?	bowl rim	Vitrified light gray paste with crushed sandstone temper (angular quartz grains and white matrix along with grain clusters cemented with matrix); paste also contains "pearly plates" (mica bits) and tiny black minerals; traces of probable faded carbon paint on interior with polish; exterior also smoothed and lightly polished.
42KA5279	1	x	Untyped Utility	jar body	Abundant shale/clay platelets with coarse quartz sand grains as temper; shale plates are up to 2 mm long but less than 0.5 mm thick; they are black to dark gray with some reddish brown cores and appear vitrified; poorly finished on interior and exterior with a somewhat rough undulating surface; temper grains and shale plates exposed on exterior but do not protrude; similar to some of early Formative pottery from the Escalante River basin, such as at Gates Roost.
42KA5286	1	x	Shinarump Plain	jar body	Semi-vitrified brownish gray paste, crushed sandston temper with white matrix.
42KA5293	1		Kanab Polychrome	bowl body	Appears like a polychrome but cannot be certain becaus of paint weathering (Figure 6.45e); exterior totally slipped, interior has black paint and red slip/paint; vitrified reddish paste with dark core; crushed sandstone temper with amorphous pink to gray blobs (not crushed sherd).
42KA5311	1		Shinarump White Ware?	jar body	Brownish paste with subangular to rounded quartz temper; a white wash on sherd exterior (or thin watery slip); if not whiteware then Shinarump Plain.
42KA5318	1		Sosi B/W	jar body	Neck portion of a probable Tusayan White Ware jar that is most likely Sosi (Figure 6.44b); white firing paste with carbon streak; crushed quartz sandstone temper; exterior polished with dark carbon paint.
42KA5318	2		North Creek Corrugated?	jar body	Sloppy almost clapboard corrugations; brownish paste with fine inclusions and coarse quartz temper.
42KA5330	1		Shinarump Plain	jar rim	Exterior has temper drag marks and other striations as though wiped when clay was wet (Figure 6.46d); dark gray semi-vitrified paste with brown core and crushed sandstone temper.
42KA5376	1	x	North Creek Corrugated?	jar rim	Pronounced corrugations; multi-lithic sand temper but mainly quartz.
42KA5376	2	x	Kanab Red	?	Weathered so cannot identify vessel form; no trace of slip; reddish paste with fine sand temper.
42KA5376	3	x	Tusayan Corrugated?	jar body	White firing paste with semi-coarse angular quartz sand temper; corrugations are indistinct and somewhat smoothed over; the latter is more characteristic of North Creek than Tusayan.
42KA5377	1	x	Shinarump Corrugated	jar body	Slightly vitrified light gray (2.5Y7/1) "dirty" (gritty) paste; lightest of the sherds typed as Shinarump but refired paste color is red (2.5YR5/8); abundant crushed quartz sandstone temper with white matrix that includes other materials, including pearly plates (mica pieces); corrugations indistinct and smoothed over.

(Table 6.17 cont.)

Site No.	Sherd No.	Nip	Type	Vessel Form	Description
42KA5377	2	x	Shinarump White Ware?	bowl body	Slightly vitrified light gray dirty paste with abundant crushed quartz sandstone temper with white matrix—identical to S1 above; polished on interior but no obvious slip but perhaps a float; rough exterior.
42KA5379	1	x	Shinarump Corrugated	jar body	Largely obliterated corrugations that are smoothed over; light gray partially vitrified dirty paste with abundant quartz sand with white matrix.
42KA5379	2	x	Black Mesa B/W	bowl body	Thick carbon streak (most of vessel wall) with white on exterior; solid black carbon paint with a design of pendant dots on solid elements (Figure 6.44a); fine clean quartz sand.
42KA5391	1		Shinarump Corrugated	jar body	Corrugations are poorly executed, more like simple clapboards; paste is light gray on interior, vitrified and mottled dark reddish brown and gray on exterior; abundant quartz temper with white matrix.
42KA5391	2		Kanab Red	bowl body	Reddish paste with dark core that is slightly vitrified; paste contains large plates of unmixed clay and quartz temper with white matrix; no evidence of exterior slip but heavily soil stained—perhaps a trace of interior slip (?).
42KA5392	1	x	Kanab Red	bowl body	Vitrified dark gray exterior, vitrified light gray core and red vitrified interior; no evidence for interior or exterior slip, both appear smoothed and perhaps lightly polished; abundant sandstone temper with abundant black particles.
42KA5392	2	x	Virgin Series whiteware?	jar body	Light gray paste that is white on exterior; moderate amount of angular quartz sand temper with some white matrix and some other minerals; trace of a carbon paint line on exterior.
42KA5392	3	x	North Creek Corrugated?	jar body	Clean white paste with coarse quartz temper; perhaps a good example of corrugated pottery produced locally on the Kaiparowits Plateau.
42KA5392	4	x	North Creek Corrugated?	jar body	Identical to S3 and perhaps from the same vessel.
42KA5392	5	x	Untyped Utility	jar body	Corrugated with semi-indistinct corrugations; white paste tempered with crushed sherds and quartz sand.
42KA5392	6	x	North Creek Corrugated?	jar body	Identical to S3 and perhaps from the same vessel.
42KA5411	2		Snake Valley Gray	jar rim	Slightly averted rim with a somewhat polished exterior (Figure 6.46g); typical paste and temper: clear angular quartz with abundant mica.
42KA5411	3		Emery Gray	jar rim	Crushed latite tuff temper, a temper type that occurs in the Escalante River basin (Geib and Lyneis's [1996] temper type b); fugitive red slip over polished exterior; white paste (Figure 6.46a).
42KA5411	4		Emery Gray	jar rim	Short (abrupt) strongly everted rim (Figure 6.46b); tempered with poorly sorted crushed basaltic andesite (Geib and Lyneis's [1996] temper type a.
42KA5418	1		North Creek Corrugated?	jar body	Nicely done exuberant corrugations; light gray paste with quartz sand temper; paste contains abundant small aplastic inclusions that are likely natural to the clay.
42KA5418	2		Virgin Series, whiteware?	jar body	Perhaps a whiteware but might simply be plain gray; paste is brownish gray and like S1 contains abundant small aplastic particles; tempered with a moderate amount of quartz sand.
42KA5434	1		Shinarump Plain	jar rim	Highly vitrified, dark brown paste turned maroon (mottled dark red and brown) on exterior surface (Figure 6.46e); abundant quartz sand temper (probably crushed sandstone).

(Table 6.17 cont.)

Site No.	Sherd No.	Nip	Type	Vessel Form	Description
42KA5434	2		Shinarump Plain	jar body	Somewhat vitrified paste partially oxidized to a yellowish red on exterior; abundant quartz temper.
42KA5434	3		Hildale B/G	jar body	White to light gray clean paste with moderately sparse, subrounded to subangular, coarse quartz temper; exterior is poorly finished for a whiteware—irregular and poorly smoothed with no polish (Figure 6.44e).
42KA5434	4		Shinarump Corrugated	jar body	Gray vitrified dirty paste with slightly pinkish discoloration; abundant angular quartz and other minerals for temper; surface corrugations are quite indistinct and appear more like a wavy surface than true corrugations; they are not smoothed over because the surface texture is very rough.
42KA5434	5		Shinarump Corrugated	jar body	Moderately indistinct corrugations; somewhat vitrified, dark gray dirty paste oxidized to a red on exterior—basically the same color and look as Kanab Red; abundant crushed quartz sandstone with white matrix.
42KA5434	6		Shinarump Plain	jar body	Vitrified, dark gray-brown dirty paste with mottled red and gray-brown exterior surface; abundant crushed quartz sandstone temper with some white matrix.
42KA5434	7		Shinarump Plain?	jar body	Dirty brown paste with dark gray core (no vitrification); poorly sorted quartz sand.
42KA5434	8		Virgin B/W	bowl body	Perhaps North Creek-style; fine lines do not look like a Hildale hatchure (Figure 6.44n); medium to dark gray paste with abundant quartz temper (subrounded to subangular) with some white matrix (crushed sandstone); white interior slip is cracked; faded carbon paint.
42KA5434	9		Kanab Polychrome	bowl rim	Slipped on exterior but somewhat faded; red paint bands outlined with black at angle to rim (Figure 6.45f); typical reddish paste with fine quartz sand and angular white matrix—crushed sandstone.
42KA5434	10		Shinarump Corrugated	jar body	Moderately indistinct corrugations; medium gray dirty paste, except at exterior, where oxidized reddish; abundant crushed quartz sandstone temper with white matrix.
42KA5434	11		Hildale B/G	bowl body	Medium gray paste that is somewhat "dirty" and contains clay pellets along with a moderate amount of coarse quartz sand; no slip, paint is faded (Figure 6.44f).
42KA5434	12		North Creek Gray?	jar body	White paste with sparse, coarse quartz grains and also some clay pellets; exterior has a surface manipulation that looks something like finger prints or perhaps corn cob impressions (?)—exterior may have been corrugated then smoothed over.
42KA5435	1		Untyped Utility	jar body	Quite indistinct corrugations but not smoothed over—very rough surface texture; a slightly vitrified, hard, white paste that is fairly clean; tempered with crushed sherd and quartz sand.
42KA5435	2		Shinarump Corrugated	jar body	Dark gray, dirty paste, vitrified but still mostly gray on exterior with thin oxidized rind of reddish brown color on interior; abundant temper of crushed sandstone with white matrix; corrugations somewhat indistinct but not smoothed.
42KA5435	3		Untyped Utility	jar body	Similar to S1 but perhaps a different vessel—slightly vitrified, fairly clean, hard light gray paste tempered with crushed sherd and quartz sand; corrugations are quite indistinct but not smoothed, very rough surface texture.
42KA5435	4		Shinarump Corrugated	jar body	Dark reddish brown, dirty paste with abundant crushed sandstone temper (subangular and angular quartz with white matrix) and a few reddish brown tabular clay plates.

(Table 6.17 cont.)

Site No.	Sherd No.	Nip	Type	Vessel Form	Description
42KA5435	5		North Creek Corrugated?	jar body	Hard, white, somewhat dirty paste tempered with moderately sparse, subangular quartz sand; small neat corrugations that are smoothed over.
42KA5435	6		North Creek B/G	bowl rim	Design of encircling wide bands (ca. 1.2 cm) of very faded and "watery" black carbon paint (Figure 6.44h); hard light gray clean paste with moderately sparse, subrounded to subangular quartz temper.
42KA5435	7		Kanab B/R	bowl rim	Black line on rim, single black line on interior (Figure 6.45d); no evidence of slip; vitrified paste with dark core; finely crushed sandstone temper with reddish clay plates.
42KA5435	8		Kanab Red	bowl? body	Weathered so difficult to identify vessel form; no evidence of slip; typical fine quartz sand temper and reddish vitrified paste.
42KA5435	9		Untyped Utility	jar body	Plain utility sherd with an odd surface texture that is rough but slightly smoothed over as though "wet wiped"; clean, yellowish paste with sparse quartz grains.
42KA5435	10		Coombs Variety whiteware	bowl rim	Wide encircling bands just below rim (Figure 6.44d); poorly finished on exterior and only moderately well finished on interior; no evidence of slip; hard, white, clean paste with crushed basaltic andesite temper.
42KA5435	11		Untyped Utility	jar body	Plain utility (?) sherd; exterior is semi-rough but smoothed over and somewhat polished; clean white paste with sparse but coarse quartz grains.
42KA5436	1		Untyped redware	bowl rim	Redware slipped on interior and exterior but no design even though sherd is large and well preserved (Figure 6.45j); tempered with a mixture of different sherds and even what appears to be a tiny obsidian chip; not a Tsegi Orange Ware paste, slip, or temper; likely a local production variation of Kanab Red.
42KA5436	2		Shinarump Plain	jar body	Rough exterior; semi-vitrified dark grayish brown, dirty paste, oxidized to reddish brown on exterior; moderate amount of crushed sandstone temper (angular quartz grains and white matrix with some grain clumps).
42KA5436	3		Emery Gray	bowl body	Polished interior but evidently not on exterior; appears to have an interior float but not a slip because temper is evident on interior; no design is obvious; abundant, poorly sorted crushed basaltic andesite as temper within a dirty, dark gray paste; one edge of sherd is ground flat, but use is unknown.
42KA5436	4		North Creek B/G?	bowl rim	Very clean white paste with abundant coarse, subangular quartz grains; poorly finished interior and exterior surfaces with temper protruding, especially on the exterior; faded carbon paint band just below rim and on rim (Figure 6.44i); also rodent teeth marks (?) on rim.
42KA5436	5		Kanab Polychrome	bowl body	Exterior slip and red paint bands on interior outlined by black lines (Figure 6.45g); interior red band is partially exfoliated and the paint seems to have resulted in increased surface exfoliation; typical paste and temper: vitrified and brownish on exterior, at least at the fresh break (fire cloud?); 3–5 mm thick vessel wall.
42KA5436	6		Kanab Polychrome	bowl body	Same as above but perhaps not the same vessel because this sherd is thinner (2.5–3.5mm) and paint on interior well preserved (Figure 6.45h); typical paste and temper of fine quartz with white matrix.

(Table 6.17 cont.)

Site No.	Sherd No.	Nip	Type	Vessel Form	Description
42KA5436	7		North Creek B/G	bowl body	Very clean white paste with subangular, moderately sparse, coarse quartz grains; design is moderately sharp (Figure 6.44g) but still not the usual dark black of Kayenta whiteware; poorly finished interior and exterior surfaces, with the exterior the worst; temper shows through on interior and color appears grayish with a thin white wash.
42KA5436	8		Virgin B/W?	bowl body	North Creek-style with faded, watery carbon paint (Figure 6.44m); interior nicely finished and polished, not polished on exterior; light to medium gray, dirty paste with abundant poorly sorted quartz grains with white matrix (crushed sandstone).
42KA5437	1		Virgin B/W	bowl rim	North Creek-style of 6 encircling bands, each about 5–6 mm thick with a 2–6 mm gap between each (Figure 6.44r); faded, watery carbon paint; medium gray vitrified paste with reddish bands towards interior (seen in section); abundant angular quartz with white matrix; thick, polished, and cracked interior slip with thin exterior slip.
42KA5437	2		Shinarump Plain	jar body	Rough exterior except for 2 "smoothed" bands; brown to dark gray, dirty paste that is not vitrified; abundant quartz sand with white matrix.
42KA5437	3		North Creek Corrugated?	jar body	Very narrow coils with indistinct corrugations—basically clapboard coils—that were lightly wiped while wet; medium to dark gray fairly clean paste with moderately sparse, coarse angular quartz grains.
42KA5437	4		Shinarump Corrugated	jar body	Distinct corrugations; semi-vitrified, dark gray to brown, dirty paste with abundant angular quartz with white matrix.
42KA5437	5		North Creek B/G	bowl rim	Encircling bands of faded "watery" carbon paint about 2–3 mm thick with 4–7 mm gaps between the bands (Figure 6.44k); corrugated exterior with corrugations smoothed over; light brown clean paste with moderately sparse, subrounded to subangular quartz grains.
42KA5437	6		Virgin B/W	bowl rim	Design like some North Creek B/G (Figure 6.44s); medium gray, dirty paste with abundant quartz grains with white matrix and some grain clumps (crushed sandstone).
42KA5437	7		Tusayan Gray Ware?	jar body	Plain gray but clearly not Lino or Kiet Siel Gray, looks like PII technology; very clean white paste with moderately sparse, subangular quartz grains, well sorted.
42KA5437	8		Virgin B/W	bowl body	North Creek-like design (Figure 6.44p); faded paint that has "blistered" the surface (paint is 'puffy' with small bumps); light gray paste on interior but vitrified and oxidized forming a thin reddish rind at exterior, though covered by a thin slip; slip mostly exfoliated on exterior, but thick and intact on interior.
42KA5437	9		North Creek B/G	bowl rim	Two encircling bands 3–2 mm wide with a 3–5 mm gap (Figure 6.44j); fairly clean medium gray paste without a slip; not well finished on exterior and with a clear coil juncture and only moderately well finished on interior—protruding temper and not well polished.
42KA5437	10		Kanab Polychrome	bowl body	Design is quite faded but there is clearly one part with no slip, one with a red paint band outlined with black lines (Figure 6.45i); there is also a black line across the red; exterior has small traces of red slip; paste contains some rounded quartz grains as well as the usual angular grains; also a few unidentifiable angular black pieces.
42KA5437	11		North Creek B/G?	bowl rim	One faded encircling band just before rim and a trace of some other paint further down (Figure 6.44l); fairly clean white paste that is somewhat vitrified especially on bowl interior.

(Table 6.17 cont.)

Site No.	Sherd No.	Nip	Type	Vessel Form	Description
42KA5437	12		Virgin B/W	bowl body	Very faded design band about 3 mm wide and another partial band (North Creek-like?); interior white slip now mostly faded/exfoliated but exterior slip still intact; vitrified medium to dark gray, dirty paste with abundant quartz grains with white matrix.
42KA5447	2		Virgin Series whiteware	bowl body	Whiteware bowl with corrugated exterior; corrugations are almost totally obliterated and surface is rough; interior surface is smooth and polished but no design is evident; white to light gray mostly clean paste with sparse, large subangular to subrounded quartz grains.
42KA5447	3		Coombs Variety whiteware	bowl rim	No design on this moderately large rim sherd; polished on interior but not the best finish (drag marks still evident) and no slip, exterior is somewhat smoothed but not polished; clean white paste with a moderately sparse temper of crushed glassy basaltic andesite.
42KA5448	1		Virgin B/W	bowl rim	Mixed North Creek and Hildale styles with a corrugated exterior (Figure 6.44t); paint is somewhat faded and watery; lines are 2–3 mm for encircling bands and about 1.5 mm for hachure lines; corrugations are moderately indistinct and partially smoothed over (or use polished?); partially vitrified (but not oxidized) dark gray, gritty paste tempered with abundant quartz grains and white matrix including some grain clusters (crushed sandstone); somewhat cracked white slip on interior, none on exterior; slip and some paint on rim.
42KA5448	5		North Creek Corrugated?	jar body	Exceedingly thick (9 mm) sherd from near base; corrugations are distinct and well done but somewhat smoothed over (likely because bottom of jar); paste is white and somewhat dirty with a carbon streak; tempered with sparse, coarse, subangular to subrounded quartz grains.
42KA5451	1		North Creek Corrugated?	jar body	Indistinct corrugations that are smoothed over; fairly clean light gray paste with sparse, mostly angular quartz grains.
42KA5452	2		North Creek Corrugated?	jar body	Moderately distinct corrugations; white gritty paste (lots of tiny aplastics) tempered with sparse large subrounded to subangular quartz grains.
42KA5455	1		North Creek Corrugated?	jar body	Identical to S2 of KA5452 above except that corrugations on this sherd are less distinct.
42KA5455	2		Virgin Series whiteware	jar body	Somewhat dirty, white to light gray paste with a moderate amount of subrounded to subangular quartz and other mineral grains, poorly sorted; interior is rough, exterior smooth and was perhaps lightly polished; no design evident; used sherd with worked edge having the shape of a ceramic scraper but weathering has obscured wear traces.
42KA5456	2		Virgin B/W	bowl body	Hildale-style with corrugated exterior (Figure 6.44q); white interior slip is crackled and partially exfoliated, design is faded; exterior not slipped and corrugations are indistinct and partially smoothed over; vitrified dark gray dirty paste with reddish brown mottling; tempered with abundant fine to medium quartz grains with white matrix and grain clusters (crushed sandstone).
42KA5456	3		Shinarump Plain	jar body	Typical paste and temper for unvitrified examples of this type: medium to light gray paste with abundant poorly sorted quartz grains with white matrix and grain clusters.
42KA5458	1		Citadel Polychrome	bowl body	Total exterior red slip with red paint band outlined by black lines on interior (Figure 6.45c); typical paste and temper for Tsegi Orange Ware: abundant crushed sherds that are mostly light firing within an orange crumbly paste with gray core.

(Table 6.17 concluded)

Site No.	Sherd No.	Nip	Type	Vessel Form	Description
42KA5460	1		North Creek Corrugated?	jar body	Indistinct corrugations that are smoothed over (almost look polished); a somewhat gritty paste that is medium to dark gray except for a whitish band near exterior; sparse subangular, coarse quartz grains.
42KA5463	1		Shinarump Corrugated	jar body	Dark brownish gray, dirty paste with some mica and abundant poorly sorted angular quartz grains with white matrix and grain clusters (crushed sandstone); corrugations are fairly indistinct.
42KA5486	1		Untyped Utility	jar body	A thick (ca. 6 mm) plain utility sherd with a rough exterior; brown to reddish brown paste that is packed with shale plates of great size (up to 5 mm long and 1 mm thick) along with some angular quartz grains; similar to S1 from 42KA5279.

ally found in the Kaiparowits Plateau–Escalante River basin region. One good example comes from Gates Roost (42KA178) along Twentyfive Mile Wash, where Gunnerson (1959b) recovered five sherds from a single utility jar that he classified as North Creek Gray. The sherds have a dark brownish vitrified paste and abundant clay/shale plates. Corncobs from this site have a calibrated ^{14}C age of about A.D. 540–770 (Geib 1996:87–88, Tables 15 and 16). This raises the possibility that the sherds reported here also date to the early Formative prior to about A.D. 900. The occurrence of the vessel at 42KA5279 along with Emery Gray appears to support this temporal assessment. The vessel at 42KA5486 appears to be a pot drop unrelated to the other remains on the site so there is no additional temporal information in this instance.

Utility Sherds with Sherd Temper

There are four body sherds of untyped utility ware that contain sherd temper: three are from corrugated jars (42KA5392, S5 and 42KA5435, S1 and S3) and one is from a plain jar (42KA4797, S3). Unidentified sherd-tempered utility pottery and decorated whiteware occurs in low frequencies on Puebloan sites throughout the Kaiparowits Plateau and the Escalante River basin. This pottery recalls the Johnson Series that Colton (1952) proposed, a series that since has been dismissed as invalid. The plain gray jar sherd has a brownish paste abundantly tempered with crushed white sherds but the corrugated examples have hard white or light gray pastes. All three corrugated sherds have indistinct corrugations, like most of the corrugated jar sherds that we collected or saw on the Kaiparowits Plateau. The two sherds from 42KA5435 clearly did not come from the same vessel because they contain different sorts of crushed sherds and other inclusions and have distinct paste colors. Sherd 1 from this site is interesting because of the inclusion of tiny vitrified fragments of probable Shinarump ware that have a black, dark gray, and reddish brown color. This sherd also appears to contain igneous rock fragments, as might be expected if Emery Gray sherds were crushed. The other two sherds have crushed fragments of vessels with light-firing pastes and quartz sand temper. Both of the sites with the sherd-tempered utility ware contained many examples of Anasazi pottery that are typical for this portion of the Kaiparowits Plateau. Thus, there is every reason to think that the sherd temper is just an occasional deviation from the local norms of production.

Utility Sherds with Sand Temper

The most interesting sherds of this group occur at site 42KA4812—four fragments from a single jar, one of which we collected. The vessel wall is thin (ca. 4 mm) but uneven. Its exterior has a brownish cast (7.5YR6/4, light brown) and is smoothed but not polished. It lacks the Lino-like exterior of abundant temper drag marks. Large temper particles peek out from the paste but do not actually protrude. The interior is rough and temper particles protrude above the paste. There are many casts where temper grains have fallen out, but virtually no interior temper drag marks. The vessel has clean, dark gray paste tempered with medium to coarse, rounded to subrounded quartz sand. This vessel resembles early Basketmaker III utilitarian pottery typed as Obelisk Utility (Reed, Wilson and Hays-Gilpin 2000; Spurr

and Hays-Gilpin 1996). Similar sherds in the Escalante River basin also seem to occur in early ceramic contexts. The vessel fragments from the Kaiparowits Plateau are quite similar to sherds recovered from Bowns Canyon (Geib and Fairley 1986:153, designated as Paria Gray) and Cow Canyon (Geib, Fairley and Davenport 1987:32–34, designated simply as plain gray). Douglas McFadden (personal communication 1999) reported that Obelisk-like pottery occasionally occurs on early Basketmaker III sites of the Grand Staircase.

Most of the sand-tempered utility ware sherds are classified either as part of Shinarump Utility (i.e., Shinarump Plain or Shinarump Corrugated) or as part of the Virgin Series of Tusayan Gray Ware (i.e., North Creek Gray or North Creek Corrugated). A few sherds are considered part of the Tusayan Series of Tusayan Gray Ware. Three sherds, however, seem different from the bulk of sherds classified as part of the Virgin Series and yet they are at odds with sherds of the Tusayan Series. Differences between these sherds and Shinarump are obvious so this presented no chance for confusion. These three sherds are perhaps of local production on or closely around the Kaiparowits Plateau, thus they likely fit within the range of variability classified as North Creek Gray and Corrugated (see below). The sherds are S1 from 42KA5265 and S9 and S11 from 42KA5435. The example from 42KA5265 was initially thought to be a possible candidate for Southern Paiute pottery because of its exterior fingernail indentations. Inspection of a fresh break under a microscope showed a clean, somewhat hard paste tempered with quartz grains; the sherd has an exterior carbon discoloration. The nature of the paste is far more similar to Anasazi pottery than Paiute with its coarse and crumbly brownish paste with heterogeneous aplastic inclusions (Baldwin 1950). Moreover, this sherd occurred on a site with a few sherds of Anasazi and Fremont pottery, which makes Anasazi assignment of the vessel fragment even more probable.

The two sand-tempered utility sherds from 42KA5435 (S9 and 11) are plain gray with exterior surfaces that are rough but smoothed-over, as if the vessels were wiped with a wet hand as they dried prior to firing. This did not create a uniform level surface, just a smoothing of high topography on an otherwise irregular surface. The exterior of S11 even looks somewhat polished, although this might be result from handling polish rather than production polish. With their plain gray exteriors, light firing pastes, and sand temper, these sherds might be mistaken for Kiet Siel Gray, yet they differ from the sherds of this mid-late Pueblo III type of the Kayenta Anasazi region. If these were true Kiet Siel Gray fragments, they would have been associated with a decorated ceramic assemblage vastly different from that at 42KA5435 with its Pueblo II pottery types. As we mentioned above, these sherds are likely of local production on or closely around the Kaiparowits Plateau and likely fit within the range of variability classified as North Creek Gray and Corrugated.

Utility Sherd Lacking Temper

The final unidentified utility sherd does not appear to be tempered; the paste is gritty, containing many fine aplastic inclusions as well as large to small angular chunks of uncrushed clay. This tiny jar sherd was on a Post-Formative site (42KA 4563) that had a Desert Side-notched point. This sherd does not resemble typical Southern Paiute pottery (Baldwin 1950; Euler 1964), but research suggests that this pottery may be more variable than previously recognized (Firor 1994; Westfall, Davis and Blinman 1987). The sherd from 42KA 4563 may provide further evidence for this variability, but there is no certainty that the sherd is truly associated with the other remains. Expedient Anasazi pottery can also resemble this sherd.

Sherd-tempered Redware

Three redware sherds present an interesting hybrid of Shinarump and Tsegi Orange Ware technology. One is a bowl rim sherd from site 42 KA5436 (S1) and the other two are from 42KA4797 and likely derive from a single vessel (form is unidentifiable because of weathering). The bowl rim sherd (Figure 6.45j) is tempered with a mixture of sherds of different colors and textures, some of which might be Shinarump ware of one sort or another. The sherds included as temper are distinctly different from those of Tsegi Orange Ware, thus there is no doubt that this vessel was produced outside of the Kayenta Anasazi region. Further supporting this assertion is the paste and slip of the sherd, which are not like those in Tsegi Orange Ware but appear basically no different than the slip and paste of Shinarump Red Ware. The sherd is slipped red on both the interior and exterior. No design is evident even though the sherd is a large rim portion; it seems probable that the vessel was simply a plain red bowl. The other two sherds likewise contain sherd temper that differs from that of Tsegi Orange Ware, plus they also contain many small inclusions, some of which

appear to be poorly crushed and mixed clay.

These vessel fragments are good examples of what Margaret Lyneis (1998:24) called the "problem in Utah ... with sherd-tempered redware that is not strictly white-sherd-tempered Tsegi Orange Ware." It is worth pointing out that Tsegi Orange Ware actually contains crushed orangeware sherds as well as white and gray wares (both of which appear white), but this does not change the important point that there are sherd-tempered redware vessels that are not Tsegi Orange Ware or were not produced in the Kayenta heartland.

Desert Gray Ware

The pottery types of Desert Gray Ware identified during the Kaiparowits Plateau Survey are Emery Gray, Snake Valley Gray, and Snake Valley Black-on-gray (Madsen 1977). Emery Gray was made locally within the general region, evidently within the Escalante River basin where both igneous rock (for temper) and appropriate clay occur in close proximity to one another. Snake Valley Gray and Black-on-gray are imports from the west and despite a considerable distance to the closest production location of this pottery, sherds of both types are frequently represented in low numbers at sites on the Kaiparowits Plateau and in the Escalante River basin.

Emery Gray

In general the collected Emery Gray sherds or nips contain the black and glassy basaltic andesite temper that is typical for Emery Gray of the Escalante River basin (Geib and Lyneis 1996, temper category A; Spurr 1993). This temper is derived from the cap rock of Boulder Mountain. None of the sherds has the more granular, salt-and-pepper looking basaltic andesite temper that is typical for northern portions of the San Rafael Fremont area (north of the Fremont River along Muddy Creek and tributaries). One sherd, however, is somewhat similar to this in that the groundmass is less glassy and grayish instead of black (42KA5223, S1). There is one Emery Gray sherd (42KA5411, S3) that contains crushed latite tuff, a temper agent represented at low levels in the Emery Gray sherds of the Escalante River basin (see Geib and Lyneis 1996:Figure 72, temper category B). Just like in many of the examples from the Escalante River basin, this sherd seems to contain latite tuff temper to the exclusion of other rock types. This might indicate that the vessel was produced where igneous rock types were more constrained in their variability, with latite tuff predominating. This happens in the upper portion of the Escalante River west of the town of Escalante. Latite tuff forms the cap rock for the Table Cliff Plateau as well as the southern portions of Boulder Mountain; thus most of the igneous cobbles found in the drainages feeding into the upper Escalante River are of this material.

As is usual for the Emery Gray made in or near the Escalante River basin, the paste is mainly clean, hard, and light colored (essentially white). One Emery sherd (42KA4536, S3) has a gritty dark gray paste. This sherd is from a bowl, as is another (42KA5223, S1), but the other Emery Gray sherds are from jars. Two of these are rim portions, one of which is from a small globular vessel with a short, strongly everted lip (Figure 6.46b); the other has a straight rim. The two sherds identified as coming from bowls have polished interior surfaces; one also has a polished exterior (42KA5223, S1) and one has what appears to be an interior float (42KA 4536, S3). None of the Emery Gray sherds exhibit surface manipulation (incising, punctuation, applique), but this practice is rare in the region. Three of the collected jar sherds have fugitive red on the exterior.

Most Emery Gray sherds found during the Kaiparowits Plateau Survey occur on sites lacking any Anasazi pottery. The converse is also generally true: sites with Anasazi Pottery lack Emery Gray. Nonetheless, we found a few instances of co-occurrence, which is known for the greater Kaiparowits Plateau region and the Escalante River basin and was one reason for the postulated contemporaneity between the Fremont and the Anasazi (Jennings 1966; Lister 1964). Geib (1996) demonstrated that this co-occurrence was largely the result of the mixing of deposits from temporally discrete intervals,[7] and that there are sites or components of sites separated vertically or horizontally that contain unmixed assemblages of Fremont pottery alone.

On the Kaiparowits Plateau Survey we found 14 sites with Emery Gray. At two of these (42KA 5223 and 42GA4783) the single sherds of Emery Gray appear intrusive. Eight of the other 14 sites have unmixed Fremont assemblages (Emery Gray alone or Emery with Snake Valley Gray), and one of them (42KA5279) has Emery with an unidenti-

[7]Mixing resulted from a combination of prehistoric human and animal activity, lack of stratigraphic boundaries between the thin tissues of depositional events briefly separated in time, and excavation methods that failed to recognize subtle depositional breaks.

fied utility jar containing clay/shale plates (see above). When Emery Gray occurs by itself or with Snake Valley Gray an early Formative temporal affiliation (ca. A.D. 500 to 1050) is likely and a Fremont cultural affiliation is probable. An early Formative affiliation seems likely for 42KA5279 as well because examples of the pottery with clay/shale plates are known from sites dated to this interval (e.g., Gates Roost).

There are three sites where Emery Gray occurs along with Anasazi types: 42GA4790, 42KA5265, and 42KA5436. 42GA4790 is a small shelter or rock ledge, just the sort of site that is likely to have been reused time and time again, resulting in type mixing. 42KA5265 is different, consisting of a small artifact scatter in an open setting unlikely to have encouraged site reuse—no natural features afford shelter or other benefits. The question here is with identification, as none of the sherds were collected: are the sherds Emery Gray or Coombs Variety of Tusayan White Ware? The third site is an Anasazi structural habitation (42KA5436) with 3–5 rooms and a trash midden. There is no evidence for multiple occupations at this site location and all remains seem clearly derived from the people living in the small roomblock. The interesting aspect of the Emery Gray sherd is that one of its edges is ground, which raises the possibility that the sherd was scavenged for use at this site as some sort of tool and therefore has no implications regarding some sort of cultural interaction.

Admixture of Fremont and Anasazi pottery at some sites is clearly the result of site reoccupation, but at other sites this is not the case. Nonetheless, it is worth pointing out that we recorded about 20 Anasazi structural sites during the Phase 2 survey and 42KA5436 was the only one where we found Emery Gray or any other Fremont pottery type. Not only did these sites sometimes contain abundant pottery (therefore making the evident lack of Fremont pottery far more significant), but these open structural habitations occurred in settings unlikely to have had previous use. On a regional level, it is perhaps significant that many of the cases of admixture of Anasazi and Fremont types, at least in significant numbers (assuming all difficulties in ceramic identification have been resolved), occur at shelters and similar settings likely to have been reoccupied.

Kearns (1982:Table 24) reported no Emery Gray from the sample survey for the northwest portion of the Kaiparowits Plateau (Tract II of the Escalante Project), an area that partially overlaps our Collet Top sampling frame. The project, however, did identify Coombs Gray, including its polished variety. These sherds occurred on a few sites with no other pottery, or in one case (42KA2253) with various unidentified plain gray. In all probability, the sherds identified as Coombs Gray are what we would have typed as Emery Gray (see discussion by Geib and Lyneis 1996:169).

Snake Valley Gray

A single rim sherd of Snake Valley Gray (Figure 6.46g) was collected from 42KA5411 (S2), a Fremont temporary residential site with 30–50 surface sherds identified as Emery Gray. Given the finding of this single sherd, it is possible that other fragments of this jar occur below the surface at the site. This sherd has a typical paste and temper for this type: abundant clear angular quartz and black biotite in a gritty-looking gray clay. The fragment is somewhat oxidized, imparting a pinkish cast like that seen on refired sherds. The sherd is somewhat polished on the exterior and the rim is slightly everted. Snake Valley Gray occurs with some regularity but in low frequencies on sites of the Kaiparowits Plateau and Escalante River basin and is commonly found in association with Emery Gray and plain, sand-tempered utility pottery. 42KA5411 was the only site from our sample with a sherd of this type.

Snake Valley Black-on-gray

A single sherd of Snake Valley Black-on-gray (Figure 6.46f) was found at site 42KA4578 on Long Flat; it occurred along with North Creek and Shinarump Corrugated. It is an interesting perforated flat lug handle of a jar. It has a faded black (carbon) horizontal band painted across the jar body and along the handle edge. This sherd has a typical light gray paste that contains abundant clear angular quartz and black biotite. Snake Valley Black-on-gray occurs less frequently than Snake Valley Gray at sites of the Kaiparowits Plateau and Escalante River basin, but when it does, association with Anasazi types is expectable.

Shinarump Gray, White, and Red Ware

Pottery was identified as part of the Shinarump Series following what has become the consensus view as detailed most recently by Lyneis (1998; also Walling and Thompson 1988). We follow Lyneis in recognizing the sand-tempered redware pottery produced in the Virgin Anasazi region as Shinarump Red Ware, which includes Thompson's (Walling et al. 1986:360–361) proposed types: Kanab Black-on-red, Kanab Red, and

Kanab Polychrome. Furthermore, we concur that Colton's (1956) San Juan Red Ware: Little Colorado Series should be abandoned to the dustbin of old typologies.

Shinarump Red Ware

Most of the Anasazi structural sites and some of the nonstructural sites contained redware sherds. In all, almost 40 percent of the sites with sherds had redware pottery (24 of 62) and of these, more than 95 percent had Shinarump Red Ware (23 of 24). Just five of the sites had sherds of Tsegi Orange Ware and in each case it was a fragment or fragments of a single vessel. This is perhaps to be expected in that Tsegi Orange Ware would be an import originating from roughly 80 km southeast of Collet Top on the Rainbow Plateau and Paiute Mesa, where the closest production centers for this pottery were located. Although production locations per se for Shinarump Red Ware remain undefined, it seems probable based on the type of red-firing clay used for this ware that the general source location was west of the Cockscomb. This is still a distance of about 40 km or more, but substantially closer. Moreover, there is other evidence pointing to a flow of goods west to east over the Cockscomb, including large amounts of Shinarump Gray Ware and White Ware and agatized wood.

Examples of all three recognized types of Shinarump Red Ware were found on the survey, with Kanab Red the most common (15 sites) followed by Kanab Black-on-red (9 sites) and Kanab Polychrome (6 sites). We have no doubt that some of the sherds identified simply as Kanab Red are actually Kanab Black-on-red and perhaps even Kanab Polychrome, but that weathering removed all traces of paint and even slip. This may not always be the case because we found some moderately large red-slipped sherds that exhibit no traces of black paint. It is possible that these represent fragments of vessels decorated in limited areas, but they may also represent true red-slipped vessels with no decoration. There is also a good chance that some of the Shinarump Red Ware identified as Kanab Black-on-red is actually Kanab Polychrome, weathered such that traces of black paint were evident but one could not be certain that the red (which was probably actually yellow prior to firing, just like with Tsegi Orange Ware) had been applied in wide decoration bands rather than an overall slip.

Four Kanab Polychrome sherds were collected for laboratory analysis. All are slipped on the exterior, although one (42KA5437, S10) has a badly weathered surface with just minute traces of slip remaining. Total slipping of bowl exteriors makes Kanab Polychrome comparable to Citadel and Cameron Polychromes of Tsegi Orange Ware, types that began in late Pueblo II perhaps around A.D. 1100 (Ambler 1985:62). Three of the four collected Kanab Polychrome sherds have simple designs analogous to Citadel Polychrome (also simple Tusayan Polychrome), consisting of wide bands of red outlined by black lines; the fourth Kanab Polychrome sherd (42KA5437, S10) might have had a design analogous to Cameron Polychrome with black lines forming a hachure across the red bands (in Cameron Polychrome the hachure can also be across the unslipped orange areas between the red bands).

All of the collected examples of Shinarump Red Ware are from bowls but we observed five examples of jar sherds in the field, including several sherds from a Kanab Polychrome jar at 42KA5378. The temper of all of the collected Shinarump Red Ware sherds is quite consistent in its general character, consisting of what appears to be finely crushed sandstone—angular, often clear quartz grains with adhering white matrix and loose angular fragments of the same matrix. Also present here and there are quartz grain clumps held together by white matrix. The chief variability among the redware sherds in temper inclusions seems to result principally from differences in the degree of rock crushing and the amount of temper added. The Shinarump Red Ware sherds either display a uniform red through the entire thickness of the vessel body or they have a dark core. The paste is almost always vitrified to varying degrees, and indeed vitrification is one of the features that distinguishes Shinarump Red Ware from Tsegi Orange Ware, because the latter are virtually never vitrified and are often so soft that the surfaces exhibit abundant weathering spalls.

Shinarump White Ware

The whiteware sherds frequently found at Kaiparowits Plateau sites can be grouped into two general classes based on surface color and appearance and, more precisely, on the nature of the paste and temper upon microscopic examination of a fresh break. The latter of course was done only in the laboratory with collected sherds and consequently the field identifications entail some degree of error in separating sherds into these two general classes. One of these classes is Shinarump White Ware; the other is designated as the Virgin Series of Tusayan White Ware and is discussed

below. Some of the sherds found on the Kaiparowits Plateau are classic examples of Shinarump White Ware, having a medium to dark gray vitrified paste with sand temper and a crackled white slip. These were the criteria that we used in the field to identify Shinarump White Ware, but while analyzing collected sherds in the laboratory it became evident that the collection contained light-fired whiteware and grayware that, except for color, were indistinguishable from Shinarump White Ware and Shinarump Gray Ware. Microscope examination of the paste and temper along a fresh break revealed a somewhat vitrified and gritty (or "dirty") paste tempered with abundant angular quartz with white matrix (crushed sandstone) that seems identical to that of sherds classified as Shinarump. But for the light color, they appear no different than Shinarump.

These problematic sherds seem to be examples of Shinarump vessels that were fired with better than average control of the firing atmosphere, specifically elimination of oxygen so that iron in the paste did not oxidize to a reddish color. As a simple test of this idea, one of the collected sherds of this sort was refired in a kiln at 900°C (S1 of 42KA5377). We identified the sherd in the field as North Creek Corrugated based on its light paste, but laboratory analysis suggested that its paste and temper were no different from sherds classified as Shinarump Corrugated or any other types of Shinarump Gray Ware and Shinarump White Ware. The refired color for the paste of this sherd is red (2.5YR5/8), vastly changed from its fired paste color of light gray (2.5Y7/1). If the sherd had been even partly as dark as its refired color there is no doubt that we would have classified it as Shinarump Corrugated instead of North Creek Corrugated. There are whiteware sherds in our Kaiparowits Plateau Survey collections with the identical problem that we identified in the field as part of the Virgin series of Tusayan White Ware because of their light color, including one from the same site (S2 of 42KA5377). Sherd 2 of 42KA5377 has paste texture and inclusions that appear similar to those of Shinarump White Ware.

One upshot of this is that our site records underrepresent the quantity of Shinarump White Ware and Shinarump Gray Ware, and likely also the number of sites with pottery of these wares. For example, at some sites we found only light-firing sherds field classified as the Virgin Series of Tusayan White Ware and Tusayan Gray Ware; site 42KA5377 with the refired sherd mentioned above is one of these. The field record for 42KA5377 documented North Creek Corrugated, North Creek Gray, and Hildale Black-on-gray, but the small nips removed from two of these vessels suggest that they are part of the Shinarump Series as discussed above. For this particular site the failure to recognize the light-fired Shinarump potentially decreased the diversity and number of individual vessels represented by the sherds. On a larger scale, the underrepresentation of Shinarump vessels decreases the volume of ceramics potentially originating off the Kaiparowits Plateau and indicative of west-east exchange over the Cockscomb. Based on the assumption that the dark-firing Shinarump wares are made from iron-rich Chinle clays, then the proportion of sherds of these wares has implications for the directionality and intensity of interaction. It is possible that Shinarump White Ware and Gray Ware was made locally on the Kaiparowits Plateau but demonstration of this will require intensive study coupled with clay and temper sourcing.

This is just one small example of the problem with field identifying sherds, one that clearly illustrates that a sherd in hand is worth many in the bush when it comes to deriving useful technological information. There is no substitute for collection in this regard and most field identifications probably should be treated as best guesses, especially in areas like the Kaiparowits Plateau where ceramic types are poorly defined. The problem in this case is exacerbated by the ware and type definitions themselves and the over-reliance placed on color as a means to distinguish Shinarump. Of course, paste color is a characteristic that one can fairly evaluate in the field, especially on a sunny day. Details of temper and paste are another matter, and even the best hand lens fails to provide clear insights (worse still, a hand lens can deceive one into believing that an adequate inspection was done). It might be possible to devise effective criteria that would allow Shinarump White Ware and Shinarump Gray Ware to be identified on a more consistent basis, but this remains to be seen.

In any event, based on this admittedly limited sample, informed by sporadic observations over the years, it may be time to expand upon the color criteria for identifying Shinarump White Ware and Shinarump Gray Ware and distinguishing them from other whitewares and graywares of southern Utah. In legal parlance, the presence of dark paste is sufficient but is not necessary for the Shinarump designation. Irrespective of paste color, the presence of the specific crushed sandstone temper

and vitrified gritty paste is sufficient for the Shinarump designation, but making this call in the field may be difficult. Perhaps we should focus upon those aspects that Shinarump producers clearly controlled and probably cared about because it mattered—namely the clay and temper used in pottery manufacture—rather than to focus upon something that Shinarump producers were less in control of and perhaps cared less about because it did not affect the quality of the final product—namely the firing atmosphere.

Shinarump White Ware occurs at 7 percent of the sites overall and 45 percent (28) of the 62 sites that contained pottery. Some of the vessel fragments have no designs and on some the designs are badly faded or consist of limited portions; these sherds are simply classified as Shinarump White Ware. The sherds with intact designs of sufficient size are identified as Virgin Black-on-white, specifying the analogous Virgin Anasazi design style: e.g., North Creek, Hildale (Figure 6.44m–t). North Creek style sherds are the most common. The carbon paint on nearly all of the Shinarump White Ware sherds is faded and watery looking, vastly different than the solid black carbon paint common to Tusayan White Ware of the Kayenta region. Most sherds of this ware are from bowls, but there are a few jar sherds. The bowls are usually slipped on the interior and exterior, although some have only an interior slip. The slip is usually cracked from differential shrinkage (paste shrinking more than the slip). Some bowls have exterior corrugations; these were classified as Virgin Black-on-white rather than Toquerville Black-on-white for the same reason that exterior corrugation on Tusayan White Ware vessels is not now considered a valid type (i.e., Shato Black-on-white); it is merely a variation of whatever type the exterior treatment occurs on.

Some of the Virgin Black-on-white pottery appears atypical, especially sherd 1 from 42KA4614 (Figure 6.44o). This sherd is tentatively identified as Shinarump White Ware because of its purplish paste and heavy white slip. Although purplish, the color is actually unusual for Shinarump and the paste is not vitrified; more important, the temper uncharacteristically consists of well-rounded quartz grains.

Shinarump Gray (Utility) Ware

Much of the above discussion about Shinarump White Ware applies equally to Shinarump Gray Ware. In our sample there are few differences in paste texture and temper between sherds that we classified as Shinarump Gray Ware and sherds classified as Shinarump White Ware. Compared to Shinarump White Ware, paste vitrification is more intense in the Shinarump Gray Ware and partial oxidation of the exterior is more common, resulting in a dark reddish brown surface color (Figures 6.45k, 6.46e). Many of the utility sherds found on the Kaiparowits Plateau are classic examples of what has come to be the consensus opinion of Shinarump Gray Ware (see Lyneis 1998): a vitrified dark gray to reddish brown surface color (often referred to as purplish or purplish red) and abundant quartz temper. Nonetheless, laboratory analysis revealed that some utility sherds from the Kaiparowits Plateau are essentially identical in paste and temper to the classic examples of Shinarump Gray Ware except that they have a relatively light gray paste and lack the oxidation that results in a reddish brown surface color (Figures 6.45h and 6.46d). Color alone seems an insufficient reason to differentiate the lighter gray utility sherds from the dark gray to brown utility sherds. Irrespective of surface or core color, any sherds with the characteristic paste and temper of Shinarump Gray Ware are designated as such in Table 6.17. Of course, our field identification of Shinarump Gray Ware was based largely on surface color so there is little doubt that we have underreported the true incidence of this ware relative to light-firing sherds identified as North Creek Corrugated and North Creek Gray.

The name Shinarump Brown was initially used to refer to the plain utility sherds of this ware, but the name was dropped in favor of Shinarump Plain in recognition that brown was too exclusionary (or too confusing) of a color referent. Retaining the term gray in the overall ware category for Shinarump Plain and Shinarump Corrugated has the potential to be equally misleading, thus the color-neutral designation of Shinarump Utility might be the preferred term.

Shinarump Plain and Corrugated are common ceramic types identified in the project area. The corrugated sherds usually exhibit very poorly done corrugations, ones that are indistinct and often appear smoothed over. Some have a surface treatment that was Moenkopi-like, although the flattened coils are narrow (more reminiscent of the clapboard corrugation seen on late Pueblo II Tusayan Corrugated). The range of variability in surface treatments is considerable. Poorly done corrugation is also a common feature of the sherds classified as North Creek Corrugated.

Tusayan Gray and White Ware, Virgin Series

Most light-firing, sand-tempered whiteware and grayware sherds from the Kaiparowits Plateau were classified as part of the Virgin Series of Tusayan Gray Ware and Tusayan White Ware (Colton 1952). NNAD archaeologists are quite experienced with ceramic types of the Tusayan Gray and White Ware produced locally in the Kayenta Anasazi region because that is where we do the bulk of our excavation and survey work. A few of the collected sherds are classified as part of Tusayan Gray Ware, Tsegi Series or Tusayan White Ware, Kayenta Series (Colton 1955), but the vast majority of the sherds with light-firing paste and sand temper are clearly different in both paste and temper from Kayenta whitewares and graywares. Besides the evident differences in material constituents, which some may see as insignificant, there are as well clear differences for the whiteware in paint quality and vessel finishing and in vessel finishing for utility ware. For example, the carbon paint on the Kaiparowits whiteware sherds classified as part of the Virgin Series is faded and watery in contrast to the dense solid black seen on Tusayan White Ware of the Kayenta Series. Likewise, the finish of the Kaiparowits Plateau whiteware sherds classified as part of the Virgin Series is usually considerably inferior to the finish seen on sherds of Tusayan White Ware of the Kayenta Series: vessel walls are often bumpy and otherwise irregular, often with protruding temper and surfaces that are poorly polished if at all, especially on bowl exteriors. Because of paste and firing conditions, the whiteware lacks the clean white surfaces of Tusayan White Ware, Kayenta Series and the pottery has an unmistakable black-on-gray rather than black-on-white appearance.

Some of the Virgin Series whiteware from the Kaiparowits Plateau appears to have subtle subjective differences in design treatment from Kayenta whiteware, but this would require larger samples of larger vessel portions (and whole vessels) to document adequately. Nonetheless, the illustrations of Virgin Series types, such as shown in Walling et al. (1986:Figures 183–198), make it clear to us that the Virgin Series designs are *not* strictly analogous to those of the Kayenta region, with some less so than others. The claim that "Black Mesa Black-on-white becomes St. George Black-on-gray in the Virgin Series ... Sosi Black-on-white becomes North Creek Black-on-gray in the Virgin Series (Walling et al. 1986:354, also see Table 34) is only partly true, in that some of the sherds included in certain Virgin Series types are not the same as their supposed Kayenta equivalents. For example, we would classify some of the North Creek Black-on-gray shown in Walling's Figure 187 (h–p) as Black Mesa Black-on-white and not Sosi Black-on-white. Allison (1998) has also noted differences between Kayenta and Virgin design styles and has used a design element approach in an analysis of Virgin pottery.

Utility ware sherds of the Kaiparowits Plateau classified as part of the Virgin Series of Tusayan Gray Ware exhibit several contrasts with sherds of Tusayan Gray Ware, Tsegi Series that are worth mentioning. One is the common use of plain exteriors (North Creek Gray) during Pueblo II, something that was not seen in the Kayenta region until middle Pueblo III with the advent of Kiet Siel Gray. The evident Virgin Anasazi predilection for producing plain exteriors during Pueblo II is seen equally well in Shinarump Plain. On corrugated vessels it appears that a common surface manipulation involved varying degrees of smoothing out the corrugations. Mainly this appears to have involved wiping the exterior surface with a wet hand before the vessel was dry, something that might have simply been an artifact of production—turning the vessel with wet clay-grimed hands. On some sherds the high portions of corrugations appear lightly polished, something that might have happened during post-firing handling, although some polish may have been purposeful. In any event, these are uncommon features of Tusayan Corrugated.

Even though all of the collected sherds in the Virgin Series are different in both paste and temper from Tusayan Gray Ware, Tsegi Series or Tusayan White Ware, Kayenta Series, this does not mean that they would not be separable from any group of Virgin Series sherds from farther west in Utah. Populations living east of the Cockscomb or within close proximity thereof had access to light-firing Cretaceous clays from the Tropic Shale or Straight Cliffs Formation. It is therefore expectable that ceramics produced on and closely around the Kaiparowits Plateau, although they might be light in paste (and consequently distinctive from Shinarump Series wares), could differ from Virgin Series pottery farther west when detailed comparisons are made. It is also possible that specialists with Virgin pottery will insist that the sherds collected from the Kaiparowits Plateau are different from Virgin Series White and Gray Ware from western Utah, just like we, with our experience with Kayenta region pottery, insist that the sherds

are not part of the Tusayan Gray Ware, Tsegi Series or Tusayan White Ware, Kayenta Series. In this regard, McFadden (1982) took essentially the exact opposite approach for an analysis of 365 sherds collected from 15 sites on Collet Top. He found that "cultural affiliation of the collection as a whole is considered to be Tsegi and Kayenta Series, i.e., non-Virgin." Clearly, archaeologists with differing points of reference for ceramic identification are converging on the Kaiparowits Plateau. Because of this, we toyed with the idea of using the term "local whiteware" and "local grayware" for much of the pottery, something that Douglas McFadden (personal communication 2000) was not adverse to. In the end, however, we decided to go with the Virgin Series identification in most cases because this seemed warranted based on the non-material distinctions previously mentioned.

As one final thought about this issue, it is worth citing Beals, Brainerd and Smith (1945) in their summary report on findings from the Rainbow Bridge–Monument Valley Expedition. Although the principal focus of their project was on the Puebloan remains of the Kayenta Anasazi region, they ventured onto Fiftymile Mountain of the Kaiparowits Plateau where they located and recorded nearly 100 sites. Sherds were collected from all of the sites, allowing for study and comparison against pottery from sites of the Kayenta area. Beals, Brainerd and Smith (1945:6) concluded that "these collections [the sherds] did indicate, however, marked differences in the ceramic typology of the region from that of any of the other regions [Kayenta] studied by the Expedition." The significance of this statement should not be underestimated because it comes from archaeologists that knew Kayenta ceramics quite well.

The Virgin Series sherds were distinguished from Shinarump Series sherds principally based on their lighter and unvitrified paste. Temper too appears different, consisting of rounded to subangular quartz sand and other mineral grains with rounded clay pellets common (chunks of unground clay, see Lyneis 1998:11), but this required analysis of collected sherds using a microscope. As discussed previously, some light-colored sherds field identified as part of the Virgin Series of Tusayan Gray and White Ware would be reclassified in our laboratory as Shinarump Gray and White Ware.

We were hampered in the identification of ceramic types for Virgin Series whiteware by the common fading of designs (as previously mentioned the paint quality was poor and even on well-preserved sherds the paint appeared thin and watery) combined with the small fragments of whiteware that we usually found. The most common types identified during the Phase 2 survey were North Creek Black-on-gray and Hildale Black-on-gray (Figure 6.44e–l). We identified a few sherds of St. George Black-on-gray, but these always occurred on sites with a ceramic assemblage consistent with a post A.D. 1050 or more likely post A.D. 1100 temporal assignment—i.e., no site had a pure St. George Black-on-gray assemblage or one lacking corrugated pottery. Note that we did not use the proposed type names for whiteware with corrugated exteriors but instead adopted the common approach in the Kayenta region, which is to treat corrugation as a minor variation of a given type—e.g., North Creek Black-on-gray corrugated variety (ceramic type proliferation is a serious problem in Southwest archaeology and should be avoided when no information will be lost). No Virgin Series whiteware sherd had a design style that came even close to resembling Flagstaff Black-on-white. Of course, the examples of Glendale Black-on-gray illustrated in Walling et al. (1986:Figure 192x–cc) also do not closely resemble Flagstaff Black-on-white, suggesting that perhaps a true analogue for this Kayenta type does not occur in the Virgin region.

It deserves mention that a considerable amount of basic research needs to be done concerning the sand-tempered whiteware and grayware occurring on the Kaiparowits Plateau. For example, the finding of ceramic scrapers at several of the Anasazi habitations on Collet Top strongly suggests that pottery was produced in this highland setting. The question remains what type of pottery—was it Shinarump, which is quite common, or part of the Virgin Series, or perhaps both? Certainly the Fiftymile Mountain portion of the plateau was another center of local ceramic production given its strong Anasazi presence in late Pueblo II and early PIII, but is it possible to differentiate the pottery on this portion of the plateau from the pottery on Collet Top? One might expect that Shinarump Series pottery might be rare on Fiftymile Mountain given how far east it is from the probable source area of this pottery (assuming production west of the Cockscomb), but this remains to be seen. Also, what about the white-firing, sand-tempered whiteware and grayware sherds found in low levels at Collet Top sites that do not seem like Kayenta pottery but likewise do not appear like Virgin Series pottery (perhaps

especially to a Virgin Anasazi ceramic specialist)? Was this material perhaps manufactured on the Fiftymile Mountain portion of the Kaiparowits Plateau? For both Collet Top and Fiftymile Mountain attention should be placed on trying to differentiate local from imported pottery and searching for subtle but significant distinctions in design layout or elements, vessel finishing and other treatment, and vessel forms that might give clues to the cultural origins of the Anasazi populations on the Kaiparowits Plateau. It could also be that there are differences between portions of the plateau with regard to both ceramic manufacture and cultural origins, but this remains to be seen.

Tusayan Gray Ware, Tsegi Series and Tusayan White Ware, Kayenta Series

True Tusayan White Ware and Gray Ware sherds produced in the Kayenta Anasazi region occur not too far away to the east on the Lower Glen Canyon Benches (Geib 1989:42–45), yet few were identified at any of the sites that we recorded on the Kaiparowits Plateau. The number of whiteware and grayware sherds from vessels that might have been produced in the Kayenta Anasazi region and exchanged northward to the Kaiparowits Plateau is exceedingly low. Several provisional identifications of such pottery were made in the field (it is again worth stressing that field identifications should be viewed as tentative), and a few were made based on collected sherds or sherd nips. Two possible Kayenta whitewares were collected: a probable Sosi Black-on-white jar body sherd (S1) from 42KA5318 (Figure 6.44b) and a Black Mesa Black-on-white bowl body sherd (S2) from 42KA5379 (Figure 6.44a). The two possible Kayenta graywares include a nip from a Tusayan Corrugated jar body sherd (S3) from 42KA5376 and a plain gray body sherd (S7) from 42KA5437.

Coombs Variety of Tusayan White Ware and Gray Ware

Lister (1960) created the Coombs Variety of Tusayan White Ware, Kayenta Series to account for whiteware pottery evidently produced at the Coombs Site and tempered with crushed igneous rock eroded from Boulder Mountain (basaltic andesite, the same material that is the most common tempering agent of Fremont pottery within the Escalante River basin [Geib and Lyneis 1996]). She also created Coombs varieties for Tusayan Gray Ware and Tsegi Orange Ware. Coombs variety whiteware (as well as grayware and orangeware) is principally found at sites in and near the town of Boulder, though it has been observed moderately far afield in low numbers (for example a sherd of Coombs Polychrome occurred at a late PII site on the northeast side of Navajo Mountain—site UT-B-63-16; Bungart et al. 1997:32). Care must be exercised so as not to confuse Coombs Gray (even Coombs whitewaare) with similar looking Fremont pottery. The Kaiparowits Plateau Survey found several sherds of Coombs Variety Tusayan White Ware. The two collected examples, both bowl rims, come from two different structural habitations on Collet Top: S3 from 42KA5447 and S10 from 42KA5435. Both of these sites contain numerous sherds, with Coombs variety accounting for a minor proportion of the assemblage. The sherds are typical examples of this whiteware variety, being made of a white-firing paste with moderately sorted black angular chunks of crushed glassy basaltic andesite. The clean white paste makes the temper all the more conspicuous, though it tends not to be abundant. It seems possible that the temper was screened (or somehow coarsely size-sorted) prior to adding it to the clay because of the relative lack of small debris in the vessels. The whiteness of the clay meant that slipping was unnecessary. One bowl rim has two wide encircling bands just below the rim, and the other lacks a design despite being a moderately large vessel portion (Figure 6.44c, d). Both are polished on the interior but lack a fine finish and their exteriors are poorly finished. Surveyors observed two sherds from a single jar of Coombs Corrugated at site 42KA5439, a multicomponent sherd and lithic scatter on Collet Top that the Anasazi might have used as a temporary camp.

Tsegi Orange Ware

Just five of the Kaiparowits Plateau sites have sherds of Tsegi Orange Ware and in each case it is a fragment or fragments of a single vessel. This is in marked contrast to the relative abundance of Shinarump Red Ware. This should perhaps be expected in that the portion of the Kaiparowits Plateau that we surveyed is anywhere from 60 to 80 km or more from the closest production centers of Tsegi Orange Ware located on the Rainbow Plateau and Paiute Mesa (Cummings Mesa is slightly closer but production there seems unlikely). The only collected example of Tsegi Orange Ware is a Citadel Polychrome bowl body sherd (S1) from 42KA5458 located on Collet Top (Figure 6.45c). This is a typical example of this type in all respects; the bowl interior has a red slip band outlined in black contrasting with the orange unpainted oxidized paste; the exterior is totally

slipped red. The crumbly unvitrified orange paste has a gray core. The sherd is tempered with abundant crushed sherds that are mostly light firing (turned pinkish or buff in the oxidized portion of the sherd section, whitish in the gray core), but including crushed Tsegi Orange Ware sherds as well, although these blend in well with the paste. This type first appeared in the Kayenta area at about A.D. 1100, occurring on late Pueblo II sites with whiteware assemblages dominated by Sosi and Dogoszhi Black-on-whites. This type is a likely source of inspiration for the local Kanab Polychrome, which appears to have the same style. It might be worth examining to what extent Cameron Polychrome, with its back hachure over red bands or back hachure over the adjacent unpainted orange swaths between the red bands, occurs in Shinarump Red Ware.

A single sherd at site 42KA4769 was tentatively field identified as Tsegi Black-on-orange, a Pueblo III type that usually dates after A.D. 1200. Unfortunately, a nip was not taken from this sherd, so the ware assignment cannot be verified. The design on the sherd consists of parallel squiggly lines, which is not a design that is ever seen on Tsegi Black-on-orange or during Pueblo III for that matter. The usual design for this type is a simple set of three or so encircling bands just below the rim on bowl interiors (Tsegi Black-on-orange is rarely recognized for jars). The use of parallel squiggly lines is a common late Pueblo I and early Pueblo II design treatment, and is seen on Deadmans Black-on-red. It might also occur on locally produced Shinarump Red Ware. This sherd is worked and may therefore have been scavenged and recycled and may have no temporal relationship to the site at which it occurs.

Jeddito Yellow Ware

Sherds of Jeddito Yellow Ware occur on two sites: one bowl rim at 42KA4572 and four fragments including one rim from a single dipper (or small bowl) from 42KA4827 (Figure 6.45a, b). Both of the rim sherds were collected for laboratory analysis, which included having them examined by Kelley Hays-Gilpin, an expert in Jeddito Yellow Ware. She identified one of the sherds as Awatovi Black-on-yellow (42KA4827) based on its paste, which contains an abundance of fine aplastics, its design, and its rim treatment. This type dates between A.D. 1300 and 1350 in the place of manufacture, and provides possible evidence for Southern Paiute occupancy of the Kaiparowits Plateau during the fourteenth century A.D. The other sherd is identified as either Awatovi or Jeddito Black-on-yellow; rim treatment is consistent with either type, at least the early portion of Jeddito. Fine aplastics within the paste are more abundant than is usual for Jeddito, especially after about A.D. 1400. The one unusual aspect of this sherd is the occurrence of probable fine volcanic ash. With characteristics indeterminate between Awatovi and Jeddito, this sherd likely dates somewhere in the mid A.D. 1300s (Hays-Gilpin, personal communication 1998).

PERISHABLE ARTIFACTS AND REMAINS

Basketry

The single item of basketry (Figure 6.47) found during the Kaiparowits Plateau Survey is quite impressive, considering it was a surface find lying just outside the dripline of a small shelter (42KA5363). This item is the proximal end of a fan-shaped winnowing tray with portions of both side selvages. The fragment is partially carbonized along the broken edge but otherwise is in remarkably good condition. This artifact is constructed by close diagonal St-winning (twill twinning), with the weft splints passing over two warp rods then under one rod, alternating rod pairs in each weft row. This technique of basketry manufacture, whether for winnowing trays or other forms, is characteristic of Numic speakers (e.g., Adovasio and Pedler 1994; Fowler and Dawson 1986), and this example is identical in manufacture to Southern Paiute winnowing trays from southern Utah in the Powell collection (Fowler and Matley 1979:19, Figures 3 and 4). The warp rods of this item consists of twigs (Rhus trilobata?) that retain their bark and measure 2-3mm in diameter; there are 25 warps per centimeter. Additional warps were added in by simple insertion to create the fan shape of the tray. The continuous weft consists of splints from split twigs (same as the warp) some of which also retain bark; these measure 2-3 mm in width and 1 mm or less in thickness. The exterior of the basket had been painted red in places, though a design was not apparent. The interior appears to retain food residue mashed into voids between stitches. Winnowing trays were used to store ground meal (Fowler and Dawson 1986; Kelly 1964), so perhaps this is what the residue is. The outer warps on both sides have been pierced by a wrapping stitch which likely held an encircling rim rod or two by a simple overcast stitch; all of the Southern Paiute winnowing trays described by Fowler and Matley (1979) exhibited this treat-

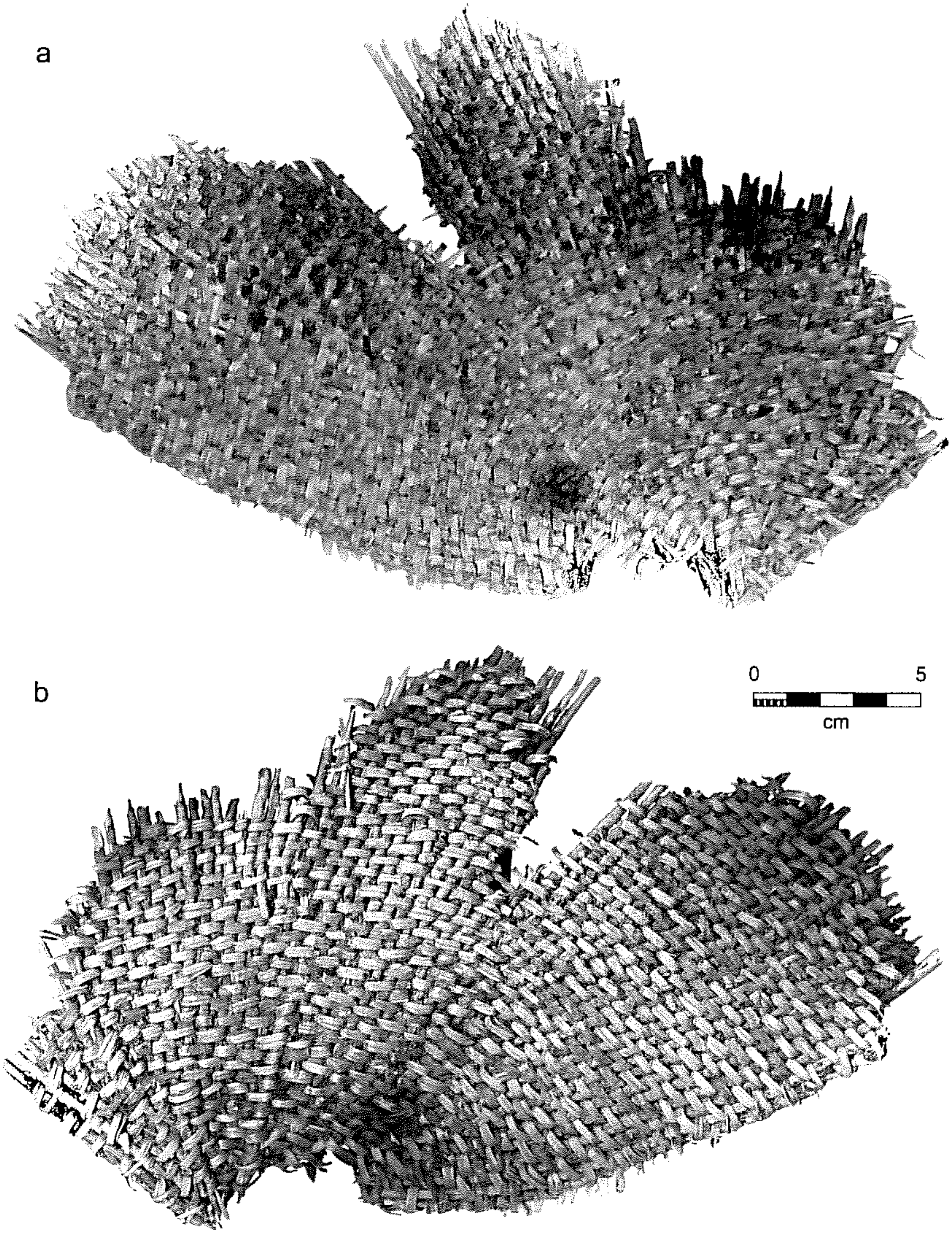


Figure 6.47. Views of a Paiute winnowing tray found during the Kaiparowits Plateau Survey: a) interior; b) exterior.

ment for the side and end selvages. Likewise, Fowler and Dawson (1986:725) have indicated that Southern Paiute winnowing trays have a rim reinforcement rod or rods coiled to the finished item.

In an attempt to learn what the residue within the basket might be, we loosened some of this material with tweezers and collected it for a pollen wash. The remains scraped from the basket were treated with hot distilled water and a 10 percent solution of sodium hexmetaphosphate. The material and solution were washed through 0.18 mm mesh screen with distilled water; materials remaining on the sieve were saved for possible plant identification. The sieved residue was then treated with acetolysis (reduces organics), rinsed with distilled water, and transferred to a vial, with a portion mounted on glass slides for analysis. Susie Smith (Laboratory of Paleoecology, Northern Arizona University) identified the pollen assemblage by counting grains on slide transects at 400x magnification to a 199 grain sum, then scanning the entire slide at 100x magnification to record additional taxa. Table 6.18 presents the results. Pollen aggregates (clumps of the same taxon) are included in the sum as one grain per occurrence. Pollen percentages represent the relative importance of each taxon in a sample ([taxon count/pollen sum] · 100).

Table 6.18 Pollen analysis results for residue from the Paiute winnowing tray recovered from 42KA5363 (sample analyzed by Susan Smith).

Taxa	Count	Percent
Degraded	8	4.0
Unknown	1	0.5
Spruce	X	X
Fir	X	X
Pine	5	2.5
Pinyon type	2	1.0
Juniper	10	5.0
Berberis	1	0.5
Walnut	1	0.5
Oak	1	0.5
Rose family	2	1.0
Sagebrush	112	56.3
Sagebrush aggregate	X(20+)	X(20+)
Cheno-Am	2	1.0
Sunflower family	1	0.5
cf. Sunflower (Helianthus)	1	0.5
Ragweed, bursage	45	22.6
Ragweed, bursage aggregate	X(10)	X(10)
Grass	7	3.5
Grass aggregate	X(8)	X(8)
Pollen sum	199	100.0
Tracers	108	

X signifies scan-identified taxa.

The sample shows a high incidence of probable background pollen, especially sagebrush, which accounts for more than half of the counted grains (56%) and likely as well the ragweed/bursage pollen, which accounts for almost a quarter of the sample (23%). The high background counts likely result because the basket lay on the ground surface with the interior surface (residue side) face up exposed to natural pollen rain. The implied assumption about artifact pollen washes is that pollen will be recovered from plant resources that were associated with use of the artifact. Studies of pollen recovery from washes of metates used experimentally to grind a variety of seeds from known subsistence plants (Cheno-Am, tansy mustard, sunflower, beeweed, and grasses) have shown that there is a wide range in the amount of pollen recovered from different plant species, which is related to how different plants pollinate (Geib and Smith 1998; Smith and Geib 1999). Other confounding factors include the architecture of seeds and protecting bracts, bristles, and leaves, and how plants were harvested and processed. A main finding of this research concerned the successive loss of seed pollen through each step of prehistoric processing—winnowing of raw seeds, parching, and grinding. Samples also always contained a significant component of other pollen types from the plant community where seeds were harvested and for some species, the environmental pollen swamped the harvested seed pollen. With tools exposed on the surface, the harvested seed pollen would become additionally swamped by pollen rain. For the particular sample considered here, of possible economic significance are the grass pollen (including an aggregate) and the one grain identified as cf. sunflower (*Helianthus*).

These are of interest in part because an examination of the macrobotanical plant remains saved from the sieve as well as inspection of residue still adhering to the basket showed the presence of a *Helianthus* sp. seed and *Sporobolus* (dropseed) lemma and palea (chaff). In this case, the macrobotanical and pollen remains together suggest that both plant resources likely formed part of the residue on the winnowing tray. Karen Wright (Paleoethnobotany Laboratory, Northern Arizona University) identified the macrobotanical remains. She also identified a cactus spine and the bases of small flowers possibly from the composite family (Asteraceae). In addition, there were many small fibers that are of interest with regard to Kelly's

(1964:163) report that a winnowing tray made by a member of the Kaiparowits Band of Southern Paiute was "coated with old yucca root pounded with water." For the Kaibab Band, Kelly (1964:81) observed a "concave surface smeared with yucca fruit ... to seal interstices." The fibers contained within the interstices of the collected basket look suspiciously like the byproduct of pounded yucca root.

Horn Flaker

A most unexpected find was a mountain sheep horn flaker (Figure 6.48) like those recovered from several Basketmaker contexts of the Four Corners region (Geib 2000b). This item came from the surface of Tibbet Cave (42KA1323), a small dry rockshelter that MNA archaeologists recorded in the 1970s, with an updated site record made by Douglas McFadden in the 1990s. The horn flaker was found on the surface of this badly looted site during a brief visit while surveying on Nipple Bench. The flaker is a short peg, 4.8 cm long, 1.3 cm wide, and 1.1 cm thick. It is partially deteriorated along one side, likely from moisture seeping through the deposits in the shelter. Portions of both ends are preserved, one much more so than the other, and exhibit extensive use-wear traces. Fractured silica fragments are embedded into the best-preserved end; these are identical to those seen in the ends of Basketmaker II horn flakers, providing conclusive proof that the tools were used for flaking stone. A small portion of this tool was submitted for collagen extraction and AMS radiocarbon dating. The measured ^{14}C age of

Figure 6.48. Mountain sheep horn flaking tool from Tibbet Cave (42KA1323) on Nipple Bench; tool has a ^{14}C age of 1030 ± 40 B.P.

the horn sample is 1030 ± 40 B.P. (Beta-155687, –20.3‰) with a calibrated two-sigma range of A.D. 960–1040. This date reveals that the horn flaker is not a Basketmaker II artifact. The date is within the time period of Fremont occupancy on the Kaiparowits Plateau, which also accords with the finding of Emery Gray at the cave. That the Fremont also used horn flakers is attested to by the presence of these tools within the Pectol collection from the Capitol Reef area of Utah.

Nonartifactual Samples

From a limited number of sheltered sites, usually ones with granaries, surveyors collected nonartifactual organic samples for potential radiocarbon dating. There was no budget for analyzing the samples within the context of this project, but Douglas McFadden encouraged their collection in the event that funding for dating might become available in the future. It is far easier to retrieve an existing sample from a museum than to relocate a site in the field to collect one. The samples consist of an 8-row corn cob (ca. 6 g; need to wash off adhering sand) from 42KA5433 (a small rockshelter with cists), a small piece of juniper bark from a cist at 42KA5430 (0.2 g, suitable for AMS dating), a piece of juniper bark (5.9 g) from a chunk of mortar from the granary at 42KA5346, and ricegrass seeds and some other organics floated from a chunk of mortar of the granary at 42KA4823.

ISOLATED OCCURRENCES

NNAD crews recorded 816 isolated occurrences during the Kaiparowits Plateau Survey, of which 754 are Native American in origin. The remaining 62 isolated occurrences are associated with Euro-American use of the area and are discussed in Chapter 9. The prehistoric isolated occurrences are discussed below and summarized in Tables 6.19 and 6.20. These tables present a

Table 6.19. Native American isolated occurrences of the Kaiparowits Plateau Survey; tabulation of occurrence type by sampling stratum.

	Collet Top			Horse Mountain			Long Flat			Horse Flat			Fourmile Bench		
Occurrence Type	n	C%	R%	n	C%	R%	n	C%	R%	n	C%	R%	n	C%	R%
Debitage scatters															
Core reduction	3	1.6	9.7	9	10.3	29.0	7	6.7	22.6				2	1.4	6.5
Cobble tool reduction	5	2.7	27.8	2	2.3	11.1	3	2.9	16.7	1	1.9	5.6	2	1.4	11.1
Biface reduction	8	4.3	20.0	4	4.6	10.0	7	6.7	17.5	5	9.4	12.5	10	6.9	25.0
Mixed biface/core	23	12.2	29.9	11	12.6	14.3	8	7.8	10.4	5	9.4	6.5	16	11.1	20.8
Subtotal	39	20.7	23.5	26	29.9	15.7	25	24.1	15.1	11	20.7	6.6	30	20.8	18.1
Flaked lithic tools															
Chert flake (used)	15	8.0	33.3				5	4.8	11.1	4	7.5	8.9	6	4.2	13.3
Coarse cobble flake (used)	6	3.2	31.6	1	1.1	5.3	1	1.0	5.3				8	5.6	42.1
Chert core tool													2	1.4	66.7
Chert core (no use)	1	0.5	6.7	2	2.3	13.3	4	3.8	26.7	2	3.8	13.3	5	3.5	33.3
Coarse cobble tool	14	7.4	22.2	8	9.2	12.7	12	11.5	19.0	4	7.5	6.3	8	5.6	12.7
Coarse cobble (no use)							5	4.8	83.3						
Uniface	5	2.7	23.8	2	2.3	9.5	4	3.8	19.0				5	3.5	23.8
Ind. biface fragment	4	2.1	16.7	6	6.9	25.0	5	4.8	20.8	2	3.8	8.3			
Thick biface	14	7.4	20.0	8	9.2	11.4	5	4.8	7.1	6	11.3	8.6	20	13.9	28.6
Thinned biface	24	12.8	28.9	8	9.2	9.6	13	12.5	15.7	7	13.2	8.4	17	11.8	20.5
Projectile point	42	22.3	25.1	19	21.8	11.4	18	17.3	10.8	12	22.6	7.2	33	22.9	19.8
Other flake tools	4	2.1	40.0	1	1.1	10.0	1	1.0	10.0	2	3.8	20.0			
Subtotal	129	68.6	24.5	55	63.2	10.5	73	70.1	13.9	39	73.6	7.4	104	72.2	19.8
Grinding tools															
Mano	6	3.2	21.4	4	4.6	14.3	2	1.9	7.1	1	1.9	3.6	6	4.2	21.4
Grinding slab	4	2.1	40.0	1	1.1	10.0	1	1.0	10.0				1	0.7	10.0
Subtotal	10	5.3	26.3	5	5.7	13.2	3	2.9	7.9	1	1.9	2.6	7	4.9	18.4
Ceramics	9	4.8	60.0							1	1.9	6.7	1	0.7	6.7
Other isolated finds	1	0.5	11.1	1	1.1	11.1	3	2.9	33.3	1	1.9	11.1	2	1.4	22.2
Total	188	100.0	24.9	87	100.0	11.5	104	100.0	13.8	53	100.0	7.0	144	100.0	19.1

categorization of the finds by type, for example a small scatter of core reduction flakes or an isolated projectile point. This is not a count of artifacts but a count of artifact kind. Although 566 of the prehistoric finds are isolated individual artifacts or small scatters containing similar artifacts, there are 188 instances where multiple objects occur together, such as core reduction flakes with a biface. These multiple occurrences are listed again in Table 6.20, to account for the second type of remains.

Most of the isolated occurrences consist of single artifacts and diffuse artifact scatters that lack context, such as flakes dispersed along a drainage. Isolated occurrences represent a range of prehistoric economic activities within the study area that includes hunting, butchering and animal processing, gathering and plant processing, and random discard and tool loss. Flake scatters appear to represent tool production and modification associated with resource extraction activities. Hunting and butchering activities are inferred from loci with one or more used bifaces and one or more projectile points, or from loci with bifaces and utilized flakes. Isolated projectile points, which are mostly basal portions, may have been lost while hunting, or discarded after recovering them from an animal during butchering. Gathering and plant processing are inferred from the occasional isolated grinding tool and possibly some of the core reduction scatters and cobble tool refurbishing debitage. A few isolated occurrences are more difficult to interpret, such as rock alignments that could be natural or cultural.

As indicated in Table 6.19, the majority (n = 526, 70%) of the isolated occurrences are flaked stone tools. Thinned bifaces (n = 83) and projectile points (n = 167) together comprise 48 percent of the flaked tools, followed by 13 percent thick (early stage) bifaces. Heavy-duty cobble tools of

(Table 6.19, Part 2)

	Smoky Mountain			Brigham Plains			Nipple Bench			East Clark Bench			Total	
Occurrence Type	n	C%	R%	n	C%	R%	n	C%	R%	n	C%	R%	n	C%
Debitage scatters														
Core reduction	3	3.8	9.7	1	2.4	3.2	3	7.0	9.7	3	18.8	9.7	31	4.1
Cobble tool reduction	1	1.3	5.6	2	4.9	11.1				2	12.5	11.1	18	2.4
Biface reduction	4	5.1	10.0	1	2.4	2.5	1	2.3	2.5			4	0	5.3
Mixed biface/core	7	9.0	9.1	1	2.4	1.3	6	14.0	7.8				77	10.2
Subtotal	15	19.2	9.0	5	12.2	3.0	10	23.3	6.0	5	31.3	3.0	166	22.0
Flaked lithic tools														
Chert flake (used)	8	10.3	17.8	2	4.9	4.4	3	7.0	6.7	2	12.5	4.4	45	6.0
Coarse cobble flake (used)	2	2.6	10.5				1	2.3	5.3				19	2.5
Chert core tool	1	1.3	33.3										3	0.4
Chert core (no use)	1	1.3	6.7										15	2.0
Coarse cobble tool	8	10.3	12.7	4	9.8	6.3	5	11.6	7.9				63	8.4
Coarse cobble (no use)										1	6.2	16.7	6	0.8
Uniface	2	2.6	9.5	2	4.9	9.5	1	2.3	4.8				21	2.8
Ind. biface fragment				4	9.8	16.7	2	4.7	8.3	1	6.2	4.2	24	3.2
Thick biface	9	11.5	12.9				5	11.6	7.1	3	18.8	4.3	70	9.3
Thinned biface	6	7.7	7.2	4	9.8	4.8	3	7.0	3.6	1	6.2	1.2	83	11.0
Projectile point	21	26.9	12.6	14	34.1	8.4	5	11.6	3.0	3	18.8	1.8	167	22.1
Other flake tools	1	1.3	10.0				1	2.3	10.0				10	1.3
Subtotal	59	75.6	11.2	30	73.2	5.7	26	60.5	4.9	11	68.7	2.1	526	69.8
Grinding tools														
Mano	2	2.6	7.1	5	12.2	17.9	2	4.7	7.1				28	3.7
Grinding slab							3	7.0	30.0				10	1.3
Subtotal	2	2.6	5.3	5	12.2	13.2	5	11.6	13.2				38	5.0
Ceramics	1	1.3	6.7	1	2.4	6.7	2	4.7	13.3				15	2.0
Other isolated finds	1	1.3	11.1										9	1.2
Total	78	100.0	10.3	41	100.0	5.4	43	100.0	5.7	16	100.0	2.1	754	100.0

coarse materials, such as cobble choppers, comprise 12 percent of the stone tools, and another 9 percent are used chert flakes. The remaining stone tools are used cores, unifacial tools such as scrapers, or miscellaneous tools like drills or gravers. Most of the isolated lithic tools are broken, and probably were discarded when they were no longer useful. A few complete tools may have been lost at activity areas or dropped during travel.

Debitage scatters without tools comprise 22 percent of the total (n = 166). Within the debitage scatter category, both biface reduction and core reduction technologies occur, constituting 24 and 19 percent, respectively. Reduction or resharpening flakes from heavy-duty cobble tools of coarse materials (such as cobble choppers) comprise 11 percent of the scatters. Many of the debitage isolates (n = 77, 46%) contain evidence of both biface and core reduction; this category also contains the occasional flake for which technology could not be identified.

Isolated grinding tools are rare occurrences, comprising just 5 percent of the prehistoric isolated artifacts. Of the 38 grinding tools recorded, 28 (74%) are manos and the other 10 (26%) are grinding slabs. A most intriguing isolated grinding tool was a large slab cached in a tree on Fourmile Bench (Figure 6.49). The grinding slab (IO854) was wedged against the trunk of a live juniper tree at chest height, lying at a slight angle, supported by branches. The unused surface of the slab faced up, and was covered with white mineral deposits and lichen. The slightly concave, ground surface faced down, but was also covered by evaporite deposits and lichen, except for the protected area that lay against a large branch. The slab was roughly shaped by flaking and the used surface exhibited refurbishing pecking marks. Although intact grinding tools are not unusual at sites in the region (see Chapter 7), an isolated slab in good condition is an infrequent find. Analogous tree storage of a Ute pottery vessel was reported by Huscher and Huscher (1940) from the Uncompahgre Plateau in Colorado. Placing large or valuable items in a tree for protected storage implies an intention to return and use the items in the future. As noted for the vessel, storage above the ground in a tree would keep domestic items "safe

Table 6.20. Native American isolated occurrences of the Kaiparowits Plateau Survey; tabulation of secondary occurrence type by sampling stratum.

	Collet Top			Horse Mountain			Long Flat			Horse Flat			Fourmile Bench		
Occurrence Type	n	C %	R %	n	C %	R %	n	C %	R %	n	C %	R %	n	C %	R%
Debitage scatters															
Core reduction	6	11.1	35.3	1	6.7	5.9	2	7.1	11.8	3	25.0	17.6	3	7.5	17.6
Cobble tool reduction	4	7.4	33.3				3	10.7	25.0	1	8.3	8.3	1	2.5	8.3
Biface reduction	6	11.1	21.4	1	6.7	3.6	4	14.3	14.3	3	25.0	10.7	9	22.5	32.1
Mixed biface/core	21	38.9	25.3	7	46.7	8.4	13	46.4	15.7	4	33.3	4.8	19	47.5	22.9
Subtotal	37	68.5	26.4	9	60.0	6.4	22	78.6	15.7	11	91.7	7.9	32	80.0	22.9
Flaked lithic tools															
Chert flake (used)	3	5.5	37.5				1	3.6	12.5	1	8.3	12.5	1	2.5	12.5
Cobble flake (used)	3	5.5	75.0										1	2.5	25.0
Chert core (no use)	2	3.7	100.0												
Coarse cobble tool	2	3.7	33.3				1	3.6	16.7				1	2.5	16.7
Uniface	1	1.9	33.3	1	6.7	33.3									
Ind. biface fragment	1	1.9	50.0												
Thick biface				2	13.3	28.6	2	7.1	28.6				2	5.0	28.6
Thinned biface	2	3.7	28.6	1	6.7	14.3	1	3.6	14.3				1	2.5	14.3
Projectile point	1	1.9	100.0												
Other flake tool				1	6.7	50.0									
Subtotal	15	27.8	35.7	5	33.3	11.9	5	17.9	11.9	1	8.3	2.4	6	15.0	14.3
Mano				1	6.7	100.0									
Ceramics	1	1.9	100.0												
Other isolated finds	1	1.9	25.0				1	3.6	25.0				2	5.0	50.0
Total	54	100.0	28.7	15	100.0	7.9	28	100.0	14.9	12	100.0	6.4	40	100.0	21.3

from dogs, out of the reach of youngsters, and secure from the hoofs of a horse" (Huscher and Huscher 1940:137); the Paiute rarely used horses, but the premise is applicable. It is likely that the isolated grinding slab on Fourmile Bench relates to Paiute use of the region, based on the relatively good condition of the stone and the fact that the juniper tree is still living but must already have been of substantial size when the large slab was cached.

Another interesting case of isolated grinding tools was found in Paradise Canyon, where two manos were found cached in natural crevices in the sandstone cliffs on opposite sides of the canyon. The complete mano at IO164 measures 18 x 8 x 4.5 cm. It is made of dark red, coarse-grained sandstone and has ground facets on both faces. It was found in a small cave on the west side of Paradise Canyon, above the talus. The sandstone mano at IO171 measures 14 x 9 x 4 cm, and was found in a small hole along a natural route out of the east side of the canyon. The manos are associated with IO165, a pinyon log, 3 m long, leaning against a low rock face (Figure 6.50), which provided ladder access up a ledge at a prominent point. This was part of a prehistoric access route across Paradise Canyon linking Paradise Bench with Horse Mountain. Numerous prehistoric trails have been documented in the canyon country to the east and south of the Kaiparowits Plateau (e.g., Pattison and Potter 1977), where the massive cliff faces formed by the Navajo Sandstone required construction of hand- and foot-holds or steps that are still evident. The relatively more interbedded, blocky sandstones in the Kaiparowits Plateau offer more frequent natural routes that did not require modification. Occasional evidence of trails, such as the manos and pinyon log in Paradise Canyon, indicate that good trails were important enough to be marked and improved when they were used on a regular basis.

Isolated sherds were occasionally found during survey, mainly on Collet Top, where the bulk of the Formative resources were encountered. Ceramics comprise 2 percent of the prehistoric isolated occurrences, and 60 percent of these (n = 9) were on Collet Top. Other sampling strata yielded few isolated sherds. Ceramic types mirror those

(Table 6.20, Part 2)

	Smoky Mountain			Brigham Plain			Nipple Bench			East Clark Bench			Total	
Occurrence Type	n	C %	R %	n	C %	R %	n	C %	R %	n	C %	R %	n	C %
Debitage scatters														
Core reduction	1	4.2	5.9	1	10.0	5.9							17	9.0
Cobble tool reduction	2	8.3	16.7				1	25.0	8.3				12	6.4
Biface reduction	5	20.8	17.9										28	14.9
Mixed biface/core	10	41.7	12.0	5	50.0	6.0	3	75.0	3.6	1	100.0	1.2	83	44.1
Subtotal	18	75.0	12.9	6	60.0	4.3	4	100.0	2.9	1	100.0	0.7	140	74.5
Flaked lithic tools														
Chert flake (used)	2	8.3	25.0			8								4.3
Cobble flake (used)													4	2.1
Chert core (no use)													2	1.1
Coarse cobble tool	1	4.2	16.7	1	10.0	16.7							6	3.2
Uniface	1	4.2	33.3										3	1.6
Ind. biface fragment				1	10.0	50.0							2	1.1
Thick biface				1	10.0	14.3							7	3.7
Thinned biface	1	4.2	14.3	1	10.0	14.3							7	3.7
Projectile point													1	0.5
Other flake tool	1	4.2	50.0										2	1.1
Subtotal	6	25.0	14.3	4	40.0	9.5							42	22.3
Mano													1	0.5
Ceramics													1	0.5
Other isolated finds													4	2.1
Total	24	100.0	12.8	10	100.0	5.3	4	100.0	2.1	1	100.0	0.5	188	100.0

Figure 6.49. Views of isolated occurrence 854 on Fourmile Bench, showing a large grinding slab wedged into a live juniper tree for storage: a) orientation of slab in tree when found; b) close-up of slab showing mineral deposits around protected grinding area.

identified on sites, and are primarily from the Shinarump and North Creek series. Also noted were Kanab Red, Coombs Corrugated, and a few Emery Gray sherds, including a pot drop. Only two decorated sherds, both Virgin Black-on-white, Hildale style, were found as isolates, both on Collet Top. One interesting occurrence on Collet Top involved a cluster of six sherds from a single Shinarump Corrugated jar (see Figure 6.45k), found on a ridge crest. Just two transects later, farther up the ridge crest, the survey crew found a large neck or rim fragment of a Shinarump Corrugated jar, which conjoined with a rim sherd in the first scatter; obviously the single broken jar was dispersed along the ridge.

Isolated occurrences of cultural material that do not fit into the above categories are tabulated as "Other" in Table 6.19. These include a masonry wall segment (2 m long x 50 cm high) in a low shelter on the north side of a deep canyon on Collet Top, and two juniper branches jammed into a small natural hole in sandstone bedrock on Fourmile Bench. These two occurrences have no associated artifacts and so are of unknown age or

Figure 6.50. A pinyon log (IO165), associated with two cached manos, that marks a prehistoric trail across Paradise Canyon.

affiliation. The pinyon log acting as a ladder on the route across Paradise Canyon, noted above, was also assigned to the Other category. On Smoky Mountain, a group of three sandstone slabs clustered together, which could be natural or cultural, was recorded, and on Fourmile Bench a crew documented a small rock shelter with a dry interior and potential sediment depth that would be a good cache location but contained no visible cultural material. An enigmatic circle of limestone rocks, measuring 2.5 m in diameter, was recorded on Long Flat; this grouping may be natural or cultural, but was associated with one tan chert core flake. Two partially in situ dinosaur fossils were recorded as isolated occurrences on Long Flat. In both cases the fossilized bones were being exposed by erosion of the Kaiparowits Formation in a badland setting (Figure 6.51) and more bones certainly remain embedded in the rock.

Table 6.20 tabulates the 188 instances when multiple artifact classes were recorded as single isolated occurrences, as in a case of a tool and a few flakes. In these cases debitage scatters comprise 75 percent (n = 140) of the total and flaked lithic tools represent 22 percent (n = 42). In one case sherds are present with lithic debitage and in one case an unmodified quartzite cobble possibly used as a mano is associated with a cobble chopper. One reason there are relatively more debitage scatters than flaked lithic tools in Table 6.20 is that artifacts noted in this table are secondary to what appeared to be the primary defining artifact(s) of the isolated find. For example, at an isolated find consisting of a projectile point and three core reduction flakes, the projectile point would be listed in Table 6.19 and the core reduction flakes would appear as one incidence of core reduction in Table 6.20. In another case with two Stage 4 bifaces and a projectile point, the projectile point would be represented in Table 6.19 and the two bifaces would appear as one count in the thinned biface category in Table 6.20. We have thus emphasized the tools as primary components of the isolated occurrences, in part because tools are more likely than debitage to be temporally diagnostic.

A closer look at Table 6.20 reveals that among the debitage scatters, mixed core and biface reduc-

Figure 6.51. Partially in situ dinosaur skeleton (IO22) exposed in thin sandstone layer of the Kaiparowits Formation on the northeast portion of Long Flat.

tion debris again comprise the majority (59%), followed by biface reduction (20%) and core reduction (12%). Among flaked stone tools, used flakes predominate (19%), followed by thick and thinned bifaces (17% each) and used cobble tools and cores (14% and 10%). Only a few unifacial tools, unmodified cores, and a single projectile point were documented as secondary artifacts at isolated occurrences.

Several land use patterns and economic activities can be inferred from the isolated prehistoric artifacts (Table 6.19 and 6.20). There is a preponderance of flaked lithic tools, the vast majority of which are projectile points and thinned bifaces, followed by thick bifaces, cobble choppers, and used flakes. These artifacts indicate a primary use of the land for hunting and animal processing. More of the debitage recorded in isolated settings resulted from biface manufacture or modification, rather than production of flakes from cores. The biface reduction flakes and the isolated tools probably correspond to hunting and butchering by individuals or small groups of males. This demonstrates that biface reduction occurred not just at camps, which would be recorded as sites, but also in the field, during the course of daily activities. Following our traditional understanding of sexual division of labor, which espouses that while men are engaged in hunting activities, women are gathering and processing plant foods, the isolated occurrences represent daily routines for all members of prehistoric groups. The isolated grinding stones, as well as those documented at sites, should be related to the intensive plant processing activities of women. Processing activities also require expedient flakes and coarse tools, which are also found both at sites and in isolated contexts. The prehistoric isolated artifacts, therefore, reinforce the patterns of behaviors documented at the sites in the survey area.

The spatial distribution of the prehistoric isolated artifacts reveals a few patterns that appear meaningful. A disproportionate frequency of core reduction debitage was recorded on East Clark Bench (19%), and the ratio of core to biface debitage was also high on Nipple Bench and Horse Mountain. The frequency of cobble tool refurbishing flakes was also dramatically higher on East Clark Bench than elsewhere (13% versus 2–5%). The proportion of isolated grinding tools compared to other artifact types was significantly higher (approximately 12%) on Brigham Plains and Nipple Bench than in other sampling strata (between 2% and 6%). If core reduction and cobble tools are indicative of processing activities, particularly those related to plant processing, these artifact categories may reinforce interpretations of the lower benches around the Kaiparowits Plateau as areas used primarily for collection and processing of grasses and other plant resources.

As a compliment to this pattern, the frequency of isolated projectile points on Nipple Bench and East Clark Bench is low relative to other sample frames, which offer more attractive environments for game. Hunting was probably concentrated in the higher woodland areas, and was mainly an opportunistic activity on the lower benches. The frequency of isolated projectile points is greatest in sampling strata in the highest and most heavily wooded parts of the project area. Indeed, the frequency of isolated points generally declines with decreasing elevation, a trend that probably signals use of the higher terrain for more intensive hunting. The frequency of thinned bifaces, tools often associated with butchering, mirrors this trend. In contrast, thick bifaces, which are more general tools used for a variety of tasks, do not correlate to elevation or vegetative communities. Low-elevation benches yielded as many, or more, thick bifaces as the upper elevations. Similarly, coarse cobble tools are found in low frequencies (6–12%) in all of the sampling strata, suggesting that these items may have served a variety of purposes, ranging from plant processing to hide preparation.

Temporal placement of prehistoric isolated occurrences is often not possible, particularly when the resources consist only of debitage or non-diagnostic tools. Projectile points and ceramics offer more precise temporal information, but these artifacts comprise less than 25 percent of the isolated occurrences. Projectile points found as isolates are enumerated in Table 6.21, assigned to either a specific type (i.e. San Rafael Side-notched) or general class (i.e., high side-notched). Most (n = 56, 34%) of the projectiles are untyped dart points, often non-diagnostic tips or midsections. These artifacts likely represent pre-ceramic occupation of the area, but more specific temporal assignment is not possible. The next most common category, at 35 percent, comprises points in the Elko series, which may indicate Archaic occupation, but could also date to later periods. Points typical of the early Archaic period comprise 4 percent of the isolates, the middle Archaic is represented by 6 percent, and the late Archaic is indicated by 11 Gypsum points (7%). These low but consistent frequencies of diagnostic points demonstrate that

Table 6.21. Isolated projectile points from the Kaiparowits Plateau Survey.

Projectile Point Type	Field Recorded	Collected	Total	Percent
Untyped dart point – NFS	55	1	56	33.9
Untyped dart point, low side notched		4	4	2.4
Untyped dart point, high side notched		2	2	1.2
Untyped dart point, corner notched	1		1	0.6
Untyped willow leaf		1	1	0.6
Untyped concave base (Paleoindian?)		1	1	0.6
Elko Series (corner/side-notched)	3	2	5	3.0
Elko Corner-notched	5	24	29	17.6
Elko Side-notched	4	10	14	8.5
Elko Eared	2	8	10	6.1
Northern Side-notched	2	1	3	1.8
Hawken Side-notched?		1	1	0.6
San Rafael Side-notched		3	3	1.8
Sudden Side-notched	2	1	3	1.8
Gypsum (Gatecliff Contracting Stem)	4	7	11	6.7
Pinto Series		3	3	1.8
Jay/Lake Mohave	1		1	0.6
Sand Dune Side-notched?		1	1	0.6
Untyped Arrow Point - NFS	2	1	3	1.8
Rose Spring Corner-notched		2	2	1.2
Bull Creek		4	4	2.4
Anasazi stemmed		1	1	0.6
Cottonwood Triangular	1		1	0.6
Desert Side-notched	2	3	5	3.0
Total	84	81	165	100.0

Table 6.22. Prehistoric feature types used in this report and IMACS counterparts.

KPS Categories	IMACS Categories
Nonarchitectural	
Charcoal stain or slab-lined hearth	Hearth/firepit (HE) or Other (OT)
Fire-cracked rock (FCR)	Burned stone/fire-cracked rock concentration (FC)
Midden	Midden (MD)
Rock concentration	Rock concentration (RC)
Stone circle	Stone circle (SC)
Other	(Various)
Architectural	
Cist/pit	Cist (AE)
Rock alignment	Rock alignment (RA)
Granary	Granary (AD)
Room	Single-room structure (AP) or multi-room structure (AQ)

the project area was used throughout prehistory. Preferential use of different environments may have changed through time, depending on ambient climatic conditions, but there is no evidence that the region was completely unoccupied in any given period. Formative projectile point types make up 4 percent of the isolates, and the Post-Formative is represented by 3 percent; again these low frequencies offer evidence of continual Native American use of the Kaiparowits region into the historic period.

FEATURES

This section provides summary data and descriptive statistics on the Native American features observed in the project area. NNAD archaeologists recorded 461 features among 243 sites, 35 percent of the total 689 Native American sites. The feature types used in this report are listed in Table 6.22 with their IMACS counterparts. We attempt to strike a reasonable balance between the extremes of function-free labels, such as "fire affected rock concentration" (e.g., Halbirt and Henderson 1993: 33), and function-specific nomenclature such as "roasting pit." This is particularly important in relation to charcoal stains and fire-cracked rock (FCR) features; without the benefit of testing or excavation, it is impossible to gauge the function of many of these features based on surface evidence alone. Indeed, as explained below, the two categories probably mask variability and are not as mutually exclusive as their partitioned status implies.

The features discussed here are those assigned to the following temporal periods: Archaic, Formative, and Post-Formative. The latter are presumed to be affiliated with Southern Paiute, and some of these features may date as recently as the late nineteenth or early twentieth century (see Chapter 5, site 42KA4662, for an example). In lieu of dated remains, however, we have applied the "Euro-American" appellation only to sites with obvious non-native remains, such as cowboy camps. Features associated with Euro-American sites are discussed separately in Chapter 9.

Table 6.23 is a tabulation of prehistoric features by sampling strata, with totals for the entire Kaiparowits Plateau Survey. The most common feature types are charcoal stains (52%) and FCR concentrations (22%). Aside from the category of "other" (8%), middens (6%) and rooms or roomblocks (4%) are the next most common features types. The percentage of middens and rooms or roomblocks is nearly equal because the two feature types are usually found in association on Puebloan sites. Nearly all architectural features, and most middens, occur on Collet Top, a pattern discussed in more detail in Chapters 7 and 8. The frequency of prehistoric features ranges widely between strata. East Clark Bench has no features, whereas the Long Flat stratum contains 167 features, or 36 percent of the entire population. This is partly a factor of survey coverage; NNAD surveyed twice as many units on Long Flat (n = 18) as on East Clark Bench (n = 9), although they are essentially equal as a fraction of the stratum sampling acreage (9.8% and 9.9%, respectively). East Clark Bench, nevertheless, has only six sites in nine quarter sections, whereas Long Flat has 121 prehistoric sites in 18 quarter sections.

Table 6.24 presents more comparable figures on feature frequency among strata, showing the average number of features per prehistoric site, and Table 6.25 gives the average number of features per survey unit (quarter section) and section. Two general patterns emerge from these tables. The first is that the occurrence of features per site can be roughly partitioned into three levels: low (0.0–0.3 features per site) for East Clark and Nipple Benches and Smoky Mountain; high for Long Flat (1.4); and medium (0.5–0.8) for the remaining strata. The second pattern is that there is a general increase in feature density per unit as elevation increases, with the exception of Long Flat, which has nearly a third again as many features per unit as Horse Mountain, the stratum with the highest elevation units. Long Flat, by any measure, clearly has higher site and feature densities, and more features per site. The table also reveals some less pronounced patterns. Brigham Plains, for example, has relatively low feature density, but the second highest occurrence of features per site; a similar situation occurs on Horse Flat.

The data suggest some general differences in the manner in which prehistoric peoples inhabited and used each strata. We say this with the caveat that feature totals and means are an amalgam of cultures and time periods, but, with the exception of a large Anasazi settlement on Collet Top, all peoples on the plateau appear to have participated in a pan-cultural strategy of hunting and gathering.

Non-architectuarl features such as charcoal stains, FCR scatters, and middens are least prevalent on East Clark and Nipple Benches and Smoky Mountain. It is probably no coincidence that these three strata (with the exception of the northernmost portion of Smoky Mountain) share the same

Table 6.23. Prehistoric features by sampling stratum.

Sampling Stratum	Charcoal Stain			FCR			Slab-lined Hearth			Cist-Pit			Midden			Rock Concentration		
	n	C%	R%	n	C%	R%	n	C%	R%	n	C%	R%	n	C%	R%	n	C%	R%
Collet Top	24	10.0	29.0	0	0.0	0.0	9	90.0	10.8	4	50.0	4.8	12	44.5	14.5	0	0.0	0.0
Horse Mtn.	37	15.5	78.7	7	6.9	14.9	0	0.0	0.0	0	0.0	0.0	2	7.4	4.3	0	0.0	0.0
Long Flat	59	24.7	35.3	82	80.4	49.1	0	0.0	0.0	0	0.0	0.0	6	22.2	3.6	10	100.0	6.0
Horse Flat	20	8.4	83.3	3	2.9	12.5	0	0.0	0.0	0	0.0	0.0	1	3.7	4.2	0	0.0	0.0
Fourmile	57	23.8	70.4	5	4.9	6.2	1	10.0	1.2	4	50.0	4.9	2	7.4	2.5	0	0.0	0.0
Smoky Mtn.	14	5.9	66.6	2	2.0	9.5	0	0.0	0.0	0	0.0	0.0	3	11.1	14.3	0	0.0	0.0
Brig. Plains	23	9.6	76.7	3	2.9	10.0	0	0.0	0.0	0	0.0	0.0	1	3.7	3.3	0	0.0	0.0
Nipple	5	2.1	55.6	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
East Clark	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Total	239	100.0	51.7	102	100.0	22.1	10	100.0	2.2	8	100.0	1.7	27	100.0	5.8	10	100.0	2.2

(Table 6.23, Part 2)

Sampling Stratum	Rock Alignment			Granary			Room or Roomblock			Other*			Total		
	n	C%	R%	n	C%	R%	n	C%	R%	n	C%	R%	n	C%	R%
Collet Top	2	40.0	2.4	4	66.8	4.8	18	94.7	21.7	10	27.8	12.0	83	18.0	100.0
Horse Mtn.	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	2.8	2.1	47	10.2	100.0
Long Flat	0	0.0	0.0	1	16.7	0.6	0	0.0	0.0	9	25.0	5.4	167	36.1	100.0
Horse Flat	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	24	5.2	100.0
Fourmile	1	20.0	1.2	0	0.0	0.0	0	0.0	0.0	11	30.5	13.6	81	17.5	100.0
Smoky Mtn.	1	20.0	4.8	1	16.7	4.8	0	0.0	0.0	0	0.0	0.0	21	4.5	100.0
Brigham Plains	0	0.0	0.0	0	0.0	0.0	1	5.3	3.3	2	5.6	6.7	30	6.5	100.0
Nipple	1	20.0	11.1	0	0.0	0.0	0	0.0	0.0	3	8.3	33.3	9	2.0	100.0
East Clark	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	100.0
Total	5	100.0	1.1	6	100.0	1.3	19	100.0	4.1	36	100.0	7.8	462	100.0	100.0

*Consists of unidentified slab-lined features, slab concentrations, organic deposits, tool caches, artifact/FCR concentrations, grinding slicks/grooves, poorly defined alignments, eroded slab and artiufact scatters, possible natural uprights, modern reconstructed walls, and groundstone concentrations.

Table 6.24. Mean number of features per prehistoric site, quarter section, and section by sampling stratum.

Sampling Stratum	Per Prehistoric Site	Per Quarter-Section	Per Section
Collet Top	0.6	4.5	18.0
Horse Mountain	0.5	5.9	23.6
Long Flat	1.4	9.3	37.2
Horse Flat	0.7	3.3	13.2
Fourmile Bench	0.6	5.3	21.2
Smoky Mountain	0.3	2.1	8.4
Brigham Plains	0.8	2.8	11.2
Nipple Bench	0.3	0.8	3.2
East Clark Bench	0.0	0.0	0.0
Project Mean	0.7	4.2	16.8

environmental attributes: each is a primarily treeless shrub and grassland, in some areas interspersed with barren clay badlands. With the exception of Brigham Plains, they are also the three lowest benches. Site densities suggest that the lower benches saw less prehistoric use overall, but even when sites are present, features are not. This pattern was substantiated by NNAD's recent survey of the East Clark Bench area near Big Water, which revealed a site density of 3.3 sites per unit, but virtually no architectural or even non-architectural features (Collette and Spurr 2001). Evidently, use of the low-elevation benches did not generate discernible features, or at least not ones that preserved and were visible from the surface.

Intensity of use is greatest on Long Flat and higher strata. The ubiquity of features on Long Flat, for example, probably indicates that this was an important resource extraction area, with processing occurring at the sites. Long Flat has a greater variety of feature types, with relatively high occurrences of middens, rock concentrations, and miscellaneous features. FCR features are also most abundant in this survey stratum, accounting for 80 percent of all observed. The availability of several unique resources probably made Long Flat attractive, including water (springs and seeps), coarse alluvial cobbles for thermal features and flaked cobble tools, siliceous stone materials (nodules of Paradise chert/chalcedony and Canaan Peak cobble chert), and a variety of flora and fauna.

Fourmile Bench is immediately east of Long Flat, separated by the upper tributaries of Wahweap Creek. Flora and fauna are about the same as Long Flat, but in other respects, Fourmile has less water (at least, few permanent springs) and no sources of coarse alluvial cobbles or siliceous stone except at the far northern edge of the bench. In terms of activities that create non-architectural features, however, Fourmile Bench was used at about the same level of intensity as Horse Mountain.

One of the most intriguing finds was the Anasazi settlements on Collet Top, replete with rooms, roomblocks, and trash middens. There are no corollaries in any other sampling strata. Accordingly, there is a dramatic spike in the presence of architectural features on Collet Top (Table 6.25). Four granaries and 11 middens (the highest frequencies per stratum for these feature types), and 18 of the 19 sites with formal rooms or roomblocks occur on Collet Top.[8] And although there is an average of 1.3 architectural features per unit on Collet Top, in fact, nearly all of these are clustered within three survey units. The only comparable archaeological record known for the Kaiparowits Plateau is that of Fiftymile Mountain as reported by Aikens (1963), Fowler and Aikens (1963), and Gunnerson (1959a). Interestingly, the density of non-architectural features on Collet Top is low (2.4 features per unit), on the order of Brigham Plains (also 2.4). This may mean that Collet Top saw less use by hunting and gathering groups than other strata, or that the features are less obvious or well preserved. Although few of the Anasazi structural sites on Collet Top had examples of non-architectural features, no doubt excavation at these sites would reveal extramural hearths.

Following are descriptions of prehistoric feature types, with representative examples, and tabular data on frequency and percent by strata.

Charcoal Stains

This feature type is defined as a concentration of charcoal-stained soil (occasionally containing ash) usually between 50 and 150 cm in diameter. In many cases, however, wind and rain have dispersed the features across a wider area. Stains can consist of both charcoal dust and larger flecks and chunks of carbonized wood; in a few cases, charcoal fragments are fingernail size. Features with larger charcoal fragments are generally assumed to be of more recent origin, i.e., Formative or Post-Formative. Charcoal stains can—and often did—contain small amounts of burned and unburned rock, such as quartzite cobbles and sandstone slab fragments (Table 6.26). This is a qualitative distinction that differentiates them from FCR features, which are dominated by large quantities of burned rock (see below). Artifacts commonly occur in and around the features; less common are fragments of burned animal bone.

Discrete charcoal stains are assumed to be generalized campfires or cooking features, what are often referred to as unlined basin hearths.

[8]It is worth mentioning that the Puebloan site 42KA5229 of Fourmile Bench has a trash midden indicative of a semi-permanent habitation and although no remains of structures were seen on the surface, we have no doubt that excavation would reveal buried rooms of some sort—jacal units, pithouses, or masonry. Consequently, it is perhaps more correct to say that 18 of the 20 sites with formal living structures occur on Collet Top, with 1 on Fourmile Bench and 1 on Jack Riggs Bench.

Table 6.25. Mean number of selected feature types per quarter section by sampling stratum.

Sampling Stratum	Charcoal Stains	FCR	Non-Architectural Features[1]	Architectural Features[2]
Collet Top	1.4	0.0	2.4	1.3
Horse Mountain	4.6	0.9	5.5	0.0
Long Flat	3.3	4.6	7.9	0.1
Horse Flat	2.8	0.3	3.3	0.0
Fourmile Bench	3.9	0.3	4.5	0.1
Smoky Mountain	1.5	0.2	1.7	0.2
Brigham Plains	2.1	0.3	2.4	0.2
Nipple Bench	0.4	0.0	0.4	0.0
East Clark Bench	0.0	0.0	0.0	0.0
Project Mean	2.2	0.9	3.1	0.2

[1]Includes charcoal stains, FCR, cist-pits, and slab-lined hearths.
[2]Includes alignments, granaries, and rooms/roomblocks.

Table 6.26. Charcoal features and selected attributes by sampling stratum.

Sampling Stratum	Total		Charcoal Only			Bone			Cobbles		
	n	C%	n	C%	R%	n	C%	R%	n	C%	R%
Collet Top	24	10.0	3	5.3	12.5	3	10.7	12.5	0	0.0	0.0
Horse Mountain	37	15.5	10	17.5	27.0	1	3.5	2.7	16	35.6	43.2
Long Flat	59	24.7	14	24.5	23.7	7	25.0	11.9	24	53.3	40.7
Horse Flat	20	8.4	9	15.8	45.0	2	7.1	10.0	1	2.2	5.0
Fourmile	57	23.8	11	19.3	19.3	5	17.9	8.8	4	8.9	7.0
Smoky Mountain	14	5.9	3	5.3	21.4	5	17.9	35.7	0	0.0	0.0
Brigham Plains	23	9.6	5	8.8	21.7	5	17.9	21.7	0	0.0	0.0
Nipple	5	2.1	2	3.5	40.0	0	0.0	0.0	0	0.0	0.0
East Clark	0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Total	239	100.0	57	100.0	23.8	28	100.0	11.7	45	100.0	18.8

(Table 6.26, Part 2)

Sampling Stratum	Sandstone			Charcoal Chunks			Artifacts		
	n	C%	R%	n	C%	R%	n	C%	R%
Collet Top	18	13.8	75.0	5	7.7	20.8	9	9.6	37.5
Horse Mountain	14	10.8	37.8	6	9.2	16.2	18	19.2	48.6
Long Flat	27	20.8	45.8	16	24.6	27.1	20	21.3	33.9
Horse Flat	10	7.7	50.0	2	3.1	10.0	13	13.8	65.0
Fourmile	33	25.4	57.9	15	23.1	26.3	24	25.5	42.1
Smoky Mountain	8	6.1	57.1	8	12.3	57.1	5	5.3	35.7
Brigham Plains	17	13.1	73.9	11	16.9	47.8	5	5.3	21.7
Nipple	3	2.3	60.0	2	3.1	40.0	0	0.0	0.0
East Clark	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Total	130	100.0	54.7	65	100.0	27.2	94	100.0	39.3

Features can have more than one associated attribute; row percentages are independent of each other and do not equal 100%. Bone, cobble, and sandstone attributes can include both burned and unburned items.

Testing of similar charcoal stains in Glen Canyon revealed that they were indeed basins filled with charcoal (Bungart and Geib 1987). Warming fires are often desirable, and the 24 percent of charcoal stains without associated bone or rock may have been used in this fashion. But hearths can also have a food processing function, as in the way Northern Paiute women separated ricegrass seeds from stems in small, open fires (Wheat 1967:11; see also Weber and Seaman 1985:47). It also seems likely that fires expressly for warmth would have been built on the ground surface where the heat can radiate out rather than within basins.

Burned bone in approximately 12 percent of the charcoal stains (across all strata except East Clark and Nipple Benches) indicates that some of the features were used to roast game. This was confirmed by the testing results of hearths at two different Post-Formative sites (see Chapter 5). It is interesting to observe that both of the tested Post-Formative hearths with bone were surface phenomena, with topographic expression above the occupation surface rather than below it (i.e., no basins). These features consisted of low piles of burned rock mixed with charcoal resting upon the ground surface. Such surface features have a low probability of being preserved in the archaeological record on the Kaiparowits Plateau; thus it is perhaps not surprising that they are the product of the most recent Native American group using the area. If Archaic hunters created similar features most would have long since disappeared from the record, becoming an eroded scatter of FCR, perhaps just like many of the features that we documented during the survey.

At the start of fieldwork, NNAD surveyors were more than willing to consider charcoal stains in association with artifacts as prehistoric cultural features. As the survey continued, however, it became apparent that a great number of tree and shrub burns occur in the area (Figure 6.52). The older, decomposed burned tree stumps result in surface charcoal stains that look remarkably like prehistoric hearths. Complicating matters, tree roots often pull up subsurface sandstone fragments and cobbles, which resemble FCR upon burning. These natural burns are common to all survey strata, especially those of higher elevation such as Horse Mountain, Long Flat, and Collet Top. NNAD archaeologists observed several burning trees in the aftermath of thunderstorms on both Long Flat and Horse Flat, and witnessed a huge sagebrush fire on Fiftymile Mountain. The result of such a fire in a forested area probably resembles what we saw on Collet Top, where a quarter of one unit had been catastrophically burned, killing all trees and reducing many to stumps and oxidizing all sandstone outcrops. Tree burns also had an effect on site exposure. Burns eliminate the tree canopy and accumulated duff, leading to scoured, basin-shaped blow-outs that expose cultural remains. The important point is that archaeologists should be cautious in assuming a cultural origin of charcoal stains and FCR concentrations. Mother Nature is doing a good job of creating her own versions of prehistoric-looking features on the Kaiparowits Plateau.

Of the total number of charcoal stains recorded (n = 239), Long Flat and Fourmile Bench have the most with 59 (25%) and 57 (24%), respectively, followed by Horse Mountain with 37 (16%). These percentages are not strictly comparable, however, as Long Flat contains 18 survey units, twice as many as most other strata. Table 6.25 demonstrates that the density of charcoal stains tends to increase as elevation increases through the survey strata, with a couple of exceptions. Using this measure, Horse Mountain has the highest density at 4.6 features per quarter section, followed by Fourmile Bench (3.9) and Long Flat (3.3). One obvious interpretation is that increases in elevation are inversely correlated with temperature means and extremes; in other words, it is colder on Horse Mountain than East Clark Bench. The colder it is, the greater the need for campfires. But this does not explain why Collet Top—which is nearly as high as Horse Mountain—has relatively few charcoal stains or non-architectural features in general. Perhaps the numbers are being skewed by the presence of a unique cultural-functional locus: the semi-permanent habitations of a large Anasazi settlement. An alternative, non-cultural explanation is that some of the increase is due to the counting of natural burns, particularly on Horse Mountain and Paradise Bench.

The availability of alluvial cobbles, sandstone, and (in limited amounts) limestone also probably factored into the kinds and quantities of thermal features seen within each survey stratum. More than half of the stains (55%) contain sandstone slab fragments, many of which are burned. Only 10 intact or semi-intact slab-lined features were recorded, but the local sandstone is highly friable and many of the 133 charcoal stains with sandstone fragments may be eroded slab-lined hearths. On Brigham Plains and Collet Top, the availability of sandstone slabs and lack of alluvial cobbles accounts for the high percentage (74% and 75%,

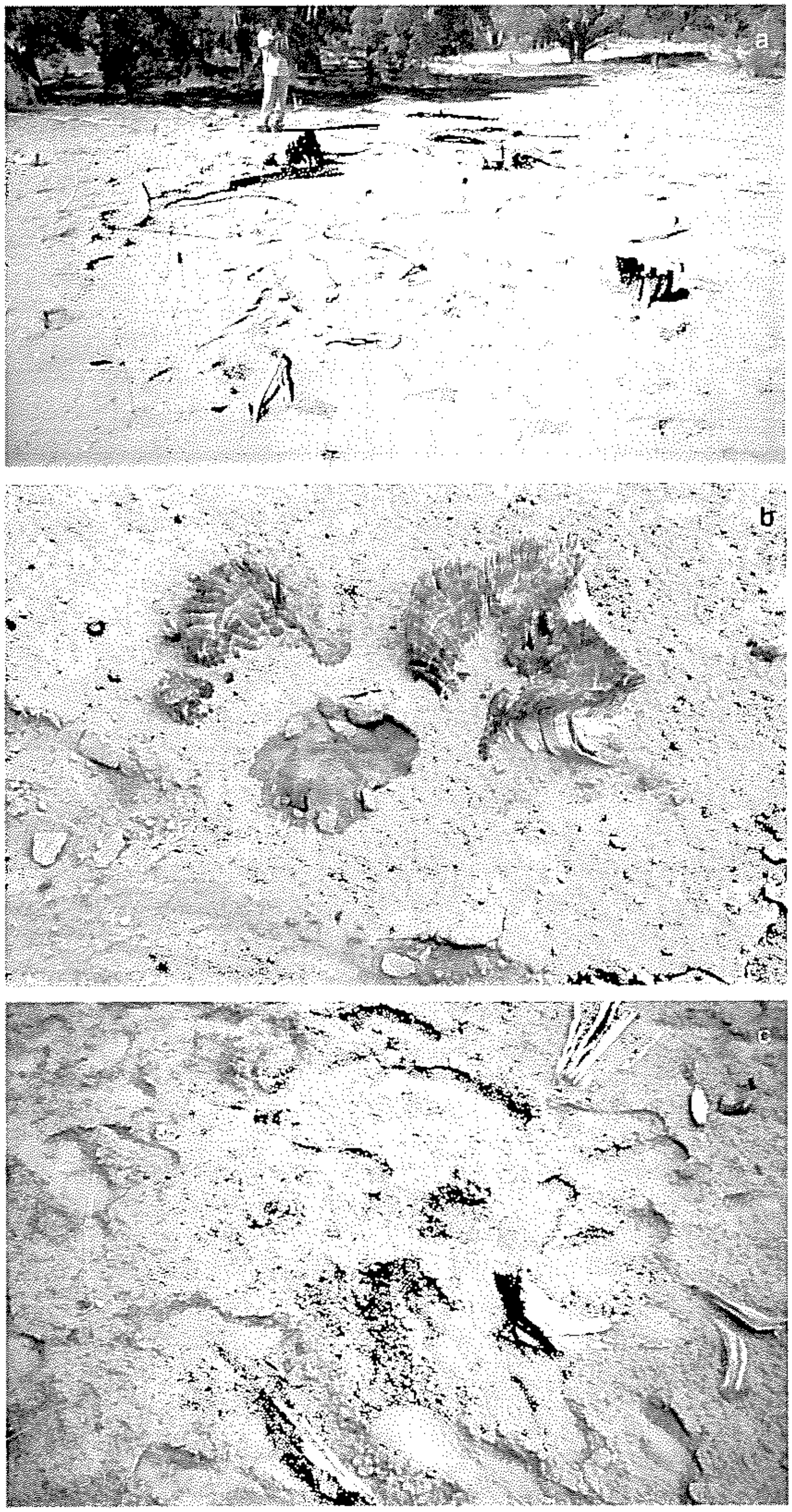


Figure 6.52. Examples of natural tree burns on the Kaiparowits Plateau. Obvious at first (a), the carbonized stumps decay (b), and become buried such that they can be mistaken for cultural features (c); the example at bottom still retains traces of the carbonized lower trunk but the charcoal stain could be confused for a hearth.

respectively) of stains with slab fragments. Conversely, when cobbles are commonly available, such as on Long Flat and Horse Mountain, use of sandstone diminishes (46% and 38%, respectively). Long Flat, with high densities of surface cobbles, is the only stratum where the percentage of FCR features exceeds that of hearths (49% to 35%). The sandstone that is most readily available on Long Flat for use as hearth linings is from the friable Kaiparowits Formation. Differences in the degree of sandstone durability among benches is perhaps another reason for differences in the proportion of slab-lined hearths recorded.

As discussed in Chapter 7 (also Chapter 5), the presence of charcoal chunks on the surface of hearths may be an indicator of relative feature age; in lieu of diagnostics, the presence of surface charcoal generally denotes Formative or Post-Formative affiliation. The presence of bone on the surface might also be temporally significant, especially if the bone is unburned. Sixty-one sites contain hearths with surface charcoal chunks or flecks. About half (n = 31) of the sites have known or suspected Formative/Post-Formative components based on ceramics or arrow points. Among these sites, 66 features have charcoal fragments and 28 have burned bone (a few features have both). Smoky Mountain has the highest percentage of stains with charcoal chunks (57%) and burned bone (36%), associated with eight sites. Brigham Plains also has a high percentage of stains with charcoal chunks and burned bone, associated with seven sites. Brigham Plains is partially within the area that Kelly (1964) identified as the core use territory for a portion of the Kaiparowits Band of Southern Paiute. It is also along a possible route for Virgin Anasazi hunters coming from the west; both factors might account for the higher numbers of recent-looking hearths. Smoky Mountain is also on the southern edge of the plateau, though not as close to Wahweap, and six of the eight sites were considered Formative/Post-Formative. As a caveat, several of the sites with surface charcoal fragments and burned bone also have Archaic diagnostics; some of the sites appear to be genuinely multicomponent, whereas others may reflect scavenging behavior on the part of later people.

FCR Features

Without the benefit of excavation, it is impossible to determine the configuration or function of most FCR features observed during the Kaiparowits Plateau Survey. It is entirely possible that what we call charcoal stains and FCR features simply represent the remains of like features that appear different due to the vagaries of surface exposure. Also, they may represent points along a functional continuum that we have yet to understand. Whether they have intrinsic cultural meaning is unknown, but they do have discriminative characteristics that deserve further study.

A program of limited testing during the summer of 2000 demonstrated that charcoal stains and FCR features may, at the least, reflect different post-depositional processes when originating from different time periods (see Chapter 5). In brief, FCR features that dated to the Archaic were often simply the lagged-out remains of eroded "middens," which, in turn, were an amalgamation of debris from discrete hearths and the activity associated with using these features. In comparison, charcoal stains of Formative and Post-Formative affiliation were usually bounded, basin and surface hearths that were still relatively intact. In these examples, preservation, or lack of it, has played a large role in how surveyors perceived the features, although they may have had similar attributes originally. Regardless, there may still be functional differences that we do not fully understand, as discussed below.

In contrast to charcoal stains (defined above), FCR features are distinguished by large quantities of burned (and some unburned rock) in concentrations generally 1–3 m in diameter. Light to moderate charcoal staining is sometimes evident. Except on the lower benches of the Kaiparowits Plateau, FCR is usually in the form of Quaternary cobbles (present in 84% of the features), with lesser quantities of sandstone (29%, Table 6.27). On Brigham Plains and Smoky Mountain the FCR is composed entirely of burned sandstone, a factor of availability. Light to moderate charcoal staining occurs in about half of the total number of cases (46%). Seventeen features have charcoal chunks and seven have burned bone, but these are less evident than in charcoal stains. Fire-cracked rock features are amorphous in shape and should not be confused with the more formal donut-shaped features commonly known as agave or mescal roasting pits (Gasser 1982b; Mera 1933, 1938; Greer 1967) observed on the Arizona Strip (Moffitt, Rayl and Metcalf 1978; Wells 1991), in the Grand Canyon (Huffman 1993; Fairley et al. 1994), and elsewhere; this type of feature was not seen during the Kaiparowits Plateau Survey.

Table 6.25 shows the density of FCR features per quarter section by survey stratum. The vast majority of the 102 FCR features (n = 82 or 80%)

Table 6.27. FCR features and selected attributes by sampling stratum.

Sampling Stratum	Total		Charcoal Stains			Bone			Cobbles		
	n	C%	n	C%	R%	n	C%	R%	n	C%	R%
Collet Top	0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Horse Mountain	7	6.9	6	13.6	85.7	0	0.0	0.0	4	4.6	57.1
Long Flat	82	80.4	33	75.0	40.2	6	100.0	7.3	78	90.7	95.1
Horse Flat	3	2.9	2	4.6	66.6	0	0.0	0.0	1	1.2	33.3
Fourmile	5	4.9	0	0.0	0.0	0	0.0	0.0	3	3.5	60.0
Smoky Mountain	2	2.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Brigham Plains	3	2.9	3	6.8	100.0	0	0.0	0.0	0	0.0	0.0
Nipple	0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
East Clark	0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Total	102	100.0	44	100.0	43.1	6	100.0	5.9	86	100.0	84.3

(Table 6.27, Part 2)

Sampling Stratum	Sandstone			Charcoal Chunks			Artifacts		
	n	C%	R%	n	C%	R%	n	C%	R%
Collet Top	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Horse Mountain	3	10.0	42.8	1	5.9	14.3	1	2.8	14.3
Long Flat	17	56.6	20.7	14	82.3	17.1	33	91.6	40.2
Horse Flat	3	10.0	100.0	0	0.0	0.0	1	2.8	33.3
Fourmile	2	6.7	40.0	0	0.0	0.0	0	0.0	0.0
Smoky Mountain	2	6.7		0	0.0	0.0	0	0.0	0.0
Brigham Plains	3	10.0	100.0	2	11.8	66.6	1	2.8	33.3
Nipple	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
East Clark	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Total	30	100.0	29.4	17	100.0	16.7	36	100.0	35.3

Features can have more than one associated attribute; row percentages are independent of each other and do not equal 100%. Bone, cobble, and sandstone attributes can include both burned and unburned items.

occur on Long Flat. The high density of such features on Long Flat is very likely due to the ubiquity of alluvial cobbles in this area. Table 6.27 shows that nearly 60 percent of the FCR features on Long Flat are not associated with obvious charcoal staining, whereas charcoal co-occurs with FCR in nearly all of the features in the remaining strata (albeit a small sample of just 11 features). Although the lack of charcoal may have a functional basis, it could also result from post-depositional processes. Charcoal from older, perhaps Archaic features may have disintegrated and washed or blown away over thousands of years, leaving only rock. Testing of FCR scatters on Long Flat showed this to be the case (see Chapter 5). The Long Flat FCR features are also the only ones containing burned bone, and have more associated artifacts but far less associated sandstone.

By ethnographic analogy, the most likely use for the cobbles was to retain heat for various types of cooking or thermal processing. The Havasupai, to use one historic example, made extensive use of stones to cook both plant and animal remains. Stone boiling in baskets sealed with pinyon pitch was a common practice. Heated stones were used to cook soups and mush (using ground seeds, beans, corn, or pinyon nuts), green corn, dumplings, greens, game such as rabbits and quail, and even eggs (Weber and Seaman 1985:61–74). Teas, poisons, and dyes could also be made with this method. Stones were also used in earth ovens or *pavuks*. Large animals could be roasted in a pit by filling the abdominal cavity with hot stones, and stones might be used to line the pit itself. Animal meat and a *piki*-like bread were also baked on thin slabs of sandstone over coals or an open fire. It is

logical to assume that the presence of pediment Quaternary cobbles on Long Flat and Horse Mountain probably made these areas that much more attractive to hunters and foragers, and may have influenced the kinds of resource processing undertaken.

Twenty-three FCR features have charcoal fragments, burned bone, or both. Many of the features are suspected to be associated with Formative or Post-Formative components, but only one site on Long Flat has artifacts diagnostic of these later time periods (in this case, a pair of Post-Formative Desert Side-notched points). The overall percentage of burned bone and charcoal chunks is about the same for both charcoal stains and FCR features.

Slab-lined Hearths

Slab-lined hearths are configurations of upright slabs surrounding an interior space of blackened sand and charcoal. There is no one-to-one IMACS analog, but we are considering the feature non-architectural (unlike cists, which are grouped with architectural features in the IMACS system). For most of these features the upright slabs appear oxidized. At some, the slabs are badly deteriorated and some of these features appear to have completely deflated, leaving the slabs scattered without charcoal-staining. Ten such features were recorded, and all but one are located on Collet Top (the tenth is on Fourmile Bench). All of the features are affiliated with Archaic sites or, in one case, a multicomponent site with an Archaic component. Testing projects in southern Utah (e.g., Bungart 1996; Bungart and Geib 1987; Tipps 1995) have demonstrated that slab-lined hearths date principally to the late Archaic and Archaic-Formative transition. A radiocarbon date from a tested example of this feature type is within the latter temporal interval (see Chapter 5).

Middens

The term "midden" has both descriptive and functional meaning, and was applied to 27 features across the project area. In the descriptive sense, we define middens as extensive, dense concentrations of charcoal-stained soil, burned rock (cobbles, sandstone, and occasionally limestone), tools (whole and fragmented facially flaked tools, cobble tools, metates, and manos), flakes (sometimes crazed and spalled), and occasional charcoal fragments and burned bone. Midden sizes range from about 5 to 25+ m in diameter.

Functionally speaking, what we have classified as middens appear to result from two quite different behaviors. The first kind of midden is a type familiar to all Puebloan archaeologists—a place of garbage disposal for material removed from the activity space that generates the debris. These are the middens that are so well known from Anasazi habitations. Most of the middens on Collet Top (n = 11) are of this type—refuse areas usually to the east or southeast of structures where the inhabitants discarded hearth and roasting pit fill, tools, pottery, and debitage.

By contrast, middens of the second type appear to have resulted not from secondary deposition, but from the in situ accumulation and build-up of debris in the activity space that generated the debris. In this scenario, burned rock, charcoal, artifacts, organic refuse, and the like accumulated in the activity space, which was not cleaned of debris. Rather than moving the debris from an area if it became too trashy the activity space was shifted, resulting in an expanded scatter of remains.

The difference between these quite different midden-generating behaviors is not temporal, although the secondary trash deposits are typical of Anasazi structural habitations, but rather has to do with the degree of settlement permanence and investment in facilities and structures, and the length of stay. If middens are present at Archaic sites they appear to be of the latter type, but we also documented Formative middens that resulted from the in situ accumulation process. Of course, these occurred on Formative sites classified as residential camps or special purpose camps (hunting or processing) rather than semipermanent habitations.

Thirteen middens are associated with Archaic remains (including one site—42KA4756—with both Archaic and Formative components). Ten of the 13 Archaic middens are restricted to the western third of the plateau on Long Flat, Horse Flat, Horse Mountain, and Brigham Plains. Fourteen middens are either Anasazi (n = 13) or Formative/Post-Formative (n = 1). Nine of these middens are on Collet Top, and each is associated with an Anasazi habitation, ranging from single masonry rooms to roomblocks of about eight rooms. Most of these are middens in the classic sense—dark, rich, charcoal-stained soil with charcoal pieces, burned bone, hundreds of sherds, flakes, grinding tools and other artifacts, and burned and unburned sandstone and cobble rocks (they also likely contained abundant organic refuse at the time of deposition). As mentioned,

Collet Top had a concentration of Virgin Anasazi settlements that mimicked those of Fiftymile Mountain, where such habitations are common (Aikens 1963; Fowler and Aikens 1963; Gunnerson 1959a). One midden was located on Fourmile Bench, at an Anasazi site with no discernible structures but a high probability for their presence, and two were found on Smoky Mountain.

Rock Concentrations

This feature is defined as concentrations of mostly unburned cobbles or sandstone fragments, without associated charcoal staining. The 10 features of this type that we recorded all occur on Long Flat, where cobbles are naturally abundant. The sizes of the features range from 1 to 3 m in diameter. Some of the concentrations may have been natural rock outcrops, but they always appeared discrete and out of context from the surrounding terrain. The function of the rock concentrations is unknown, but some may represent discard piles from stone heating, or in the case of sandstone concentrations, remains of slab-lined features.

Cists and Pits

This category includes eight slab-lined cists and one bell-shaped p it, with features evenly divided between Fourmile Bench and Collet Top. All of the features are associated with known or suspected Formative sites or sites with a Formative component, and all but one are in sheltered contexts. Site 42GA4736 has a slab-lined cist located within a rockshelter without any associated remains; this cist is defined by 7–8 upright slabs, measures 55 x 50 cm on the interior, and has a possible depth of at least 20 cm (Figure 6.53). Another rockshelter (42KA5430) has a cist constructed of sandstone roof spalls and sealed with clay; a lapstone or grinding slab was located nearby. Two possible slab-lined cists were found at 42KA5433, a rockshelter with a grinding slab and a cob of eight-row corn. Also on Collet Top are two slab-lined cists in a rockshelter (42KA 2253); within the same shelter is a bell-shaped pit dug into the hardpan. The rockshelter contained Fremont pottery and lots of parched and cracked pinyon nut shells, and there are no associated artifacts or organic remains. The one possible cist found on Fourmile Bench consists of an eroded upright slab at 42KA5225, an open Formative processing camp; lacking charcoal staining this slab might be part of a cist rather than a hearth. The cists may be affiliated with Fremont or Anasazi use of the Kaiparowits Plateau, and probably had a storage function, perhaps mainly for wild resources such as pinyon nuts, given that most of these features occur in unlikely farming areas.

Stone Circle

Feature 1 at site 42KA4717 on Horse Mountain is the only observed example of this feature type. It consists of a circle of large quartzite cobbles 3.5 to 4 m in diameter. There is a slight berm associated with the cobbles encompassing about two-thirds of the circle. On the south side of the feature is a possible opening approximately 1.5 m wide. The stone circle may be the remains of a Paiute wickiup, but no diagnostic artifacts from this time period were seen. The feature lies in the middle of a light-density scatter of flakes and bifaces, including an Elko Series projectile point. Although the circle looks fairly formal and symmetrical, it may be natural, perhaps the result of tree root displacement.

Granaries

The Kaiparowits Plateau Survey recorded six granaries. Given the Anasazi presence on Collet Top, it is no surprise that four of these features occur in this stratum; the other two are located on Long Flat and Smoky Mountain. Examples of these features showing different degrees of preservation are shown in Figure 6.54.

Site 42KA 4823 on Long Flat is a rockshelter with a north aspect above Tommy Water Wash that contains a partially intact granary (Figure 6.54a). The feature measures 1.5 m from front to back and may have been up to 1.75 m wide. Only one wall still stands at a current height of 75 cm with five courses. The wall is single width, of unshaped local sandstone set with abundant whitish day mortar (available in the wash bottom below the site). The approximate mix of half mortar and half stone is characteristic of these features on the Kaiparowits Plateau. Branch impressions can be seen in several mortar fragments. The granary was probably roofed with day over timbers and thatch and did not reach to the height of the shelter ceiling; no clay remnants are visible on the ceiling. The doorway is within the only existing wall and is about 40 cm wide. Several flakes of purple quartzite occur on the florr of the shelter and on a ledge below the granary. Lithic tools include a core, a cobble chopper, a grinding slab fragment, and a pair of grinding slicks on an adjacent boulder. No ceramics are present, but a Formative age for the granary is certain based on its architec-

Figure 6.53. Example of an intact cist at 42KA4736, a rockshelter on Collet Top (20 cm arrow scale).

ture. Surveyors collected a corn cob fragment lying within the granary for potential radiocarbon dating. Also for this purpose they collected a chunk of mortar from the roof (with beam impressions) to recover organics. Disaggregation of this sample in water revealed a quantity of ricegrass seed. This seed is only available during a brief June to early July harvest interval, which suggests that the granary likely was constructed during early summer. It also may have been constructed, at least in part, to store the ricegrass harvest.

The best-preserved granary occurred at 42KA 5385, within a small shelter at the head of a canyon on Collet Top (Figure 6.54b). Unfortunately this feature was inaccessible; thus its measurements are estimates and we could not recover samples for dating. This feature is constructed of sandstone slabs and abundant mud mortar (the usual ca. 50/50 mix). It measures about 1 m high, 3 m wide, and at least 1.5 m deep. A stripped juniper pole with carbonized end is visible in the photo and another occurred next to it. These are perhaps roof supports and have the potential to be tree-ring dated. Below the small shelter with the granary are bedrock grinding slicks and two juniper logs that may have functioned as a ladder to provide prehistoric access.

On Smoky Mountain, 42KA5347 is a shelter that contains a small and poorly preserved granary distinguished by the copious amounts of mud laid between stones; again the construction is roughly half stone and half mortar. Site 42KA5376, on Collet Top, is an Anasazi shelter with two granaries, one dismantled and one partially intact. A mano and possible grinding slick are associated. Another shelter on Collet Top, 42KA5416, harbors

Figure 6.54. Examples of granaries recorded during the Kaiparowits Plateau Survey: a) an eroded example at 42KA4823 under a small shelter on a ledge above Tommy Water Wash on Long Flat, b) a nearly intact and inaccessible example at 42KA5385 in a shelter at the head of a small canyon on Collet Top.

a highly eroded granary that appears to have been divided into two enclosures; the largest is nearly gone, and what remains is encrusted within a packrat nest. No artifacts are associated.

Rock Alignments

Rock alignments consist of rocks that usually appear to be the remains of a wall, but in some cases could be natural alignments of bedrock. On Smoky Mountain, a dry-laid wall within a shelter (42KA5308) may be of more recent origin than the prehistoric artifacts on the site. The sheltered Fremont site 42KA2253 on Collet Top contained an eroded wall fragment, in association with more substantial and intact masonry walls and a bell-shaped pit. Rock alignments, which may be wall remnants on open Anasazi sites, were also seen at 42KA5449 and 42KA5462 on Collet Top.

Rooms or Roomblocks

Except for one masonry dwelling with two rooms on Jack Riggs Bench (part of the Brigham Plains sampling stratum—Figure 6.55a), other formal rooms and roomblocks for living purposes occurred only on Collet Top (Figure 6.55b). The remains on Collet Top seemed to somewhat mimic findings from earlier survey on Fiftymile Mountain during the Glen Canyon Project (Aikens 1963; Fowler and Aikens 1963; Gunnerson 1959a). McFadden (1982) detected such a settlement during reconnaissance in the area and had forewarned us of what our pending discoveries might be. Still, the Puebloan structural sites came as a welcome surprise, one that helped round out the picture of prehistoric occupation on the Kaiparowits Plateau.

On Collet Top we documented a total of 18 sites with formal living structures, ranging from jacal rooms (42KA5452) to masonry and jacal roomblocks with up to eight rooms (42KA5435). All are associated with an Anasazi occupation that probably occurred between late Pueblo II and early Pueblo III, or McFadden's (2000) Fiftymile Mountain phase. All 18 of the structural sites occur in just three units (132, 189, and 190) on the Collet Top proper portion of the Collet Top sampling stratum. As a rule, masonry rooms and roomblocks are built of local sandstone blocks and slabs that appear to have been single width and wet-laid. Our judgment of abundant mortar use in masonry construction comes from wall fall with obvious large spaces between the slabs and blocks, spaces that would not have been there had the stones been dry-laid one directly upon the other. Based on in situ courses and wall fall, original wall height varied from low (ca. 1–5 courses) to full height.[9] The low walls probably served as footers to support brush or jacal superstructures. In a couple of cases (e.g., 42KA5435) the large amount of wall fall indicates full-height masonry, possibly of storage rooms. Structures are typically associated with middens, including a diversity of Anasazi pottery. Examples of the types of structural features encountered on Collet Top are described below.

Burned Jacal Rooms (42KA5452)

Site 42KA5452 has two extensive charcoal stains (Features 1 and 2) that appear to be the remains of burned jacal structures. Feature 1 is a fairly rich charcoal stain with large, burned jacal fragments, numerous burned and unburned sandstone slabs, several sherds, and a couple of cobbles that appear smoothed or abraded from rubbing against yielding material. The feature has the appearance of a roughly square structure—perhaps 3.5 m to a side. On the southwest end of Feature 1 are 3–4 adjacent, flat-lying slabs that may mark wall locations, such as upright slab basal supports or the remains of slabs from the roof. Feature 2 is a larger 9–10 m diameter charcoal stain to the east; this feature also has a substantial amount of burned daub—some almost fist size—with stick impressions in several cases. Also present are burned sandstone slabs and sherds.

Slab-lined Floor (42KA5450)

Feature 2 at site 42KA5450 consists of at least five large sandstone slabs that appear to have been laid to create a slab floor (Figure 6.56). Some of the slabs may have been shaped. The feature is up to 3 m long and 1.25 m wide, but may be wider if additional slabs to the southwest are included. The slabs seem to "fit" together too well for this to be natural, and are more flat lying than would usually be the case in nature. Presumably this is the slab floor of a perishable superstructure, a common occurrence at Virgin Anasazi sites according to McFadden (1996:22).

[9]Estimates of wall height on the Kaiparowits Plateau are complicated by two factors: (1) the abundant use of mortar, which often accounts for 50 percent of the wall fabric, so that five courses of masonry translates into a wall at least 10–11 courses high (each course of masonry separated by a course of mortar); and (2) the friable nature of much of the sandstone on the Kaiparowits Plateau, such that some masonry blocks once tumbled and lying on the ground could have disintegrated, at least to the extent that estimates of wall height are effected.

Figure 6.55. Examples of masonry structures recorded during the Kaiparowits Plateau Survey: a) tumbled masonry walls of two adjacent rooms built against a sandstone ledge and incorporating two small shelters at 42KA4733 on Jack Riggs Bench of the Brigham Plains sampling stratum; b) a single, detached masonry room at 42KA5379 on Collet Top.

Single, Detached Masonry Rooms (42KA5379 and 42KA5455)

A good example of a single detached masonry room is shown in Figure 6.55b; it occurs at site 42KA5379, and is the single architectural feature. The square masonry room has an interior measurement of about 3 by 3 m and is built of sandstone slabs and blocks gathered from the immediate vicinity. There are 1–3 courses of intact masonry, plus a fair amount of wall fall rubble. A break in the masonry at the southeast corner may be a door. Wall slabs measure up to 90 by 40 by 10 cm but most are in the range of 50 by 30 by 8 cm. The masonry shows no evidence of mortar, just small chinking stones. There does not appear to be enough rubble to represent full-height walls, so perhaps some was scavenged for use elsewhere, or the upper walls were built of wood or jacal. The interior fill is intact, so excavation could produce intact deposits and offer information on construction details. A bladed road pushed some wall fall from the south wall to the east, but did not disturb the room or most of the rubble.

Two types of single detached masonry rooms are present at 42KA5455. Feature 1 is a roughly square (ca. 4 m to a side) masonry room of unmodified local sandstone blocks and slabs. It is currently one course high, but wall fall covering a 1 to 1.5 m wide area suggests multiple original courses, though not full height. There is far less wall fall on the northwest side, which may have been open or of jacal. The stone elements probably provided basal supports for a perishable superstructure. Feature 2 is another masonry room, smaller than Feature 1, but with more substantial wall fall. In situ wall elements are not visible, but there are five or more courses of wall fall along the west side that have fallen over in a stack. The maximum dimensions of the wall fall are about 6.5 by 5 m, but the structure was certainly not this big. The walls are of unshaped sandstone blocks and slabs, currently mounded up to 50 cm above the present surface. There is charcoal-stained soil with small charcoal chunks visible among the rock, suggesting that the structure burned. Based on wall fall, this may have been a near full height masonry room, possibly partially subterranean; it may have served as a storage room.

Two-Room Masonry Roomblock (42KA5458 and 42KA4733)

Site 42KA5458 contains a two-room structure and the most substantial Formative midden found on the survey. Feature 1 consists of two attached rooms, forming a rectangular roomblock that faces the midden. Room 1 is on the north end of the roomblock, and is the more visible of the two rooms. The room appears to be roughly square and approximately 3.5 m to a side. The majority of the wall fall of this room is along the south wall, extending in quantity at least 2.5 m outward and continuing downslope to the south. There is lightly charcoal stained soil among the wall fall, suggesting that the room burned, but it could be spillover from an interior hearth or just the result of activity in and around the structure. Room 2 is attached to the first, with a masonry dividing wall in between. This room could be about the same size as Room 1. The original heights of the masonry walls are difficult to estimate but perhaps were only about five courses.

Site 42KA4733, an Anasazi Pueblo II habitation on Jack Riggs Bench (Figure 6.55a), is notable because it is the only other site with masonry architecture that we recorded outside of Collet Top (another Anasazi site with masonry rooms is situated just outside of the unit that contains 42KA4733). Features 1 and 2 are the remains of two adjacent masonry rooms built against a low sandstone ledge. The rooms—each about 2 by 4 m in size—incorporate two shallow shelters as their back walls. The masonry is all local sandstone slabs, which are very friable; some may be roughly shaped. It is possible that the lower 20 cm or so of the walls are preserved, covered by wall fall and sediment. Based on the fire reddening of the sandstone and heavy charcoal staining mixed with the wall fall, it is evident that both rooms burned. The walls have tumbled to grade, with no clear patterning to the fall. Mixed with the masonry is a sparse scatter of sherds, flakes, a few manos, and several flaked stone tools. There is a diversity of ceramic types and vessel forms, including serving and cooking containers. The rooms are situated directly in front of a drainage, so it is likely that much of the habitation trash has eroded away.

Multi-room Masonry Roomblock (42KA5435)

At site 42KA5435, also known as Gag House, there is a probable eight-room masonry and jacal roomblock evidenced by wall fall, scattered sandstone blocks and spalls, and burned mortar (see Figure 7.9). Three rooms appear to have been constructed entirely or almost entirely of full-height masonry (Rooms 2, 4, and 5). Given the spaces between masonry blocks evident in the wall fall it appears that abundant mortar was used in construction, much like the granaries in the

Figure 6.56. A slab floor for a probable brush/jacal structure (F3) at 42KA5450 on Collet Top. The visible portion measures 3 x 2.5 m, but may be larger when you include portions covered with sand and vegetation.

Figure 6.57. Along the east wall of shelter 42GA4763 is a series of deep grooves/slicks on the ledge. The grooves are in two areas: one with 7 grooves, and one with 13 vertical and 8 horizontal grooves.

area, which have roughly half masonry and half mortar. The other rooms appear to have been of jacal with masonry footers. The jacal rooms burned (indeed the entire pueblo evidently burned) leaving scatters of oxidized and fire-hardened clay and soil. Precise room counts are not possible for the burned jacals, but based on the size of the areas covered by the debris, there are perhaps five such rooms.

Other Features

This is a catch-all category that includes grinding slicks and grooves, poorly defined rock or wall alignments that may be natural or human-made, a groundstone concentration, and slab and artifact concentrations, usually with no or only very light charcoal stains. The 36 features in this category are randomly distributed across most strata; they cross-cut cultural lines, but certain "types" tend to cluster on specific strata.

On Collet Top, for example, 9 of the 10 features in this category are associated with Formative or known Virgin Anasazi habitations. One is a wall constructed by looters (at 42KA2253), two are grinding slicks, and six are scatters of slabs and artifacts that are difficult to define; they may be the remains of (1) eroded, unburned brush structures, (2) open activity areas, or (3) thermal features that have lost all charcoal due to deflation and erosion. The tenth feature is a possible rock alignment or wall within a very large, possible Archaic site that has been severely disturbed by chaining (42KA5461). The alignment may be simply a bulldozer push, or a cultural feature that is not affiliated with the preceramic artifacts at the site.

On Fourmile Bench, 7 of the 11 "other" features are at 42KA5466, a multicomponent Formative-Archaic site with numerous sketchily defined concentrations of burned and unburned rock, charcoal stains, and artifacts that mark various kinds of features (e.g., hearths) and use areas. Some of the features cannot be pigeonholed as to form or function; these tend to be scatters of slabs and artifacts that, as suggested above, could be the remains of structures, activity areas, or thermal features. Until further investigation, such features are lumped here as "other."

The remaining other features tend to be isolated examples of specific feature types, or poorly defined activity areas. Site 42KA5465 has an activity area that may have been part of a brush structure or shade, perhaps in association with the surrounding trees, which, if the site is of "recent" Paiute use (last 100–200 years), may have been standing. Site 42GA4763 is a rockshelter with sharpening grooves (Figure 6.57), and the Fremont site 42KA5279 has a possible activity area. Two possible upright slabs at the Fremont site 42KA 5411 may be either cultural or natural; there is a linear scatter of eroding slabs—some possibly burned—at the Formative site 42KA5517; and another Formative site, 42KA5554, also has a scatter of 15+ slabs.

Surveyors also observed the following: a partially slab lined feature (possibly a cist) of Post-Formative affiliation at site 42KA4572; a small concentration of unidentified carbonized remains (Feature 1) and a wad of cached grass stems (Feature 3) in a Post-Formative rockshelter at site 42KA4728; a probable Post-Formative mano cache and some FCR beneath a juniper at site of 42KA 4781 (the rest of the remains at the site may be earlier); a slab-lined cist or hearth (Feature 1) and concentration of partially burned slabs (Feature 2, probably an eroded slab-lined hearth) at 42KA 4824, a site of unknown affiliation; and five dispersed artifact or FCR scatters at the multicomponent Formative and Post-Formative site of 42KA 4827.

CHAPTER 7

SUMMARY OF NATIVE AMERICAN SITES

TEMPORAL ASSIGNMENT

Chronological placement of sites and other remains is one of the most essential concerns for archaeologists. It is also one of the most difficult problems during survey, especially in areas like the Kaiparowits Plateau where the majority of Native American sites comprise flaked stone artifacts. Temporal diagnostics are the currency of the survey archaeologist, creating a desire to find projectile points or sherds while recording sites, something to provide that all-important temporal bracket. How familiar it is while documenting a site to think, "I wish we could find a point or two." Unfortunately, it is all too common that there are no points, perhaps because someone removed them before the archaeologist chanced upon the site, or perhaps even more frequently because the original occupants were not kind enough to leave any in the first place. The outcome is the same no matter the cause: scores of "unknown" lithic scatters. Of course finding a projectile point or two does not necessarily solve the problem and in fact it can wildly misinform, enabling one to assign a time period to a site that is thousands of years off. We begin this portion of the report with a discussion of traditional temporal diagnostics used during the Kaiparowits Plateau Survey, with projectile points first, followed by ceramics. The point types collected or recorded during survey were described and illustrated in Chapter 6. The ceramic discussion is comparatively brief because just 11 percent of the recorded Native American sites have sherds and most of those have only a few.

Traditional Diagnostics

Projectile Points

Projectile points are the most important temporal markers for aceramic sites because no other stone artifacts have as much patterned morphological and technological variability with temporal implications. Surveyors made a diligent search at each site to locate these diagnostics, and of the 689 Native American sites recorded, points occur at 398 of them (58%). Of course, at many sites the discovered projectile points were undiagnostic fragments. The BLM contract allowed for collection of temporal diagnostics, both to enable laboratory analysis and consistent identification and to preclude the removal of these critical artifacts by relic collectors. Indeed, it became apparent during the course of fieldwork that sites across some portions of the Kaiparowits Plateau—Paradise Bench, Collet Top, and Fourmile Bench in particular—had been heavily picked over. We collected 398 projectile points, 315 from 208 sites and 83 additional points as isolated occurrences. Many point bases were left at sites,[1] usually small fragments often damaged by fire (crazed and spalled); these are both less likely to be removed by point collectors and less temporally sensitive because type identification is less certain. Crew chiefs described and typed when possible the point bases left in the field. The outlines of some of these point fragments were traced for later reference.

Field and laboratory classifications of projectile points were made principally on the basis of morphology according to existing point typologies for the northern Colorado Plateau (Holmer 1978, 1986; Holmer and Weder 1980) and Great Basin (Hester 1973; Thomas 1981). Several points were classified as Cortaro, a late Archaic point style identified in southern Arizona (Roth and Huckell 1992). We also identified a few points that were tentatively classified as Sand Dune Side-notched (Tipps, Hewitt and Lucius 1989:89–92; also Geib and Ambler 1991). Typological placement of points was made on observation alone, not on measurements and comparison with metric data such as presented in Holmer (1978). In making typological assignments in the laboratory, we had recourse to many published illustrations of projectile point types to help with consistency of identification. All of the collected specimens are illustrated by a series of photographs in Chapter 6;

[1]NNAD's point collection rate for sites was 32 percent: 315 of the 978 total points found at sites. Because a fair proportion of the total points were tip and midsection fragments as well as badly disfigured or otherwise undiagnostic base portions, the collection rate of typeable points was probably over 60 percent.

these should allow other researchers to evaluate our assignments and draw their own conclusions. Field classifications were made by crew chiefs with a good understanding of projectile point typologies and considerable experience working in the region.

Projectile point classification is one problem; another is placing temporal brackets around given point types. Dates derived from excavations on the northern Colorado Plateau are used for point types of the study area; proposed temporal spans for point types derived from research in the Great Basin or the San Juan basin are not used. We use projectile points to place sites into general temporal categories, with Archaic being the least specific but most commonly used category. Sites placed in this group usually have Elko Series projectile points. Elko points are perhaps the least temporally sensitive point class found on the Colorado Plateau, occurring from the early Archaic through the late Formative. Indeed, many archaeologists will not use Elko series points to assign sites to any temporal period. We propose that when Elko points occur on sites with patinated flake and tool assemblages (see patina discussion below), an inference of Archaic minimal age (ca. >2000 B.P.) is warranted. More specific placement within the Archaic period, however, requires other projectile point types: Pinto points, Northern Side-notched, and Sand Dune Side-notched for Early Archaic (ca. 9000–6000 B.P.; Humboldt Concave Base is another early Archaic temporal diagnostic but none were found during the Kaiparowits Plateau Survey); various high side-notched points (Sudden, Hawken, and San Rafael) for Middle Archaic (ca. 6000–4000 B.P.); and Gypsum points, McKean Lanceolate, and Cortaro for the late Archaic (ca. 4000–2000 B.P.). Temporally diagnostic arrow points included Rose Spring Corner-notched for the early Formative period (ca. A.D. 200–1000), Bull Creek, "Anasazi" short stemmed, and a few other arrow points excluding Desert Side-notched for the late Formative period (ca. A.D. 1000 to 1200), and Desert Side-notched for the Post-Formative period (ca. A.D. 1300–1900). Cottonwood triangular might be diagnostic of the Post-Formative period if these could consistently be separated from unfinished arrow point preforms and from Formative Bull Creek points. Because we were not confident of doing this for this project, we excluded this type as a temporal diagnostic.

Using projectile point types for temporal assignment is fraught with a series of well-known difficulties. One of these is the limited number of typeable point fragments that usually occur at any single site. Generally, just a point or two are found at any one site, unless of course the site is quite large. Large sites, though, appear to be the accumulation of many different use episodes and often have point types from different temporal intervals; thus, there still might be just a point or two for every use episode. It does little good to bemoan the low incidence of temporal diagnostics and ignore their inherent information value because of evident sample size inadequacies. We believe that it is preferable to assign a temporal affiliation based on a point or two than to relegate a site to the oblivion of unknown temporal affiliation. Moreover, as argued later, there may be relative dating evidence that can help bolster a temporal assignment based on diagnostic artifacts.

Another problem with temporal diagnostics is artifact recycling or heirloom bias, where later occupants of an area pick up more ancient artifacts for reuse. An excellent ethnographic example of this is the Huichol use of a fluted point in a curing ceremony (Weigand 1970) and an archaeological example is the notching and edge retouching of a Clovis point for evident use as a cutting tool (Hesse 1995). The Kaiparowits Plateau Survey generated its own good example of this problem with site 42KA4563 on Long Flat. While marking artifacts with pinflags in preparation for recording this site, six different Archaic dart points were found and we initially assumed an Archaic temporal affiliation. But inconsistencies became apparent during the detailed field examination of the lithic assemblage: first, there were almost as many points as flakes; second, the flakes were from simple core reduction, not biface reduction or pressure retouch; third, the flakes lacked a patina even though some of the points were heavily patinated; and fourth, there was a whole grinding slab and at all previously suspected Archaic sites such tools had long since weathered to nearly unrecognizable fragments. These concerns prompted an even more diligent search, which turned up a Desert Side-notched arrow point. We ultimately concluded that the Archaic points had been collected for reuse by Post-Formative foragers and that the site probably dated to sometime after A.D. 1300. We were perhaps lucky in this case, and had the arrow point not been found the site likely may have entered the site database as an Archaic lithic scatter. Careful attention to the remains in the field, however, can help to avert the error from recycling of temporal diagnostics.

One further problem deserving mention is Flenniken and Wilke's (1989) contention that projectile point types are poor temporal markers because of morphological change during the use-lives of dart points. They argue that point types represent sequential stages in point rejuvenation and that an array of point types of purported different time periods can result from the use, breakage, and rejuvenation of two basic archetypal forms: Northern Side-notched and Elko Corner-notched. Morphological change from breakage and reworking is something all point typologists should be cognizant of, but it does not preclude the use of point types as simple temporal markers (see Bettinger, O'Connell and Thomas 1991 and Thomas 1986b). Perhaps more significantly, some of the typological changes during point reworking proposed by Flenniken and Wilke might require different hafting arrangements—for example, the shift from a tie-on Elko point to a glue-on Gypsum point or from an Elko point requiring a foreshaft with a short notch to a Humboldt point that would have required a considerably deeper notch but more likely a split or socketed haft.

Ceramics

Pottery played a far less important role in making temporal assignments except for on Collet Top. Only 78 of the 689 sites (11%) recorded during the survey have ceramics and a fair proportion of these have just single sherds or a few sherds, usually from single vessels, with more than 60 percent having fewer than 10 sherds (48 of 78, 62%). Twenty sites have between 11 and 50 sherds, but in two of these instances it is evident that single jars are represented (pot breaks) and at one site 20 of 25 sherds are from a single vessel. Eight of the sites have more than 50 sherds and six sites have more than 100 sherds; all of these sites except one are located on Collet Top, and the other is on Fourmile Bench.

Identified pottery types are within Desert Gray Ware (Madsen 1977), Shinarump Gray, White, and Red Ware (Lyneis 1998), Tusayan Gray and White Ware, Virgin Series (Colton 1952), Tusayan Gray and White Ware, Kayenta Series, Tsegi Orange Ware, and Hopi Yellow Ware (Colton 1955). We also noted several sherds of untyped utility, whiteware, and redware vessels. The Desert Gray Ware types found during the survey are Emery Gray and single sherds of Snake Valley Black-on-gray and Snake Valley Gray. Emery Gray in this portion of Utah is considered an early Formative temporal diagnostic, produced from roughly A.D. 500 to 1000. This is based on radiocarbon dating of Fremont remains from the Escalante River basin and Kaiparowits Plateau (Geib 1996; Keller 2000; McFadden 2000). Emery Gray in other portions of the state has a considerably longer temporal span, but on the Kaiparowits Plateau, like in the Escalante River basin, Fremont occupancy seems to have ended by about A.D. 1000. In some cases, Emery Gray might date later, especially when found on sites with later Anasazi types, but sites that contained only Emery Gray were probably occupied in the latter half of the first millennium A.D. Snake Valley Black-on-gray is principally a Pueblo II type (late Formative); the single sherd occurred on a site (42KA4578) along with Shinarump Corrugated and North Creek Corrugated. Snake Valley Gray can date to the early Formative or later, but the one example of this type that we found was on a site with only Emery Gray and is thus considered early Formative.

The various Anasazi ceramic types found on the Kaiparowits Plateau all appear to date to the Pueblo II or early Pueblo III period, roughly A.D. 1050 to 1200, and likely not before A.D. 1100. Common types included Shinarump and North Creek Corrugated, Shinarump Plain and North Creek Gray, Virgin Black-on-white, North Creek Black-on-gray, and Kanab Red, Black-on-red, and Polychrome. North Creek Gray and Shinarump Plain can date much earlier than A.D. 1050, but on the Kaiparowits Plateau these types virtually always occur with later types on sites that lack evidence for earlier Anasazi components. Consequently our basic assumption is that sites with Anasazi pottery likely date to the documented time of Anasazi occupancy on the Kaiparowits Plateau, during what McFadden (2000) has called the Fiftymile Mountain Phase (ca. A.D. 1050/1100–1200).

Consistently there seem to be Virgin Anasazi sites with Pueblo II ceramic types that date later than A.D. 1200, such as Pottery Knoll (McFadden 2000; Neff, Larson and Glascock 1997).[2] There is, therefore, a chance that some of the Anasazi sites on the Kaiparowits Plateau might date later than we assume. Unfortunately, there is no way of

[2]Contrary to what Neff and others (1997:476) have claimed, the pottery assemblage at Pottery Knoll in no way "resembles Pueblo III assemblages of the Kayenta/Navajo Mountain area." The pottery styles at this site are Pueblo II and reveal a marked lag in stylistic development if the site actually dates to the Pueblo III interval.

knowing this based on the design styles. We did not, however, find any sherds suggestive of post A.D. 1200 Anasazi presence—no Tusayan Black-on-white or Tusayan Polychrome or other middle to late Pueblo III types. Indeed we did not find any Flagstaff Black-on-white or other whiteware with an analogous style. A single sherd at site 42KA 4769 was tentatively identified as Tsegi Black-on-orange, a Pueblo III type that usually dates after A.D. 1200. Because the type identification is tentative (and doubtful, see Chapter 6) and the sherd is worked (it could have been scavenged and recycled), its utility for temporal assignment is minimal.

Pueblo IV yellow wares (Jeddito Yellow Ware) have a general temporal placement of ca. A.D. 1300 to 1640, but more precise temporal placement is possible depending upon ceramic type, rim form, and sherd design styles (Hays 1991). Kelley Hays-Gilpin, an expert in Jeddito Yellow Ware, examined the two sherds of this ware collected during the Kaiparowits Plateau Survey. One is Awatovi Black-on-yellow (42KA4827) and the other might be this or early Jeddito Black-on-yellow (42KA4572). The former type has a date span of ca. A.D. 1300–1350, the latter ca. 1350–1640. Hays-Gilpin (personal communication 1999) thought that the Awatovi sherd probably dates toward the later portion of the time for this type based on its rim treatment. The sherd that was indeterminate between Awatovi and Jeddito likely dates somewhere in the mid A.D. 1300s.

Alternative Methods

Field crews on the Kaiparowits Plateau Survey endeavored to locate traditional temporal diagnostics at all archaeological sites, but they also employed several alternative means for judging the relative temporal placement of sites. The most important of these methods were patina on flakes and tools, especially those of chalcedony; various qualities that relate to the condition and scattering of remains, especially grinding tool fragmentation and weathering; and the presence/absence and relative size of charcoal on the surface of hearths and middens. Heavy carbonate accumulation as crusts on artifact surfaces also seemed to suggest some antiquity, but likely only if the crusts are relatively thick (ca. 0.5–1 mm). Laboratory analysis of collected sherds revealed thin crusts on these relatively recent artifacts. These alternative methods arose during the course of the Phase 1 survey through simple pattern recognition and most seemed validated when crosschecks with temporal diagnostics were available. Moreover, the utility of artifact patination for general temporal inferences is partially vouched for by an examination of patina on projectile point types (see discussion below). A critical trial of the alternative methods came with the small testing project conducted in conjunction with the Phase 2 survey effort and reported in Chapter 5. The test excavations obtained some chronometric verification that encouraged our use of the methods for Phase 2. A triangulation of several temporal indications can provide a strong case for relative temporal placement. Moreover, the various alternative methods provide a useful counterbalance to traditional diagnostics, allowing us to simultaneously consider additional strands of evidence. When a temporal interval suggested by traditional diagnostics is supported by alternative methods, we have greater confidence in the estimate. Future archeologists working on the Kaiparowits Plateau should be aware of these qualities and work to refine their application.

Patina

Patina was the most common indicator of relative age because nearly all sites of the Kaiparowits Plateau Survey have flaked stone artifacts. Patina refers to the chemical or physical weathering of flaked surfaces on artifacts made of cryptocrystalline silica (chert, flint, and chalcedony). Various types of patinas occur on flaked stone artifacts, with three general groups commonly recognized: desert varnish, glosses, and white discoloration (Rottlander 1975:107). These are each formed by somewhat different processes (Schmalz 1960; Shepherd 1972). The type of patina regularly observed during the Kaiparowits Plateau Survey is the whitish discoloration variety.[3] This sort of cloudy patina appears to develop most readily (or perhaps it is merely more obvious) on high-quality, semitranslucent siliceous rocks—those classified as chalcedony or that have similar qualities such as agatized petrified wood from the Morrison and Chinle Formations. The patina also occurs on opaque chert, such as the locally occurring Paradise chert/chalcedony. Figure 7.1 shows various examples of patina development on artifacts collected during the survey. All of the patinated artifacts are of chalcedony; the unpatinated Gypsum point is of red agatized wood.

[3]Gloss patina was noted on occasion, and one flake was collected from site 42KA4849 to study this sort of patina, which can be confused with gloss resulting from artifact heat treatment (see Figure 6.31).

Artifacts that are heavily patinated can have an actual depth of patina development, as shown in Figure 7.2, a close-up of the snapped barb on the point shown in Figure 7.1a. The white patinated layer can be 1 mm or more in depth.

The factors of white patina development have not been studied in the local environment of the Kaiparowits Plateau using the local cherts and chalcedonies, but this sort of discoloration is common worldwide on various kinds of chert and flint. Several studies (Schmalz 1960; Rottlander 1975; VanNest 1985) have demonstrated that white patination forms by a process known as desilicification, where silica near the surface of an artifact is dissolved by aqueous solutions. The surface porosity caused by silica dissolution increases the scattering of light, resulting in the optical appearance of a white rind (Rottlander 1975; Schmalz 1960). Of the host of environmental variables and stone properties that can influence the rate of white patina development (see listing in VanNest 1985:328), temperature and pH are known from laboratory experiments to be critical factors in silica dissolution. How these factors play out in the natural environment is not well understood. For example, do surface-exposed artifacts patinate more rapidly than buried artifacts, or vice versa? Nonetheless, it is clear that patination is a time-dependent process, and that observations on patina presence or absence and intensity likely have useful temporal information.

Various stages of patina development, from nonexistent to heavy, are evident on the Kaiparowits Plateau artifacts (see Figure 7.1), but our use of patination as a relative age indicator was mainly restricted to presence or absence observations: flakes are heavily patinated at this site and they are not patinated at this other site. Some sites have flakes with a fresh appearance—debris that looks as though the flaking was done yesterday. At several sites with unpatinated fresh-looking flakes, field crews also found Desert Side-notched projectile points or Hopi Yellow Ware sherds, indicating a Post-Formative age. The lack of patina was also noted at sites that lacked temporal diagnostics but had other indicators of relatively recent age such as hearths with surface charcoal. A uniform lack of patina, especially when accompanied by other indicators of relatively recent age, was usually considered adequate evidence for tentatively assigning a Formative or Post-Formative temporal affiliation.

At the other end of the spectrum are sites with flakes and tools turned milky white from what was certainly a considerable time of weathering. Some of the artifacts are so patinated that the original color and translucency of the raw material is obscured. At many of the sites with heavily patinated artifacts, surveyors found Archaic dart points, which were also patinated. In the case of Knife River Flint, moderate to pronounced patina is likely an indicator of at least an Archaic minimal age (Root et al. 1986:445–446). Based on our field observations this appears to be a reasonable expectation for the Kaiparowits Plateau as well. From what researchers have learned about patina formation on the relatively well studied Knife River Flint, a lack of patina does not necessarily mean recent age; even Paleoindian artifacts are frequently unpatinated (Ahler 1994:111; Root et al. 1986:440–446). An example from our survey is a probable Paleoindian stemmed projectile point fragment of agatized wood that lacks the white patina. The depositional environment clearly plays an important role—e.g., are the soils highly alkaline? Did ground water flow across the artifacts? Were there alternating periods of burial and exposure by deflation? Were artifacts affected by fires? We believe, based on our field observations, that moderate to heavy artifact patination generally provides a means to usefully assign sites to an Archaic minimal age even in the absence of other evidence. Such assignments are of course tentative, but better, we believe, than having numerous flaked stone scatters of unknown affiliation.

As an independent means of examining the utility of patina as a relative age indicator, we evaluated the extent of patination evident on the projectile points collected during survey. The four attribute states recognized are an absence of patina, and three steps in a progression of patina development—light, medium, and heavy. This evaluation had to be made for a variety of raw materials, which complicates the matter. Each face of each point was evaluated independently, but only the results of the most patinated faces are presented here. The degree of patina development was often best assessed by contrasting one face of an artifact against the other. All burned projectile points are excluded from this comparison because when high-quality silicates such as chert and chalcedony are burned they often turn milky white in color, making it impossible to accurately assess patination. Figure 7.3 shows two examples of refit projectile points where one portion was burned but not the other, illustrating how fire can whiten some stones to mimic patina. On a few burned dart points one face is white whereas the other is not, indicating differential patination and

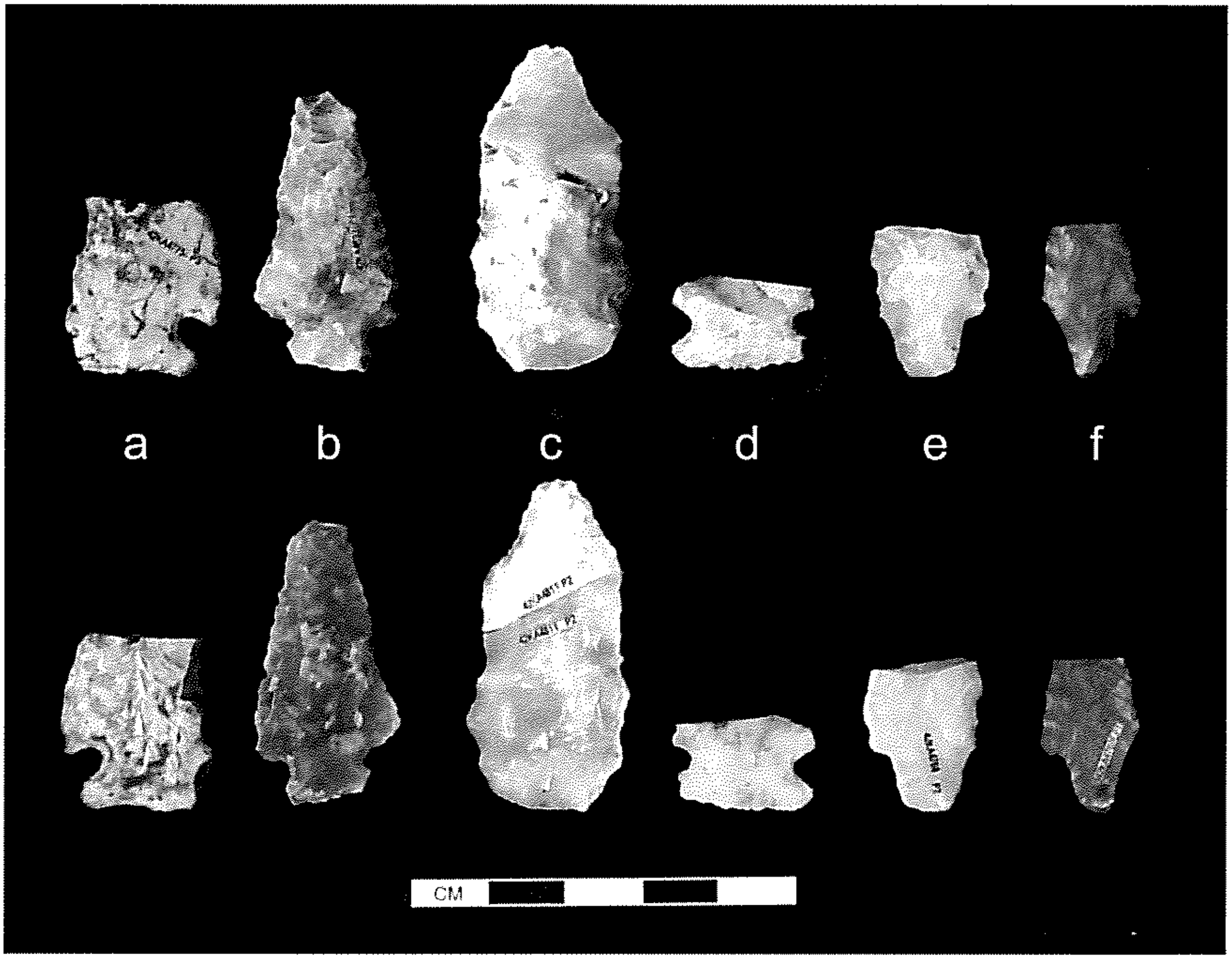


Figure 7.1. Various projectile points collected during the Kaiparowits Plateau Survey showing white patina: a) Elko Corner-notched point (P3) from 42KA4775 heavily patinated on both faces; b) point 1 from 42KA4633 showing differential patina between faces; c) an unfinished point (P2) from 42KA4811 broken in production by overshot but refit for this photo; point shows differential patina because the two fragments lay with different faces up; d) point 1 from 42KA4616 showing recent flake removal that is unpatinated; e) Gypsum point (P2) from 42KA4768 to contrast patina development on the other Gypsum point from this site shown as f; f) unpatinated Gypsum point (P1) from 42KA4768.

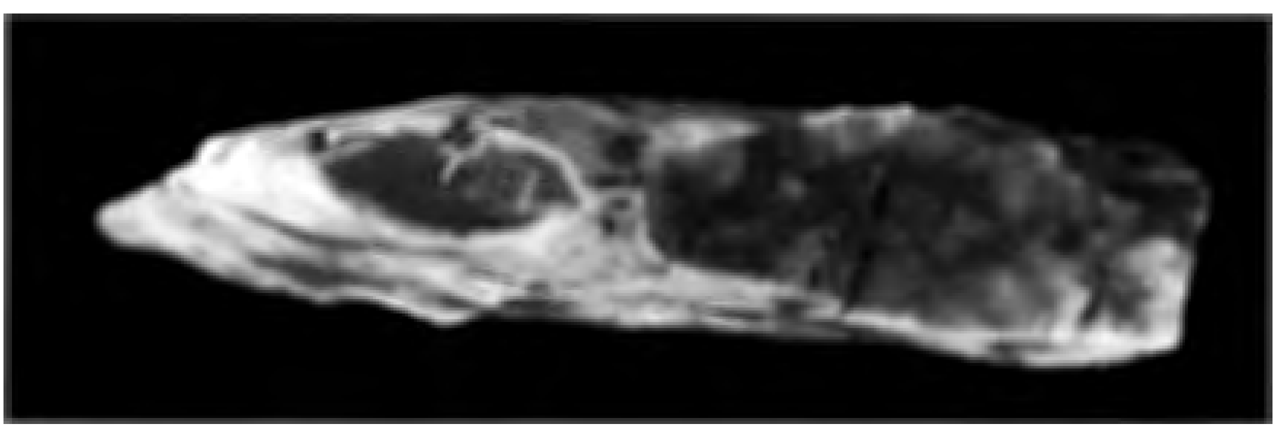


Figure 7.2. Close-up of snapped barb on the heavily patinated point shown as Figure 7.1a. This recent break shows a depth of patination that measures 0.5 mm.

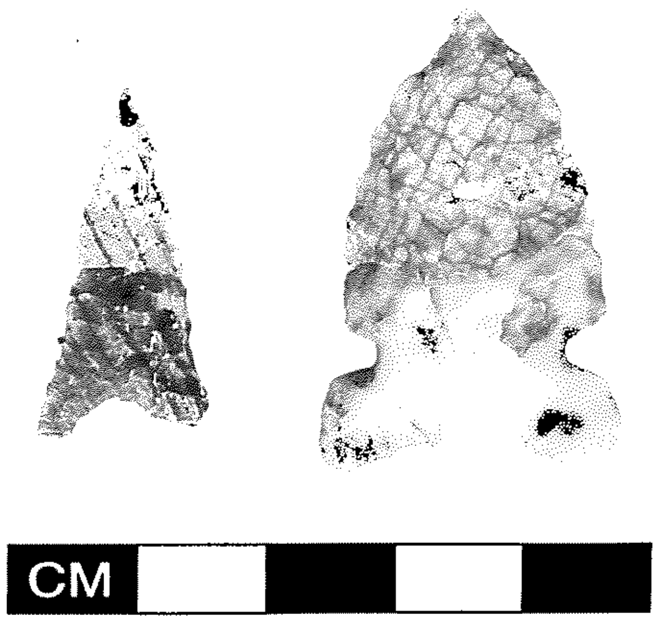


Figure 7.3. Examples of refit broken points that illustrate how burning produces a whitening that mimics patina. The top portions of both points had been exposed to fire some time in the past but not the point bases; left, an unfinished arrow point from 42GA4781; right, Northern Side-notched from 42KA5358.

the likelihood that burning had not altered our ability to make an accurate assessment. Nevertheless, it seems best to eliminate all burned points for this comparison. Table 7.1 presents the results of this analysis using several different point groupings. The points are first separated as dart-sized and arrow points. This shows that patina is absent on just over 60 percent of the dart points and more than 90 percent of the arrow points. Three arrow points (5%) have light patina and two have moderate patina, but none have heavy patina. In contrast, almost 20 percent of the dart points have moderate to heavy patina and another 14 percent have light patina.

A more useful method of looking at the data is by temporally diagnostic projectile points, those that may be placed within several broad temporal groups with a good degree of confidence. The point types used to form these groups are discussed in Chapter 6. Elko Series points are omitted from this comparison but are included separately as the third group in Table 7.1. Archaic points are presented as a massed set and are then divided into three general temporal subperiods of early, middle, and late for greater temporal resolution. There is a clear linear trend in the presence or absence of patina, with the oldest points having the highest likelihood to be patinated and the most recent points (Desert Side-notched) exhibiting no patina. The general trend of increasing patina development through time is evident even in the Archaic subperiods: more than 50 percent of early and middle Archaic points have some patina, compared to 42 percent of late Archaic points.

Elko Series points are patinated somewhat less than Archaic points overall, which is perhaps indicative of the wide temporal span of this point type. Elko Eared points, however, are more patinated than points in the rest of the series. This is the one type within the Elko Series that seems to have a greater degree of temporal specificity and the patina data seem to support this. The extent of patina development on Elko Eared points is comparable to that of known early and middle Archaic points. Because Elko points could have been made 7000 years ago or 500 years ago (see Holmer 1986), many researchers do not consider them temporal diagnostics. When Elko points occur at sites with patinated debitage and tools, an Archaic temporal affiliation seems likely. In these instances two separate lines of evidence converge. Conceivably, with a better understanding of patina development on materials local to the Kaiparowits Plateau, we might be able to differentiate among early, middle, and late Archaic sites containing Elko points.

Table 7.1. Summary comparisons of white patina on projectile points collected during the Kaiparowits Plateau Survey. Burned points are excluded because burning precludes accurate evaluation of patina (burning often discolors chert and chalcedony, making it appear white).

	Absent		Light		Moderate		Heavy		Total	
Projectile Point Groups	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
All Arrow Points	62	92.5	3	4.5	2	3.0	0	0.0	67	100.0
All Dart Points	194	62.0	51	16.3	43	13.7	25	8.0	313	100.0
Total	256	67.4	54	14.2	45	11.8	25	6.6	380	100.0
Paleoindian	8	66.7	0	0.0	1	8.3	3	25.0	12	100.0
Archaic	46	52.9	17	19.5	16	18.4	8	9.2	87	100.0
Early Archaic	(11)	(47.8)	(6)	(26.1)	(4)	(17.4)	(2)	(8.7)	(23)	100.0
Middle Archaic	(10)	(47.6)	(6)	(28.6)	(1)	(4.8)	(4)	(19.0)	(21)	100.0
Late Archaic	(25)	(58.1)	(5)	(11.6)	(11)	(25.6)	(2)	(4.7)	(43)	100.0
Formative	31	88.6	2	5.7	2	5.7	0	0.0	35	100.0
Post-Formative	18	100.0	0	0.0	0	0.0	0	0.0	18	100.0
Total	103	67.8	19	12.5	19	12.5	11	7.2	152	100.0
Elko Series (C/S-notched)	9	81.8	0	0.0	2	18.2	0	0.0	11	100.0
Elko Corner-notched	53	70.7	12	16.0	4	5.3	6	8.0	75	100.0
Elko Side-notched	31	72.1	6	14.0	5	11.6	1	2.3	43	100.0
Elko Eared	14	48.3	7	24.1	5	17.2	3	10.3	29	100.0
Total	107	67.7	25	15.8	16	10.1	10	6.3	158	100.0

The potential for using degrees of patina to differentiate remains from within the long span of the Archaic period is exemplified by site 42KA 4768 on Paradise Bench (Horse Mountain sampling stratum). This site is a relatively small and moderately dense scatter of debitage and several flaked stone tools on a sheet-washed and deflated gentle slope (Figure 7.4). The debitage is dominated by biface reduction debris from middle to late stages, including some pressure flakes. The flakes are patinated, but some more heavily than others. Most tools are projectile points, including two Gypsum points, two Elko points, and two probable Northern Side-notched points. An Archaic affiliation is supported by both the projectile point types and artifact patina; the points and patina also suggest that foragers used the site on at least two separate occasions, first during the early Archaic (Northern Side-notched and heavily patinated artifacts) and then during the late Archaic (Gypsum points and moderately patinated artifacts). The possibility of two, if not three, separate occupancies during the Archaic is indicated by the spatial grouping of each point type. Unfortunately, we did not record whether there was any spatial coincidence between the point groupings and degrees of flake patination, information that could further support the multiple-use scenario. That different materials potentially patinate at different rates is demonstrated by the two Gypsum points—one of chalcedony is moderately patinated on one face but the other of agatized wood is not patinated at all (see Figure 7.1e, f).

Three collected arrow points are lightly patinated, with two shown in Figure 7.5. One of these is classified as Rose Spring, thus it probably dates prior to A.D. 900 (Holmer and Weder 1980) and the other two are untyped side-notched of unknown age. This indicates that some arrow points can be patinated and that one must consider the relative degree of artifact patination as well as the extent of patina development on associated artifacts.

The utility of patina as an indicator of different age occupations is all the more obvious when dealing with site assemblages that consist of patinated and unpatinated artifacts. For example, consider 42KA4756, an extensive scatter of debitage, flaked stone tools, grinding tools, and fire-cracked rock on Paradise Bench (see Figure 7.15). While recording this site, the field crew observed that most flaked stone artifacts across the site are heavily patinated, but near the center of the scatter is a dense concentration of unpatinated flakes. Besides the lack of patina, the flakes of the concentration are largely different in technology and raw material from the rest of the debitage. The concentration contains abundant pressure flakes and

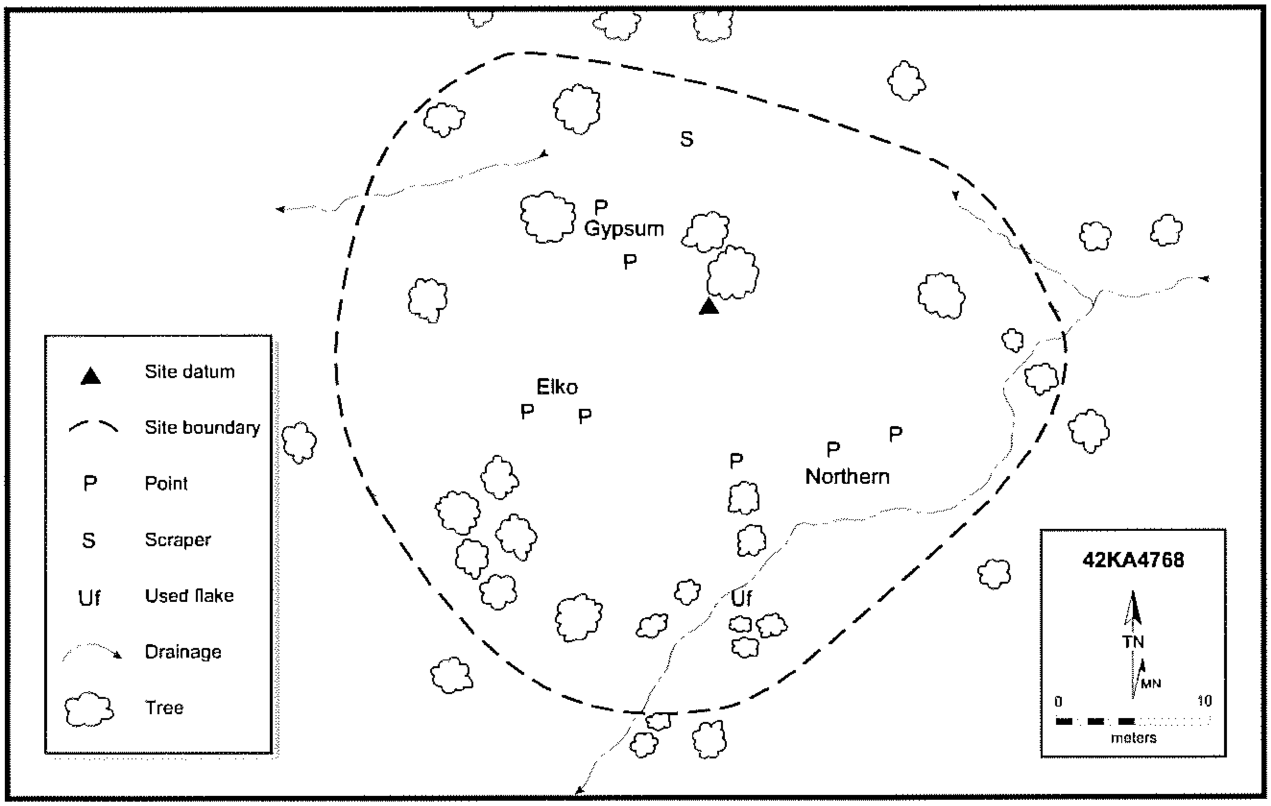


Figure 7.4. Plan map of 42KA4768 showing the find locations of three groups of different Archaic projectile points—Gypsum, Northern Side-notched, and Elko. The point type grouping likely results from three separate uses of the location during the long Archaic period. Artifacts at this site were differentially patinated and might be used to roughly segregate which remains belong to each of the three occupations.

percussion thinning and shaping flakes from very late stage bifaces (more than 500 flakes at densities of 20 per sq m). Most of the debris appears to be heat treated and consists of many exotic looking, colorful, high-quality silicates such as agatized wood and colored chalcedony. Across the rest of the site the patinated debitage is derived from a mixture of simple core reduction and biface reduction, with comparatively little emphasis on pressure flaking. The core reduction debris is mainly derived from cobble choppers and scraper planes made of coarse materials such as quartzite and metasediment; much of this is encrusted with carbonate. The crew thought that the site consisted of two overlapping sets of remains from different periods and eventually confirmed this when an assiduous search of the dense pressure flake concentration turned up Formative arrow points. In this case, differences in patina suggested the possibility of two temporal components, then distinct differences were noted in reduction technology and strategies and raw materials, and finally a diligent search revealed arrow points within the suspected later component scatter.

In this example, surveyors found temporal diagnostics to confirm that the concentration of unpatinated flakes within a larger scatter of patinated debris derived from use of the site during the Formative period, probably on a hunting excursion. There are other cases, though, when temporal diagnostics were not found to confirm the suspected comparatively recent origin of unpatinated flakes. Consider site 42KA4760, a small but moderately dense concentration of several hundred flakes and a half dozen flaked tools appearing in a deflation basin on Paradise Bench. Differences in flake patination raise the possibility of two occupations widely separated in time. Just as with the 42KA4756 example above, there are many unpatinated pressure flakes that appear quite freshly flaked; the same is true for some of the large percussion thinning flakes. Likewise, many of the pressure flakes are of agatized wood or other colorful chert or chalcedony that seem exotic. The patinated flakes are mostly of Paradise chert and chalcedony and appear to be larger and

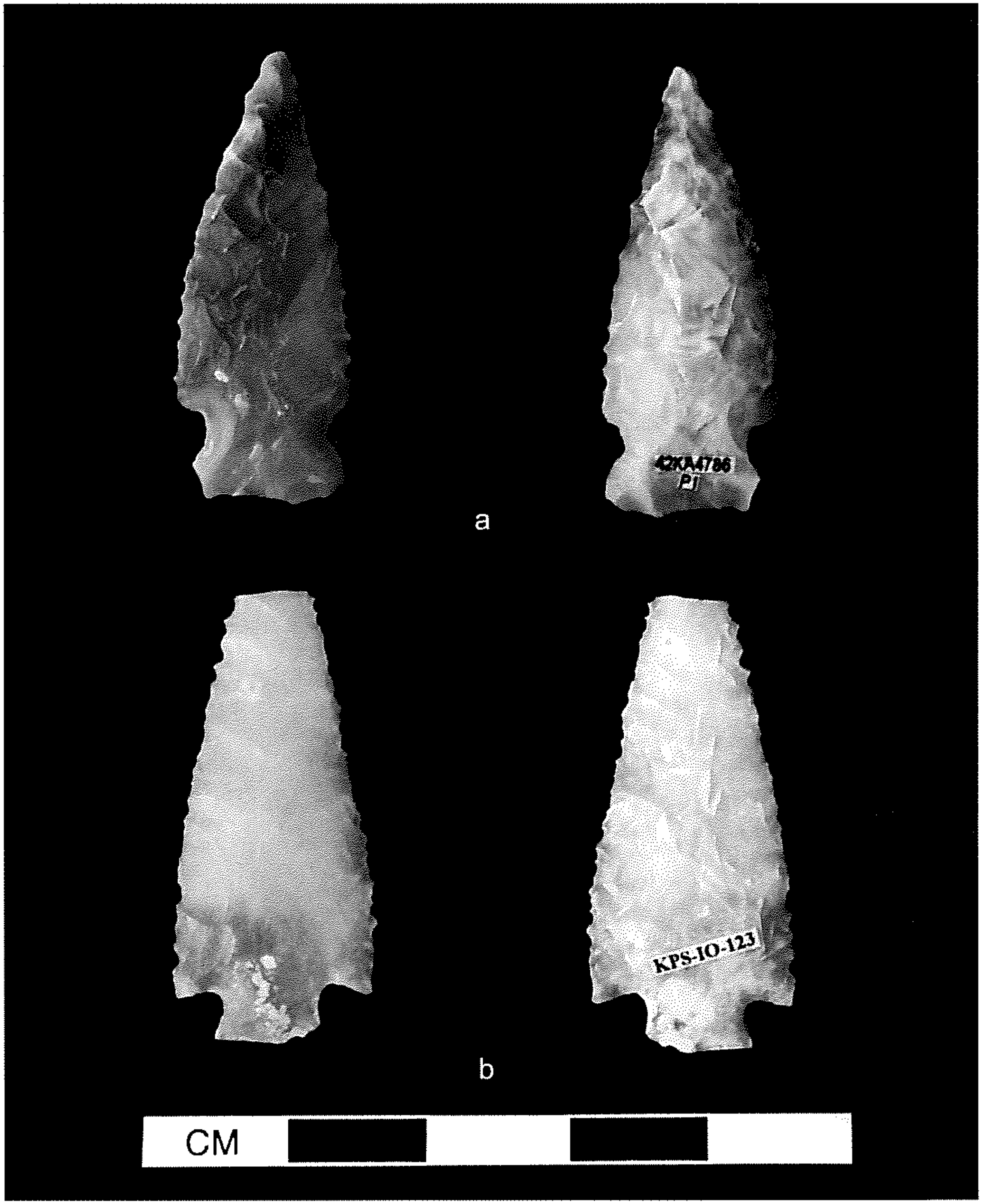


Figure 7.5. Two arrow points collected during the Kaiparowits Plateau Survey that are lightly patinated on one face: a) an untyped side-notched point (42KA4786, P1) of agatized wood, b) a Rose Spring Corner-notched point (IO123) of chalcedony.

chunkier, derived from core and early stage biface reduction as well as late stages of biface thinning. A probable Elko point base that is snapped across the notches occurs at the site; this tool and a few others are patinated but other tools lack patina. Unfortunately, a careful search of the surface did not reveal any arrow points. Our interpretation of the evidence is that the site consists of Formative or more recent remains partially intermixed with Archaic remains.

Patina is also a useful indicator for the recycling of old artifacts by more recent occupants to make new tools. Figure 7.6 illustrates three nice examples. The drill, which we found as an isolated occurrence (IO184), is made on a heavily patinated, notched point (probably Elko Series). The notches and base are unmodified, but the blade was pressure flaked to fashion a drill bit and in the process nearly all of the patina was removed except for a small patch on one face. Next to the drill is an arrow point preform snapped by a perverse fracture during pressure flaking (refit for photo). This tool was made on a patinated flake, with the pressure flakes removing the patina. Because of the depth of patina penetration (see Figure 7.2), the new flaking has not totally removed all of the patina. The third tool is an arrow point from site 42KA4578 that is made on a patinated flake of agatized wood. Flake scars have removed most of the patina from both faces; on the face shown is a small unflaked patinated portion of the original flake blank toward the base. This point comes from a small artifact scatter interpreted as a temporary residential camp that contained several Pueblo II pottery types.

Admittedly, there are many unknown factors that complicate using patina as a relative age indicator. For example, it seems evident that artifacts on the surface patinate more quickly than those below the surface. This is indicated by artifacts with heavily patinated surfaces facing up but lightly patinated surfaces facing down. Therefore, if the remains of a single-component site have been differentially surface exposed for long periods of time, there well could be contrasting patinas that might be mistakenly interpreted as resulting from different occupations. Another complicating factor is soil pH, which experimental

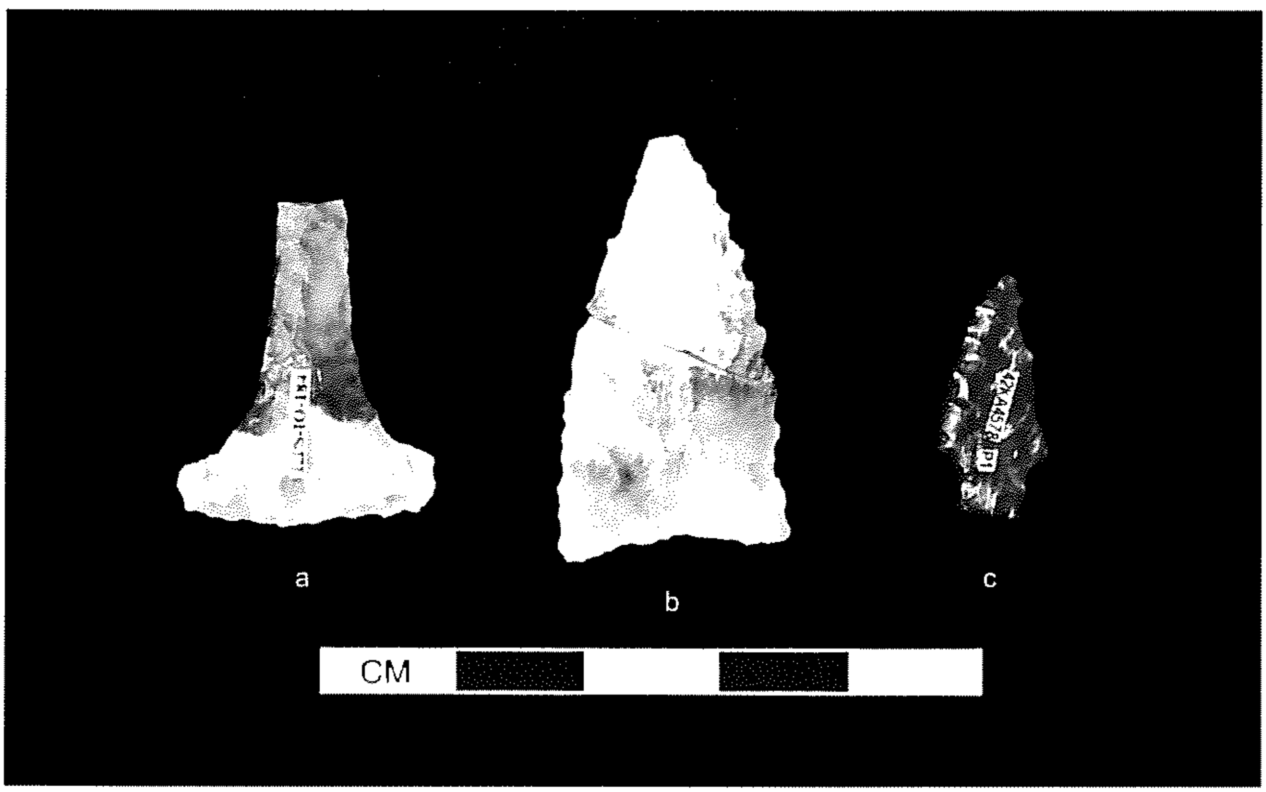


Figure 7.6. Three artifacts from the Kaiparowits Plateau Survey made on recycled patinated tools and flakes: a) a drill (IO184) made on a patinated notched dart point (Elko?); b) an arrow point preform (42KA4701, P3) made on a patinated chert flake; c) an arrow point (42KA4578, P1) made on a patinated flake of agatized wood.

studies have shown to be a critical controlling variable in white patina development (see VanNest 1985). Burial in soil horizons with different pH conditions, differential exposure to alkaline ground water, or occurrence in areas with completely different parent geology, such as the Kaiparowits Formation and the Entrada Sandstone, could all affect the rate of patina development. Also, different materials seem to patinate at dissimilar rates. Considerable research is clearly called for with local materials in the local environment before patina can provide straightforward simple answers to the question of relative temporal placement. That the method has potential merit is attested to by examples such as site 42KA4756 mentioned previously. Ignoring patina results in a potential loss of information about relative age, about multiple occupancies, and about artifact scavenging and recycling.

Carbonate Buildup

Caliche crusts on artifacts are another potential relative age indicator that surveyors became cognizant of during the second and third field sessions of Phase 1. The crusts result from secondary calcium carbonate ($CaCO_3$) accumulation. Carbonate crusts occur on sandstone grinding tools and cobble tools and flakes made of quartzite and other coarse materials (metasediment and various igneous rocks). Figure 7.7 shows examples of quartzite and metasediment cobble flakes with varying amounts of caliche accumulation on ventral or dorsal surfaces. In a few rare exceptions caliche crusts occur on flaked stone tools of finer-grained materials such as chert (examples include dart point tips at sites 42KA4756 and 42KA4762). The term "crust" is used because this buildup is not a surface stain but is a true layer of adhering material, sometimes 1 mm thick or more. This is clearly a postdepositional phenomenon because the calcium carbonate occurs on the flaked (produced) surfaces of cobble tools and flakes and on the use surfaces and broken edges of grinding tools.

Secondary carbonate likely accumulates on artifacts through the same combination of proc-

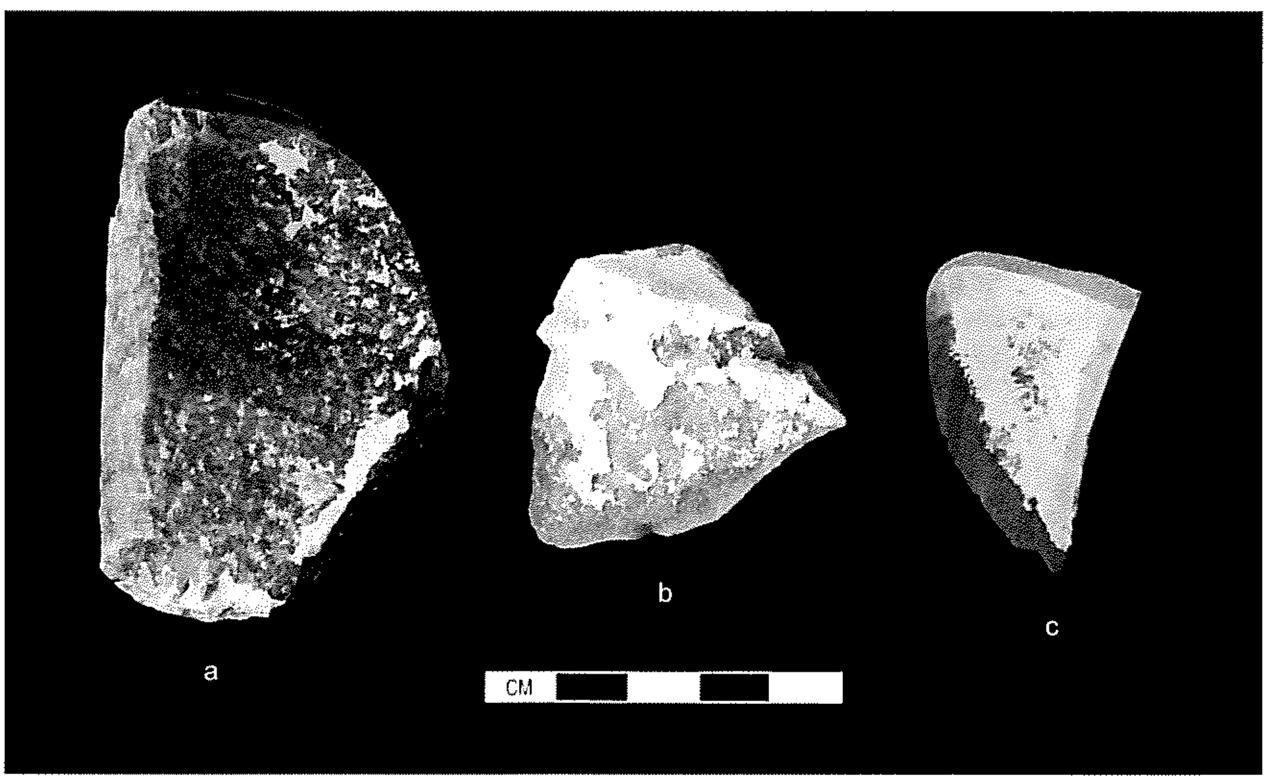


Figure 7.7. Carbonate crusts formed over the flaked surface of quartzite and metasediment artifacts: a) quartzite cobble tool resharpening flake reused as a chopper, ventral surface shown (42KA4845, F1); b) quartzite cobble flake, ventral surface shown (42KA 4808); c) a metasediment cobble flake split down the axis of force, ventral surface shown (42KA4827, F4).

esses that geologists propose to account for carbonate accumulation in soils (Goudie 1973). Principal among these for the Southwest are $CaCO_3$-rich ground water and an airborne supply from Ca^{++} enriched rainfall and solid carbonate in aerosolic dust, silt, and eolian sand (Gile, Peterson and Gossman 1966, 1979; Machette 1985:7–8). Ground water can deposit secondary carbonate at a rapid rate, as evidenced by centimeter-thick laminae on highway drainage culverts (Bachman and Machette 1977). Thus, if this process were responsible for carbonate crusts on Kaiparowits Plateau artifacts, there would be little or no temporal significance to monitoring this variable. None of the artifacts with caliche crusts that we observed occur in geomorphic positions where ground water deposition of carbonate could be involved, such as in a drainage bottom or near a seep or spring. Caliche-encrusted artifacts most commonly occur on slight topographic highs relative to the surrounding terrain, such as low ridges and knolls and usually on eolian sand. It seems likely, therefore, that the secondary carbonate on artifacts resulted from calcareous dust and Ca^{++} dissolved in precipitation. As precipitation evaporates from artifacts, the dissolved Ca remains to form a crust.

Geologists have empirically studied and theoretically modeled secondary carbonate accumulation in soils to derive quantitative measures for estimating age based on carbonate content (e.g., Machette 1985). The empirical studies of soil carbonate show that accumulation rates vary over time and across space, but in general the greater the time depth, the greater the carbonate content, such that stages of carbonate accumulation can be used to correlate and differentiate Quaternary sediments. Unfortunately, we do not know of any studies of carbonate accumulation on artifacts designed to provide temporal estimates. Geologists assume that it takes thousands of years for airborne carbonate to coat pebbles and cobbles in soil profiles; thus, similar lengths of time may be involved in the coating of artifacts. This was our working hypothesis during the survey, one that seemed to hold up because artifacts with heavy carbonate accumulations generally occur at sites that also have other lines of evidence, such as projectile points and patination, suggesting an Archaic affiliation. Thus, caliche deposition appeared to provide a supporting role for making temporal assignments: an Archaic temporal affiliation would be suspected based on projectile points or other remains and the presence of carbonate crusts reinforced this inference. The site forms at times mention this line of evidence in the dating discussion. In a few rare cases, tentative Archaic assignments were made on caliche crusts alone in the absence of other evidence. The laboratory analysis of collected sherds, however, revealed thin and small carbonate crusts on Emery Gray, various Virgin types, and even on the edges of an Awatovi Black-on-yellow sherd. This indicates that carbonate can accumulate on artifacts of relatively recent age and that this method requires considerably more study before it can be usefully applied. The presence of heavy and thick carbonate encrustation may still have some temporal implications, but again more research is needed. As a further cautionary note, carbonate-encrusted artifacts are far more prevalent at sites situated where the Kaiparowits Formation forms the bedrock (Long Flat, Horse Mountain, and portions of Fourmile Bench and Horse Flat), thus bedrock geology may play an important role in whether or not carbonate crusts form and to what extent.

Condition of Remains

Hearth Charcoal. This technique is based on charcoal degradation through time from both mechanical processes such as roots and animals and from wetting and drying, freezing and thawing, and the like. As survey crews encountered and recorded hearths or other probable thermal features (e.g., fire-cracked rock concentrations) during the Kaiparowits Plateau Survey, patterns emerged as to the surface occurrence (presence or absence) of charcoal and its size. A modern baseline of this criterion is the campfires of recent visitors from the 1960s onward that occur throughout the region. These unrecorded features have abundant surface charcoal in them, often as quite large pieces. Stepping back several hundred years in time are the hearths of Post-Formative Paiute occupants. At these, such as at site 42KA4797 on Jack Riggs Bench, charcoal is still visible on the surface, although in smaller pieces than seen on modern hearths, usually no bigger than a fingernail. Often as well, in and around Post-Formative hearths, there are surface fragments of burned and unburned bone, some relatively large. Further back in time are hearths of the Formative period, such as those recorded at 42KA4749 on Paradise Bench. At sites of this time period surface charcoal occurs as small flecks and pieces. Of course, immediately below the surface there can be small charcoal chunks with even larger pieces at further depths, but unless recent erosion or disturbance

has brought charcoal to the surface, hearth fill appears as charcoal stains and not as charcoal pieces. Hearths at sites of an even earlier age lack surface flecks, and even below the surface, using a shallow trowel probe, charcoal pieces are not readily apparent; rather the fill appears as homogeneous black or dark gray charcoal-stained sediment.

Certainly some of the variability in charcoal preservation is due to how the features were used—a hearth used for roasting might have better chances of charcoal preservation than one used for warmth and grilling meat due to differential exposure of coals to oxygen. Different fuels might be an even more important factor in charcoal preservation: for example, sage charcoal appears to degrade more quickly than pinyon charcoal. Because most of the features that we recorded on the Kaiparowits Plateau occurred within dense pinyon-juniper woodland, it is likely that fuel differences were negligible. The patterning of charcoal preservation with relative age observed on the Kaiparowits Plateau seems to hold up when other age checks were available. It is also worth mentioning that excavations along the N16 road on the nearby Navajo Reservation have enabled the authors to assess the degree of charcoal degradation against radiocarbon dates. At early Archaic hearths (ca. 9000–6000 B.P.) charcoal is nearly reduced to dust and only minute pieces are left intact (usually such features are dated by AMS). In contrast, Basketmaker II hearths dated some 3000 to 1800 years B.P. contain lots of well-preserved charcoal. If these features are exposed on the surface, however, they tend to lack surface charcoal pieces (Geib et al. 1995, 1997).

We are convinced of the general accuracy of the method as long as survey crews factor in disturbances that might have recently brought charcoal to the surface. Use of this method involved observing whether charcoal pieces are present or absent and, if present, what size the pieces are. As confirmed by testing (see Chapter 5), hearths with charcoal chunks on the surface are quite likely to be Post-Formative in age. Further back in time are hearths of the Formative period, such as those at the tested sites of 42KA4749 and 4750 on Paradise Bench. Surface charcoal in hearths of this time period appears to most frequently occur as small flecks and pieces. Of course, charcoal chunks exist immediately below the surface on Formative age sites, so evaluation of recent disturbance is important. Hearths that lack even surface flecks are likely older than the Formative period, such as the tested basin hearth at 42KA4547 that has a two-sigma calibrated radiocarbon age of 380–165 B.C. The Archaic hearths appear as black or dark gray charcoal stains and even subsurface they can contain just tiny eroded charcoal pieces.

Grinding Tools. This relative dating method involves making observations about various stages of grinding tool degradation. During the course of the Kaiparowits Plateau Survey, it became apparent that grinding tools, particularly grinding slabs, are variably preserved (Figure 7.8). Grinding tool degradation is the result of fragmentation (breaking across bedding planes), exfoliation (splitting along bedding planes), and the weathering of use-worn surfaces (chemical and physical weakening of cement resulting in loss of rock). The first two processes have less effect on manos, but many have at least one badly weathered use surface. At some sites grinding slabs are broken into small fragments 10 cm square and exfoliated along bedding planes to a thinness of 1 cm or sometimes less. Additionally, the use surfaces or broken surfaces of these fragments are coated with a thick layer of carbonate. In contrast, grinding slabs at other sites are complete or occur as large portions.

This sort of tool disintegration appears to have an important temporal dimension: the longer tools are exposed to the forces of nature the more degraded they become. The type of material that tools are made from is, of course, an important consideration. Some local sandstone such as that from the Kaiparowits Formation is quite friable, likely because of weak calcite cement, whereas other sandstone is nearly indestructible. An example of the latter is silicified purple sandstone from the Straight Cliffs Formation (fused in coal fires). Nonetheless, sites with the most severely fragmented grinding tools commonly have other evidence suggesting an Archaic age, principally temporally diagnostic projectile points, but also heavy flake patina and carbonate crusts. Indeed, in nearly every instance highly fragmented grinding slabs are also encrusted with caliche. Some sites with large grinding slab portions or whole slabs have other evidence suggesting a fairly recent origin. At 42KA4563, a Post-Formative age is supported by the presence of a Desert Side-notched point. Other sites with whole and well-preserved grinding slabs contained hearths with abundant charcoal pieces exposed on the surface. Two such examples were tested to provide independent chronometric dates: 42KA4732 on Jack Riggs Bench and 42KA4575 on Long Flat (see Chapter 5).

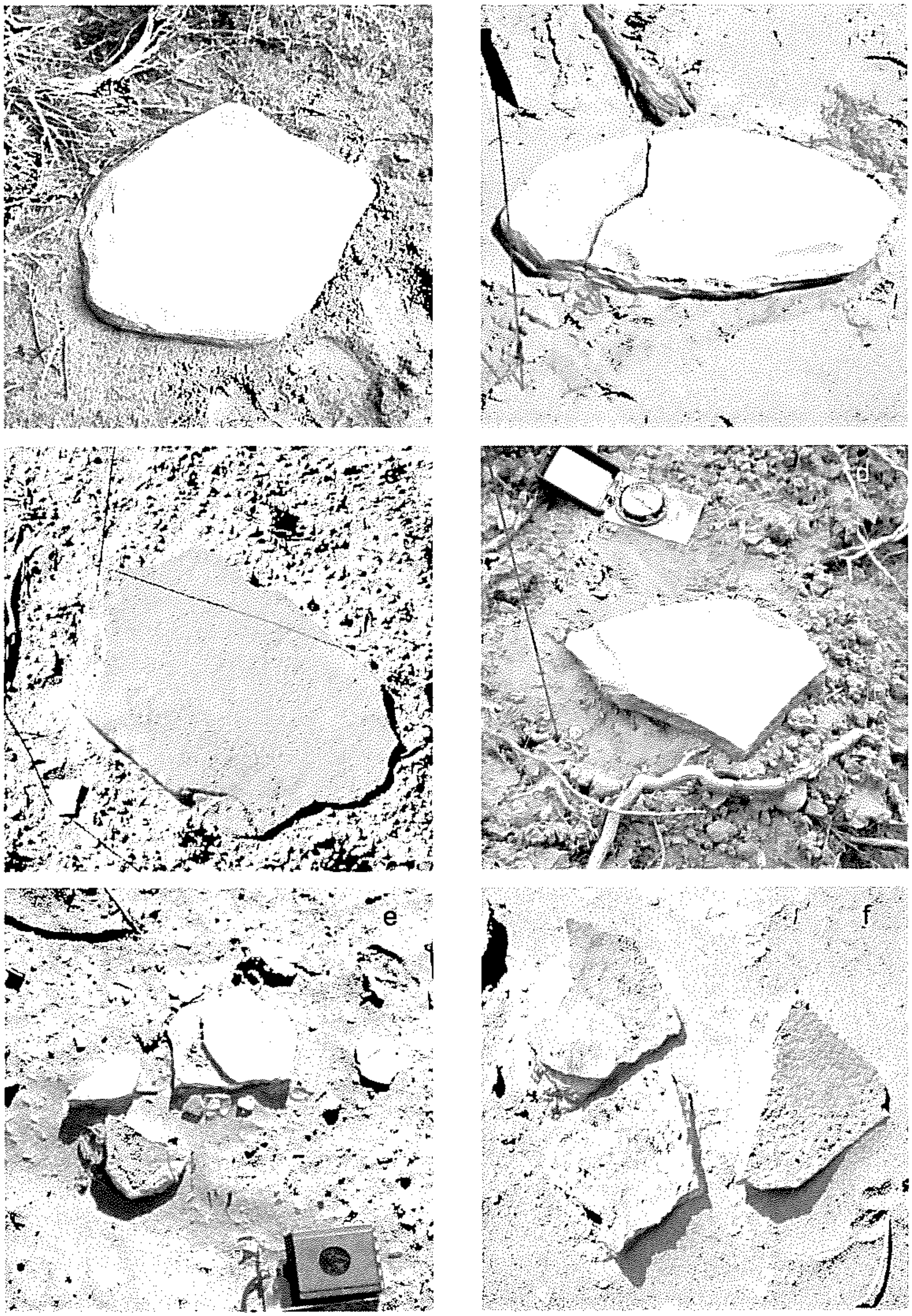


Figure 7.8. Examples of grinding slabs at Kaiparowits Plateau sites showing various stages of deterioration: a) whole and well preserved (42KA4575); b) fragmented but still essentially whole (42KA4840); c,d) pieces that represent halves or quarters of tools (42KA4708 and 42KA4640); e,f) small fragments often barely recognizable as grinding slabs (42KA4829 and 42KA4831).

42KA4732 has two of the best-preserved examples of grinding slabs found during the entire survey, but unfortunately we do not yet have a radiocarbon date from the one tested hearth at this site (no evidence was recovered to suggest an occupation earlier than Post-Formative). The tested hearth at 42KA4575, however, produced a two-sigma calibrated radiocarbon age of A.D. 1430–1630. Nearby the hearth at this small site is a whole grinding slab in excellent condition with fresh-looking pecking marks on its grinding surface; this site also has a large grinding slab fragment with a slightly exfoliated surface.

In contrast to the well-preserved whole grinding slabs are the small weathered fragments recovered from and observed on the surface of the tested midden at 42KA4552. These pieces are like those shown in the bottom row of Figure 7.8 (e and f). Wood charcoal from the midden has a two-sigma calibrated radiocarbon age of 2480–2330 B.C. In sum, it appears that the testing project verified our presumed temporal trend in grinding tool breakdown. Sites with fragmented tools that have badly weathered use-surfaces are likely to be Archaic in age, whereas sites with tools that were whole or nearly whole and with less weathered or even "fresh-looking" use-surfaces are likely to be Post-Formative. Sites with grinding tools between these extremes are more problematic, but might be Formative or Archaic-Formative transitional.

Table 7.2. Summary of the principal types of evidence used to make temporal assignments for 522 prehistoric components at 689 prehistoric sites. There are 222 sites that lacked temporal diagnostics, or surveyors did not record alternative evidence for temporal assignment; 55 sites have at least one additional component identified by some means, for a total of 744 assigned components.

Component	Count	Percent
First or Only		
Projectile points	236	50.5
Ceramics	68	14.6
Architectural style	7	1.5
Alternative (patina, etc.)	156	33.4
Total	467	100.0
Second		
Projectile points	23	41.8
Ceramics	10	18.2
Basketry	1	1.8
Alternative (patina, etc.)	21	38.2
Total	55	100.0
Total		
Projectile points	259	49.6
Ceramics	78	14.9
Basketry	1	0.2
Architectural style	7	1.3
Alternative (patina, etc.)	177	33.9
Total	522	100.0

Summary of Temporal Assignments

Based on various types of evidence, often in combination, we are able to assign a temporal affiliation to 467 of the 689 Native American sites (68%), with 222 sites left unassigned. Some of the unassigned sites were recorded during the first few field sessions, before survey crews became fully attuned to the possible alternative means of temporal assignment. The principal means for making these assignments are listed in Table 7.2. Projectile points are the most commonly used criterion (51% of all temporal assignments), with alternative methods, principally patina, used to assign 33 percent of the sites. Assignments based on alternative methods alone are generally considered provisional, which we marked on the site forms by following the suspected temporal affiliation with a question mark. There are 634 single-component prehistoric sites; this is the number of sites that lack obvious evidence of multiple components. By component we refer to broad temporal periods such as early Archaic or Formative; there is no necessary assumption that a component represents some coherent behavioral episode at a single point of time in the past—indeed most sites probably do not. At 55 of the 689 prehistoric sites, surveyors found convincing evidence for multiple components. The IMACS site form allows documentation of just two components, so information about a third component or more is difficult to track and is usually lost. We attempted to do this during the first phase of this project, documenting three sites with three components, but for the second phase we resigned ourselves to the two-component limit imposed by the IMACS form.[4] In all likelihood some of the recorded sites have more than two components. As we argue later in this chapter, some of the "single-component" sites are doubtless multiple component, but the evidence for this was not immediately apparent to the surveyors. Site size alone argues that some of these sites resulted from the deposition of multiple use episodes, likely over many millennia.

Of the total 744 prehistoric components recognized, 222 could not be assigned a temporal affiliation (Table 7.3). At some of these sites, further in-

[4]The site database that we used to generate numbers for this report (see Appendix B) only allows coding for two components just like the IMACS site form.

Table 7.3. Temporal affiliation of 744 prehistoric components at 689 Native American sites.

Temporal Affiliation	Count	Percent of Total	Percent of Identified
Unknown	222	29.8	—
Archaic general	232	31.2	44.4
Early Archaic	27	3.6	5.2
Middle Archaic	25	3.4	4.8
Late Archaic	37[1]	5.0	7.1
Archaic Total	321	43.1	61.5
Formative	117	15.7	22.4
Formative/Post-Formative	38	5.1	7.3
Post-Formative	46	6.2	8.8
Total	522	100.0	100.0

[1]One site included here as Late Archaic is listed on the site forms as Late Archaic/Formative based on feature type; for this report we have included it in the highest probability temporal period.

vestigation may reveal overlooked temporal diagnostics or other evidence for relative dating. Some of these also contain hearths or fire-cracked rock features that could be radiocarbon dated. Thirty-one percent of the sites are assigned to the Archaic period in general. Most of these contain Elko points along with patinated flakes and tools. Some are tentatively assigned to the Archaic based on patina or other alternative dating methods. Eighty-nine sites (12%) are assigned to specific intervals of the Archaic based on temporally diagnostic projectile points, which are discussed in detail in Chapter 6. What looks like an increase in sites through the Archaic subperiods (from early to late) is doubtless a spurious result because of our current inability to use Elko Series points for assignment to these three general intervals. Elko Corner- and Side-notched points are common at early Archaic sites of the greater Canyonlands region that encompasses the Kaiparowits Plateau. As a result, many early Archaic sites are likely listed as general Archaic. Elko Series points are common during the late Archaic as well, but so too are Gypsum points, so there is less chance for underrepresentation of late Archaic sites. Archaic sites substantially outnumber those of both Formative and Post-Formative periods, but upon factoring in the different temporal spans of these periods Post-Formative sites are most numerous. The Archaic period is on the order of 7000 years long, with 321 sites (0.046 sites per year), but the Post-Formative period is only about 500 years long with 32 sites (0.112 sites per year). Of course, far more Archaic sites are likely to have been lost from view or turned into background noise by erosion and burial than is the case with the most recent portion of the prehistoric archaeological record.

SITE TYPES

To conceive how past cultures might have used the Kaiparowits Plateau and how such use may have changed through time, we need a method for partitioning the range of site variability into groups that theoretically monitor aspects of settlement behavior. Our most basic interests are site function (i.e., residential vs. some sort of special purpose), how different functions were organized into overall subsistence-settlement systems, and the specific economic pursuits that were undertaken at various locations across the plateau. One way to pursue this goal is to create a site typology linked to the information of interest. Any site classification has its limitations, and these are all the more apparent and serious when site type assignments are made from survey data. There are problems with intercrew variability in observation, intersite differences in the surface exposure of assemblages and features, and a host of other concerns that may not apply, or apply with less effect, to site classifications based on data from detailed surface and subsurface studies accompanied by laboratory analyses of artifacts and other remains. Yet even with excavation data there can be a linkage problem between site type assignments and empirical data. Thomas (1986a:243) cautioned with regard to site types that "it seems preferable to exercise a degree of interpretive restraint than to blither on about what simply is not so." Although mindful of the need for circumspection with site typology, we believe that this approach has utility for providing an initial basis for describing and perhaps understanding settlement patterning.

We did not begin the Kaiparowits Plateau Survey with a predetermined site classification for assigning functional classes. Rather, we devised a typology after finishing the first phase of the survey and seeing firsthand what the archaeological record was like. This does not mean, however, that crew chiefs had no preconceptions as to potential intersite patterning in material remains and features, or how such patterns might be interpreted. Previous surveys on and around the Kaiparowits Plateau, such as the Escalante Project (Kearns 1982:197–202), provided some clear expectations as to the range of site variability and examples of how other researchers had partitioned and organized this variability. Moreover, the crew chiefs had

already grappled with the problem of site classification on various surveys within the adjacent Glen Canyon National Recreation Area (Geib, Fairley and Bungart 1986; Geib and Bremer 1996).

For the Escalante Project, which included the northwestern portion of the Kaiparowits Plateau, Kearns (1982:197–202) used two schemes, one purely descriptive and based on the presence or absence of specific artifact classes, and the other inferential. Other researchers in the general region have also separated descriptive attributes from functional inferences (e.g., Geib, Fairley and Bungart 1986:7–9; Tipps and Schroedl 1988:45–51). The seven artifact-based site types for the Escalante Project were as follows: Type I, sites with flakes and cores; Type II, same as I but also including bifaces or projectile points; Type III, same as I but also including flaked stone tools other than bifaces or projectile points; Type IV, same as I but including bifaces or projectile points and other flaked stone tools; Type V, same as any previous type but with the addition of grinding tools; Type VI, same as any previous type but with the addition of ceramics; and Type VII, other types of sites (rock art and a snare cache). These site types are of limited utility because they do not factor in features. Moreover, some of our sites could not be accounted for by this classification because virtually no sites were characterized by debitage and cores without tools (Type I) and there were few sites that did not contain some mixture of bifaces, projectile points, and other flaked stone tools. Even with the inclusion of associated features, such as for the Lower Glen Canyon Benches Survey (Geib 1989:47–49), the utility of descriptive types is best realized by providing an interpretive scenario that relates the archaeological facts to settlement behavior.

Organizational schemes based on inferred functions may have greater utility and are intuitively appealing because of their more direct link with the past behavior that is of interest for settlement studies. Like most recent examples of site typologies, that used by the Escalante Project grouped sites according to their inferred role in regional settlement-subsistence systems (Kearns 1982:197–202). There were seven principal site types and several subtypes, as follows: (1) limited activity workshops or camps; (2) hunting-related sites split into two subcategories—primary (hunting and initial processing) and secondary (hunting with more extensive processing); (3) temporary habitation sites split into three subcategories—temporary camps (single short-term stays by small social units), extended camps (more lengthy stays by single or multiple family groups often with repeated use through time), and indeterminate camps (a nebulous category between the two camp extremes); (4) lithic procurement sites; (5) rock art sites; (6) structural sites; and (7) storage facilities. As should be apparent, this typology intuitively takes into account several independent behavioral dimensions such as economic pursuit, group size, and occupation duration.

The functional site typology used in this report shares much in common with that of the Escalante Project and other examples used in southern Utah during the past 20 years. It has the following six principal site types: (1) semi-permanent residence, (2) residential camp, (3) processing camp, (4) hunting camp, (5) reduction locus, and (6) storage or cache locus. In order to avoid forceful pigeonholing, the typology had two potential outs: indeterminate or unknown and other. Lithic source area is also a potentially applicable category. The Escalante Project (Kearns 1982:313–319) documented two examples of this site type on the northwest portion of the Kaiparowits Plateau using the designation of lithic procurement sites. We documented one example of this sort of site where nodules of Paradise chert/chalcedony and coarse alluvial cobbles were acquired and initially reduced, but have included it in the "other" category. The attributes of each of the site types are discussed below with recorded examples presented to illustrate the general characteristics for each type and their range of variability.

Residential Sites

Both kinds of residential sites (camps and semi-permanent habitations) are thought of as the focal points of numerous activities necessary for the day-to-day maintenance of families or other socio-economic groups. The difference between semi-permanent residence and residential camp basically relates to duration of occupancy, with the former occupied for extended periods of the year if not the entire year and the latter occupied for just portions of the year, perhaps just a week or two up to a month or two. This contrast in the length of stay at habitations results from differing subsistence strategies and their effects on residential mobility (Binford 1978, 1980; Kelly 1983; Thomas 1983). The contrast boils down to the difference between groups largely dependent upon farming and those subsisting primarily or entirely on collected and hunted resources. Without farming, subsistence resources on the Colorado Plateau in general and the Kaiparowits Plateau

in particular were probably never sufficiently abundant, predictable, and concentrated to allow the establishment of long-term residential base camps (semi-permanent residences). To deal with the spatial and temporal incongruity of bulky subsistence resources, foragers probably depended on a strategy of residential mobility, of moving consumers to the resources. This strategy resulted in a series of residential camps, each situated in or near some seasonal resource patch and seldom used for long, though perhaps repeatedly reoccupied. With farming and its concomitant increase in food production from relatively small land parcels, there is a tendency to greatly reduce residential moves—to have relatively stable residential bases situated close to fields and many far-flung logistical camps to extract other resources.

Semipermanent Residence

NNAD's sample survey identified 13 sites classified as semi-permanent residences (less than 2% of the total of 744 Native American components), all evidently dating to the late Pueblo II–early Pueblo III Anasazi occupation of the Kaiparowits Plateau. The evidence for dating is provided by ceramic types, which on an assemblage basis were totally consistent with this temporal placement. Twelve of these sites occur on Collet Top in three sample units, with one site on Fourmile Bench and one on Jack Riggs Bench (part of the Brigham Plains stratum). The latter two were by themselves rather than being part of a larger habitation cluster (and perhaps community) as on Collet Top.[5] Both seemed to be located near or next to small microniches favorable for farming. Perhaps the limited size of the suitable farm area limited settlement to several scattered families, whereas on Collet Top denser settlement was feasible because far more acreage was suitable for growing crops. Further survey in the areas around the Anasazi habitations on Fourmile and Jack Riggs Benches might well disclose additional sites of this type but it seems clear that the settlement cannot be as dense as on Collet Top.

The habitation on Jack Riggs Bench consists of two adjacent masonry rooms, roughly 4 by 2 m each, built against a low sandstone ledge and incorporating two shallow shelters as their rear walls (see Figure 6.55a). The rooms were likely used for general living purposes rather than simply storage, according to the nature of the associated trash, which resembles that of a habitation. Although the artifact assemblage is diverse, artifacts are few in number, perhaps because the likely place for trash deposition was the drainage immediately in front of the rooms; thus, most remains have washed away. Although likely not a year-round residence, the nature of room construction suggests that the inhabitants envisioned staying at the location for a considerable duration, or planned to at least sequentially reuse it over some length of time. The immediate setting of this particular site is within a narrow, shallow slot canyon cut by a small drainage, a rather unusual and hidden setting. The choice of the particular setting for 42KA4733 might have been based principally on the location of a suitable shelter with sunny exposure to accommodate the small pueblo. The partial natural protection provided by the slight overhangs and rock ledge would have helped to minimize the upkeep on the rooms. This might better fit the idea of a habitation that was lived in not year round, but seasonally.

Far less is known about the habitation on Fourmile Bench (42KA5229) because no structural remains were evident on the surface. The nature of the trash at this site leaves little doubt in our minds that at least one, if not multiple living structures occur there, obscured by sand. The artifact density at this site was far more substantial than for the one on Jack Riggs Bench, resembling the trash at the structural habitations on Collet Top.

The 11 other examples of semi-permanent habitations all occur on Collet Top within three survey units. These habitations comprise what appears to be a community of scattered settlements for single families and small extended families. McFadden (1982) and Eaton (1998) documented portions of this community during two prior surveys on Collet Top, with McFadden's effort by far the most extensive and informative. The nature of the structures at the Collet Top habitations was described in Chapter 6. Suffice it to say that they consisted of multi-room structures of masonry and jacal, with the largest consisting of eight or so rooms (Gag House, 42KA5435, Figure 7.9). These sites contained trash middens with

[5]A second Anasazi site was noted outside the survey unit that contained 42KA4733 on Jack Riggs Bench, but time did not permit its documentation; Douglas McFadden (personal communication 1999) has since recorded this site. It is a late Pueblo II habitation with a lightly constructed room or two built under a low sandstone overhang. There are remnants of a granary tied into the back wall of one room.

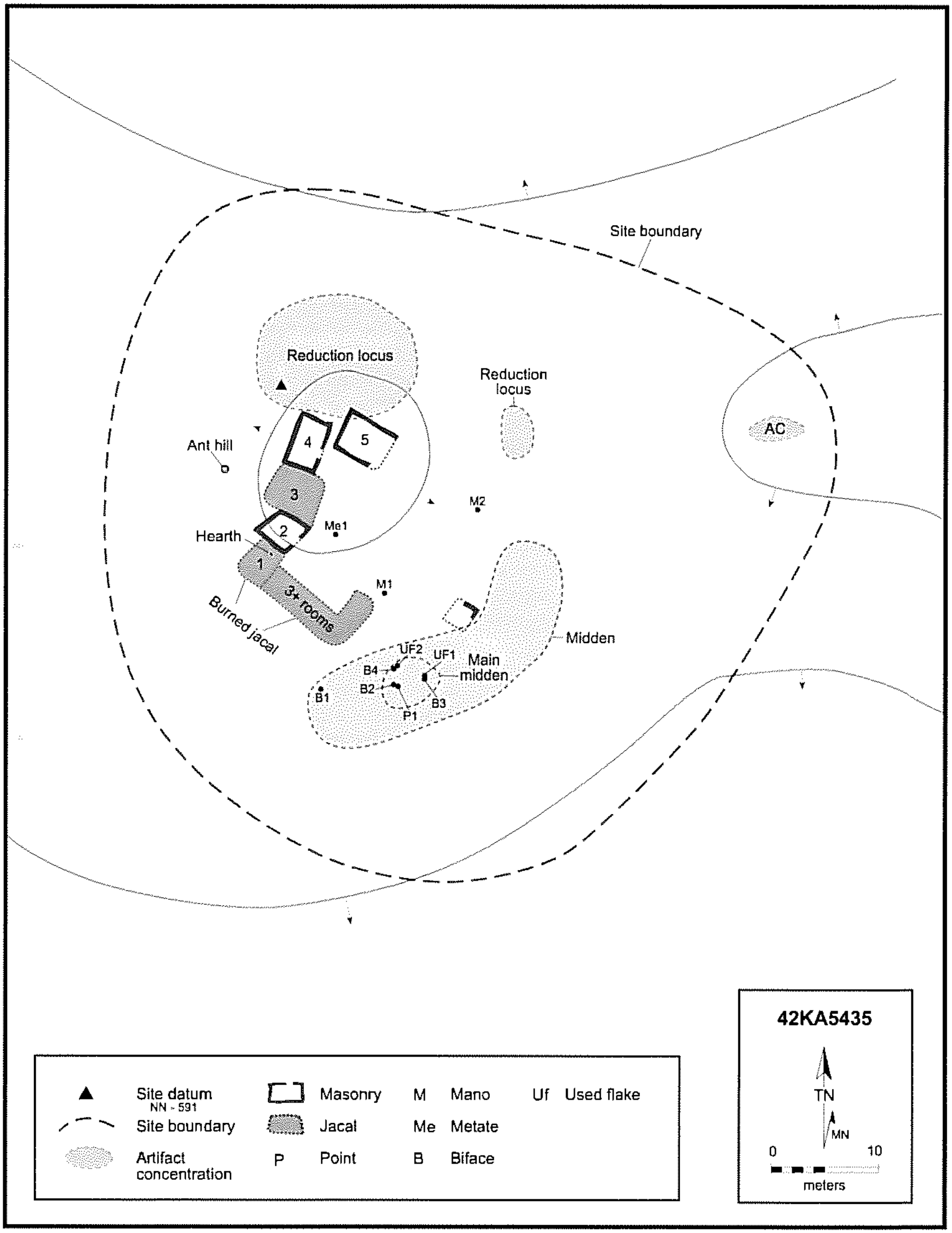


Figure 7.9. Site 42KA5435, Gag House on Collet Top, an example of a semi-permanent residence. This site had the largest roomblock of any Anasazi site recorded during the KPS project. The roomblock has at least 8 masonry and jacal rooms; the jacal rooms were burned.

moderate to high densities of artifacts mixed with charcoal staining and burned rock. The Collet Top Anasazi residential sites seemed to somewhat mimic findings from earlier survey on Fiftymile Mountain during the Glen Canyon Project (Aikens 1963; Gunnerson 1959a).

It is perhaps debatable whether these sites functioned as year-round residences, but it seems evident that the inhabitants envisioned a moderately lengthy stay at the locations, or planned to sequentially reuse them over several years. In Kent's (1991, 1992) terms, the type of construction reflects an anticipated long duration occupation. The immediate setting of these particular sites is a moderately narrow and intricately dissected mesa at an average elevation between 6200 and 6400 feet. The mesa is largely bare of sediment and overall seems poorly suited to agriculture, but there are scattered parcels of modest soil accumulation along drainages that likely served as productive farming areas. Without at least some farming it is difficult to envision people needing to construct the type of small permanent-looking settlements that we documented. Without some support from crops, subsisting in this region would have required high residential mobility and small pueblos would have been superfluous.

Temporary Residential Camps

The important attributes for identifying sites as temporary residential camps are an abundant and diverse set of stone artifacts, with the presence of grinding tools of special significance, often co-occurring with evidence for hearths and occasionally middens. Assemblage diversity is an important attribute linked to the notion that residential camps are the locus of most food processing and tool manufacture and maintenance. All of the diverse activities of camp life such as seed grinding, hide scraping, tool production, and the like ostensibly result in the accumulation of a diverse set of artifact classes. Part of this diversity includes the co-occurrence of tools commonly assumed to be associated with sex-differentiated subsistence tasks (hunting implements vs. grinding implements), with the implication that entire families occupied such camps. Assemblage diversity can be estimated intuitively or by using various measures such as simple class richness or the Shannon information statistic and derivatives (Pielou 1966; Zar 1974); we have used the intuitive method. Because of sample size effects, no simple correlation necessarily exists between assemblage diversity and site functions (Thomas 1986a:242). Sites with numerous artifacts may appear more diverse than sites with fewer remains simply because having more often results in greater variety (see Leonard and Jones 1989 for an extensive discussion of the diversity–sample size issue). But, sample size variation can be a real attribute of past behavior and not merely an artifact of our methods (Plog and Hegmon 1993, 1997). For the 689 Native American sites that we documented on the Kaiparowits Plateau, surface exposure of remains was largely the same, so we are essentially dealing with equivalent samples. Variation among sites likely results from some composite of factors relating to differences in function, occupation duration, group size, repetitive and nonrepetitive site reuse, and unobserved mixture of temporal components. Resolving these aspects is beyond the scope of the current project and indeed the database available from site records.

Grinding tools, but especially metates, are important criteria for inclusion in the residential camp class because few other stone artifacts have such a clear association with food preparation and daily consumption. This follows, in part, from Yellen's suggestion to "separate the food preparation and manufacturing activities that took place within a camp [site] ... and proceed to analyze as to camp [site] variation on this basis" (1977:83). Most stone artifacts recorded at sites were likely used in the manufacture or maintenance of other technology (general domestic activity), or were the debris from manufacture and maintenance activities. Given the importance of seeds in both Archaic and Formative diets on the Colorado Plateau (e.g., Minnis 1989; Van Ness and Hanson 1996), it is probable that families encamped for a day or two during most seasons would have needed some means for grinding. Grinding is seldom a useful processing step in preparation for storage because turning seed to flour hastens deterioration and the loss of nutrition, and increases exposure to pests (this is especially true for mobile foragers camped in the open and lacking Tupperware or similar hermetically sealed containers). Seeds for storage are best left whole and in their protective hulls. Grinding slabs and manos are therefore considered evidence of food preparation just prior to consumption. Manos are easily transported and it is likely that these tools formed part of the mobile tool kit that forager groups carried from one location to another. Consequently, they could end up at sites where the tools were never used. Metates, on the other hand, are considered "site furniture"

(Binford 1979:263–264); thus their recovery context is likely to have been their use context. As such, these tools provide a reliable means to infer in situ seed processing.

Although the presence of grinding slabs is important, an absence does not necessarily place sites into another class. We might have thought differently in another geological setting where sandstone slabs are both ubiquitous and durable. Where suitable sandstone slabs for grinding purposes occur nearly everywhere in the natural environment, such as on the Lower Glen Canyon Benches (Geib 1989), it is unlikely that grinding slabs would be transported from one camp to another given their weight. It is far easier to simply grab another slab from the nearest outcrop.[6] One finding of our survey, however, is that suitable sandstone for grinding slabs is restricted in occurrence across many portions of the Kaiparowits Plateau and much of the local sandstone is quite friable. In such a setting it is reasonable to expect that good grinding slabs would be cached for anticipated future reuse (as with IO854; see Figure 6.49), moved from one camp to another nearby, and scavenged by later occupants of the region when the need arose (see Simms 1983). As a result, there might well be habitation sites that lack grinding tools. Even more significant, though, is the extent of grinding tool deterioration evident at Kaiparowits Plateau sites (see Figure 7.8). This has already been discussed above so the details are not repeated here, but the important point is the systematic loss of grinding tools through time. At many sites of probable Archaic age, grinding slabs are represented by fragments smaller than a hand and exfoliated to less than 1 cm in thickness. Manos are often less severely fragmented and exfoliated, but they are frequently so heavily encrusted by caliche that recognition is not easy. There may be many sites on the Kaiparowits Plateau where grinding slabs have deteriorated beyond recognition. Therefore, negative evidence concerning grinding tools, by itself, did not preclude designating a site as a temporary residential camp.

Features indicative of food processing (hearths and roasting pits) also provide a good basis for inferring that sites served as camps. This is especially true of middens consisting of abundant fire-cracked rock and charcoal-stained soil; these features are the evident product of repeated fire-related processing activities. The presence of middens implies that thermal features were cleaned for reuse, something likely to occur at residential camps but not at short-term use locations. Having a more-or-less formal discard area also implies some degree of camp maintenance, an activity that is also likely to occur at residential camps but not at short-term use locations.

Temporary residential camps are moderately common within Kaiparowits Plateau sample units, accounting for 95 of the 744 total components identified at Native American sites. Many examples of this site type have an Archaic temporal affiliation. Two good examples of probable Archaic residential camps are 42KA4549 and 4552 located on the northeast portion of Long Flat (Figure 7.10); the survey attributes of these sites are listed in Table 7.4. Both sites have fire-cracked rock and artifact accumulations identified as middens as well as fire-cracked rock scatters; one has intact hearths. Both sites have a diversity of stone tool types, including grinding tools. Heavy-duty flaked cobble tools (cobble choppers, pounders, and scraper planes) of coarse materials (quartzite) are well represented. Flakes are abundant and come from a mixture of both core and biface reduction. Many of the core reduction flakes are from the preparation and resharpening of the flaked cobble tools. Limited testing at both of these sites (see Chapter 5) showed that the midden at 42KA4552 was well preserved, but that this feature was deflated at the other site. The density and diversity of remains recovered seems in accordance with our expectations for a residential camp: one of the midden test units at 42KA4549 contained more than 300 flaked stone artifacts and the midden test unit at 42KA4552 contained almost 130 flaked stone artifacts. The midden at 42KA4552 has a late Archaic radiocarbon date (two-sigma calibrated date range is 2480–2330 B.C.), but a slab-lined hearth at this site is considerably younger (two-sigma calibrated date range is A.D. 215–420). The discovery of an unexpected second component at this site does not change our interpretation that the site functioned as a residential camp, at least during the late Archaic. The current unknown is what the component associated with the slab-lined hearth functioned as—a residential camp or a limited-use processing camp of some sort.

Two potential candidates for Formative resi-

[6]This would not be true for formalized metates with high production investment such as occur at Formative habitations, but the types of slabs discussed here have minimal or no production investment. Slabs were simply collected ready to use, or were quickly formed by unidirectional edge spalling to an oval or rectangular shape—an activity that takes all of a few minutes.

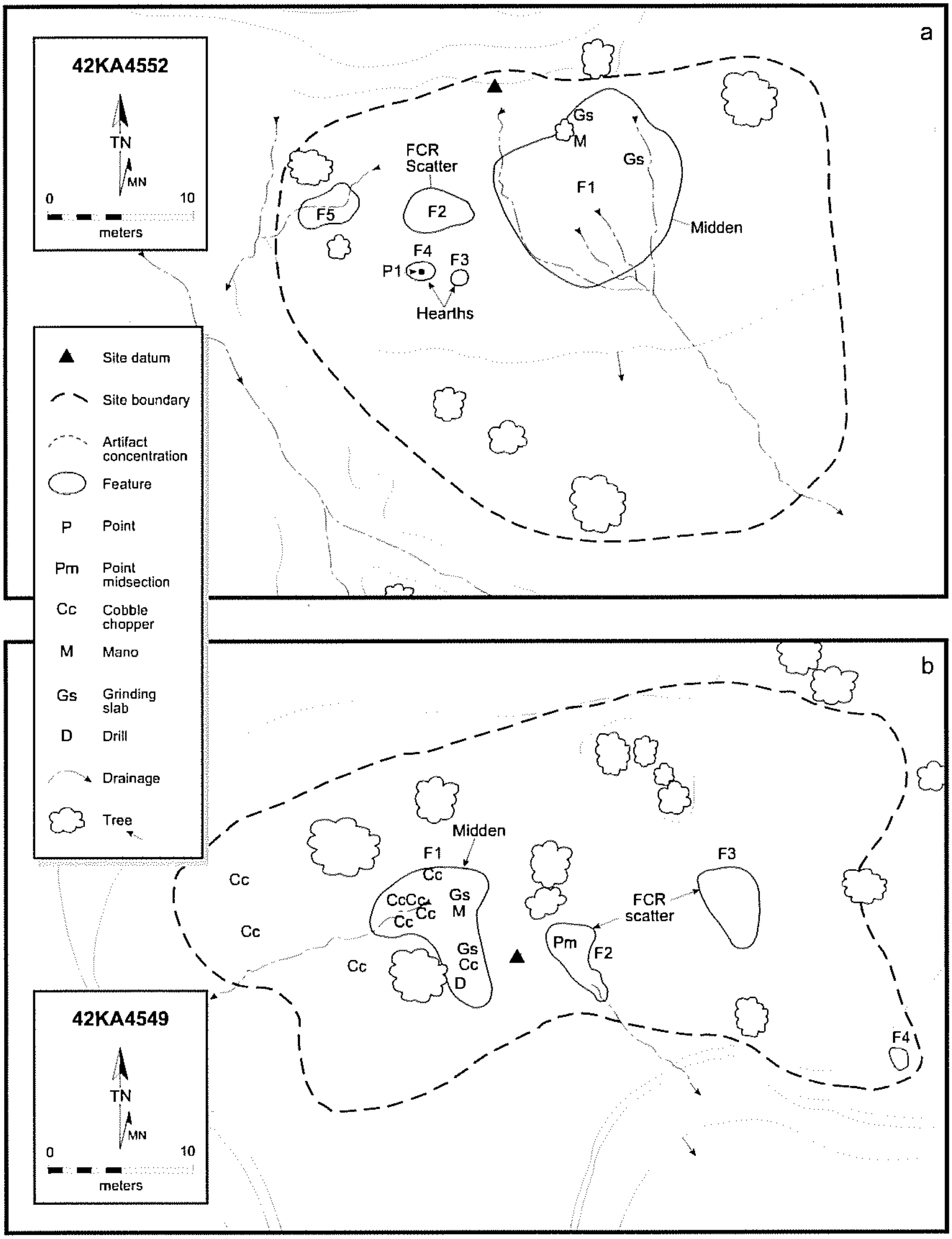


Figure 7.10. Plan maps of single-component Archaic sites identified as temporary residential camps: a) 42KA4552; b) 42KA4549.

Table 7.4. Attributes of single-component sites identified as temporary residential camps.

	Archaic		Formative	
Attributes	42KA4549	42KA4552	42KA4749	42KA4750
Site size	1000	1200	805	252
Projectile points	1	3	3	1
Bifaces	3	3	2	2
Unifaces	0	0	1	0
Other facial flaked tools	3	2	0	0
Flaked cobble tools	13	5	1	1
Grinding slabs	3	2	1	1
Mano	2	1	0	0
Debitage	500+	100–500	100–500	25–100
Decortication	common	common	rare	rare
Secondary	common	dominant	common	common
Tertiary	dominant	common	dominant	dominant
Hearths	0	2	2	1
FCR scatters	3	1	0	2
Midden	x	x	x	x

dential camps are sites 42KA4749 and 4750, located near each other within a small side canyon draining the northern edge of Paradise Bench and flowing into Escalante Canyon. The survey attributes of these sites are also listed in Table 7.4. Site 42KA4749 is in the open next to a drainage whereas 42KA4750 is situated along the base of a low sandstone outcrop that provides a slight shelter; the level area at the base of this overhang was evidently the focus of activity. The remains at both sites are similar, consisting of debitage, flaked and ground stone tools, hearths, and areas of fire-cracked rock and artifacts mixed with charcoal-stained soil that appear to be midden accumulations. Both sites have Rose Spring Corner-notched arrow points and 42KA4750 has a single Emery Gray sherd. The flakes on both sites are derived from a mixture of biface thinning and core reduction. Most core reduction flakes are from coarse-grained cobbles (quartzite, igneous rock, and metasediment), detached for the preparation and refurbishing of heavy-duty cobble tools (choppers and scraper planes). There are some chert core reduction flakes but most of the chert debitage is derived from biface reduction—mainly percussion thinning of late-stage bifaces, but also some pressure flaking. Many of the thinning flakes are heat treated. Both sites probably represent repeated use of temporary residential sites for foraging and hunting activities on and around Paradise Bench. Based on the Rose Spring points and the one Emery Gray sherd, we assume that the sites date to the early Formative period, sometime between A.D. 500 and 900.

We also tested both of these Formative camps as part of the Phase 2 effort (see Chapter 5). The tested basin hearths and recovered artifact assemblages suggest processing activities of some sort, of both plants and animals. Unfortunately, except for a few small mammal bones and one identified as cottontail, essentially no subsistence remains were recovered from the limited work at the sites. Additional sherds were found at 42KA4750, more Emery Gray as well as North Creek Black-on-gray. Carbonized juniper berries were the only plant remains found at the sites that would provide somewhat realistic radiocarbon dates (less chance for age overestimation). With a two-sigma calibrated age range of A.D. 1035–1250, the date for 42KA4750 appears to accord well with the postulated temporal span for the use of North Creek Black-on-gray on the Kaiparowits Plateau. The Emery Gray sherds suggest even earlier use of the site. The radiocarbon date for 42KA4749 has a two-sigma calibrated age range of A.D. 255–435, which is consistent with the finding of Rose Spring Corner-notched points but no pottery, but there is still the possibility of some age overestimation (ca. 100 years).

Although included in the same general site type, it is probable that Archaic and Formative residential camps differed as to integration within a larger subsistence-settlement round and that camps of these different time periods located in similar settings might have had differing seasonal or functional roles. Moreover, although we have

little doubt that Archaic residential camps were the staging points for foraging activities, whether or not this always applies to Formative residential camps remains in doubt. Some of the Formative residential camps occurred in the same settings on Collet Top as the semi-permanent Anasazi habitations and consisted of single-room structures with relatively scant artifactual remains (far sparser than occurred at the multi-room habitations). In the Kayenta Anasazi region we likely would have classified these sites as fieldhouses, and this is perhaps the specific settlement role for some of the Formative residential camps identified during the Phase 2 survey. Yet, almost half of the residential camps occurred on benches other than Collet Top, including the low and dry Nipple Bench and somewhat higher but still quite dry Smoky Mountain. There is little possibility that these Formative sites were in any way related to farming pursuits and must be residential camps associated with foraging and perhaps hunting. The results from testing two examples of the Formative residential camps combined with the survey findings strongly support the idea that some Formative populations foraged on the Kaiparowits Plateau in a manner similar to Archaic populations, with small family groups temporarily occupying camps during specific harvest times and then moving on.

Short-Term Camps

Sites in this group are thought to have functioned as temporary resting places and staging points for special-purpose task groups, principally involved in the procurement and processing of floral or faunal resources (Binford 1980:10, 1982). These are in essence logistical camps. Such sites are used for a short duration, although perhaps intermittently over a long time span. The quantity and nature of artifact debris is variable, resulting from differences in the types of resources being exploited, the season, distances between these camps and residential bases, and other factors. Artifact diversity is usually more limited than at residential camps, and certain tool types are dominant, depending on the nature of the exploited resource. Hearths may be present but other facilities are usually lacking. This type of site is generally associated with logistically organized groups, but foragers may also use such site types, especially hunting camps for procuring game beyond the daily radius of a residential camp. The two types of short-term camps that we attempted to distinguish are those used principally for hunting and those used for nebulous processing tasks. The latter are believed to have had an emphasis on plant gathering, though not necessarily to the exclusion of faunal resource acquisition and processing.

Processing Camps

The reality of processing camps as functionally distinct from residential camps is partially dependent upon the cultural and temporal placement of a site. Formative age sites assigned to this functional class have a better chance of having actually served as logistical processing sites than those associated with the Archaic or Post-Formative periods. Groups during these other two temporal intervals were more likely to have operated using a foraging strategy wherein resources other than large game were gathered within close proximity to a residential base. Foragers generally have little need for logistical camps because if a desired resource occurs outside the daily travel distance from a residential base, then the base itself is relocated close to the resource. Formative period horticulturists, in contrast, may well have had logistical camps for collecting floral resources, particularly if certain important plants were not readily available within the foraging radius of the primary habitation. This is typical for plants such as ricegrass, which flourish on lower elevation sandy benches of the Kaiparowits Plateau well away from the primary residential sites of most Formative period farmers. Examples of Formative period processing sites are known from the Grand Bench below Fiftymile Mountain, where ricegrass collecting is a probable reason for their presence (Geib 1989). Pinyon is another example because vast portions of the Kaiparowits Plateau that are heavily forested with this tree lack Formative residential sites. These were doubtless important collecting areas for this nutritious nut during good harvest years, especially if the pinyon crop close to residential sites was poor. Given the spatially patchy nature of nut harvests, with 3–7 years usually elapsing between bumper crops (Lanner 1981:78), it is expectable that Formative groups would have traveled to obtained this resource.

NNAD archaeologists identified 163 processing camps. Two examples of sites identified as processing camps are illustrated in Figure 7.11; Table 7.5 lists attributes for both of these sites and several others to demonstrate the range of variability within this site type. Some of the sites included in this class actually appear to be small versions of residential camps, whereas others seem to fit the notion of a logistical processing

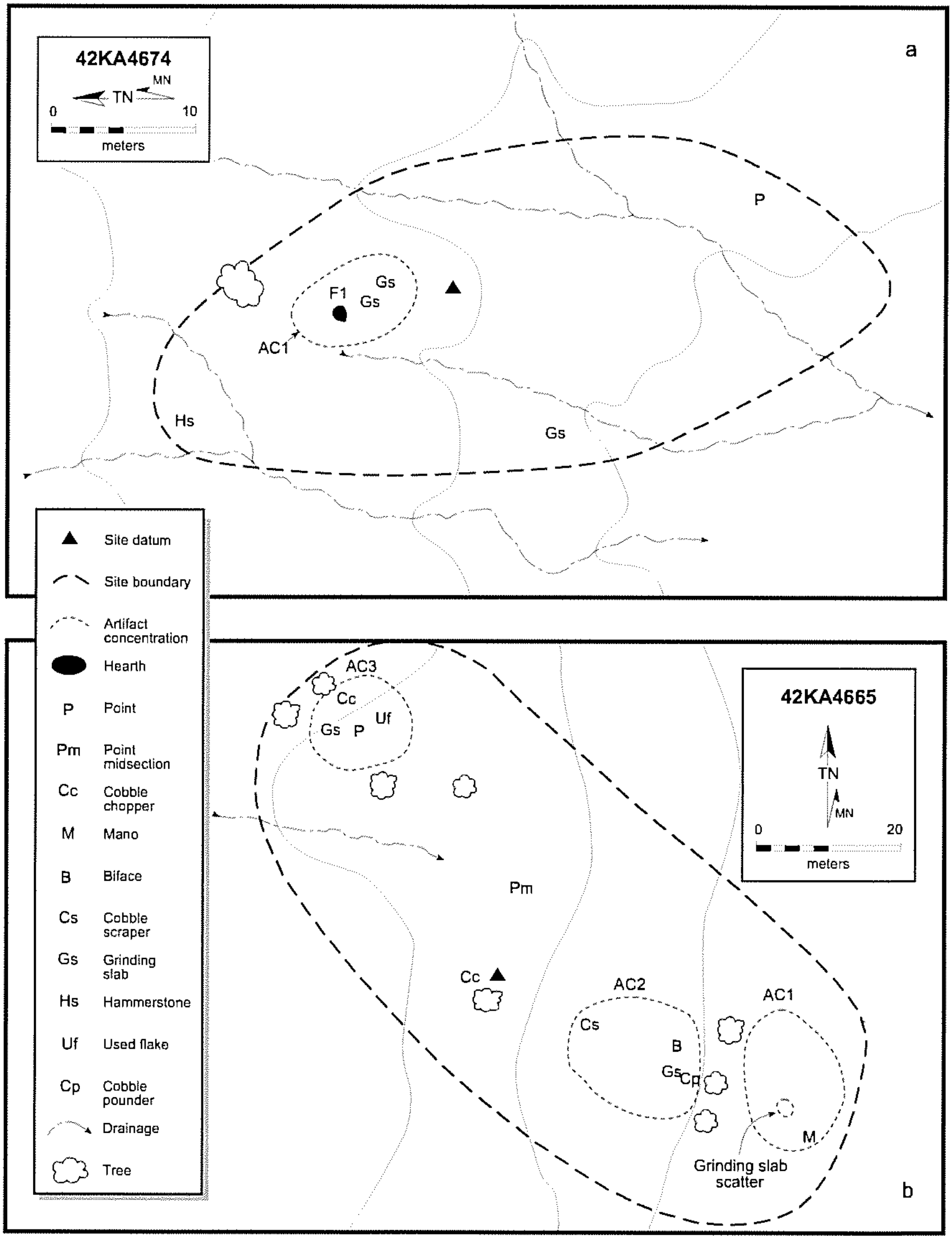


Figure 7.11. Examples of single-component processing camps: a) Late Prehistoric; b) Archaic.

Table 7.5. Attributes of single-component sites identified as processing camps.

	Archaic		Formative	Post-Formative	
Attributes	42KA4591	42KA4665	42KA4576	42KA4575	42KA4674
Site size	1120	4500	384	1674	1250
Projectile points	3	2	0	0	1
Bifaces	1	1	0	0	0
Unifaces	0	0	0	1	0
Other facial flaked tools	0	1	0	1	0
Flaked cobble tools	1	4	6	0	1
Grinding slabs	0	4	0	2	1
Mano	0	1	0	0	0
Debitage	25–100	10–25	25–100	25–100	1–9
Decortication	common	rare	dominant	common	none
Secondary	common	dominant	common	common	rare
Tertiary	dominant	common	rare	dominant	dominant
Hearths	?	0	0	0	1
FCR scatters	0	0	0	1	0
Midden	x	0	0	0	0

camp. The Archaic site 42KA4591 and Formative site 42KA4576 are good examples of the latter, whereas the other sites are examples of the former.

The Archaic site 42KA4665 (Figure 7.11b) consists of three separate loci, each characterized by grinding tools, a few flaked stone tools, and sparse flakes. Each of these loci might represent separate briefly occupied residential camps, used either contemporaneously by three families or sequentially by one family but with little overlap in remains. The modest amount of remains accords with a temporary stay, but the presence of grinding tools indicates seed processing, implying residential use. Each of these three loci is similar to what the individual Post-Formative processing sites consist of—a grinding tool or two, a few flaked stone tools, and sparse debitage. If the three loci of the Archaic site had been superimposed so that all remains occurred within one small space, then we might have classified the site as a residential camp. Because the remains are spread out down a ridge crest, the diffuse nature of the scatter suggests that the site is something less than a residential base. There are indeed fewer remains at this sort of site, but functionally they may be little different than residential sites. It seems likely that what distinguishes them is either the size of the occupying social group (one family vs. many), the composition of the social group (part of the family vs. the entire family), the length of stay (2 nights vs. 2 weeks), the frequency of site reoccupancy (none vs. many), or some combination thereof. Consequently, although the residential and processing site type categories are monitoring differences in the archaeological record, these differences do not relate to whether or not a site was used residentially—most of them probably were. The discussion of Archaic prehistory in Chapter 8 goes into more detail about this issue, comparing data from both residential bases and processing camps. Some clear differences are revealed both in the number of sites in each group that have certain tool types and features represented, and in the frequency of items within stone tool classes, debitage, and features. Yet, it seems likely that this pattern is largely the result of site size, in that residential sites are on average twice as large as those identified as processing camps. As site size increases so does the quantity and diversity of remains.

This said, there are examples like the Formative site 42KA4576 that stand out as something different. This site has heavy-duty flaked cobble tools and some flakes from their production or modification, but nothing else except fragments from a single Emery Gray vessel. This site probably was not residential; rather the occupants likely occupied the location temporarily and used the cobble tools to extract or process some resource. The same might apply to the probable Archaic site of 42KA4591. This site has a sparse artifact assemblage lacking grinding tools, and in some respects it appears more like a hunting camp because of its three point bases. It is principally the

presence of a 9 m diameter midden accumulation of fire-cracked rock and artifacts mixed with charcoal-blackened soil that distinguishes the site from other hunting camps (see below); it might simply be a hunting camp that entailed some sort of intensive field processing.

Perhaps one of the best examples of a logistic processing camp is 42GA4743 toward the northern part of the Collet Top sample stratum. This site consisted of just two whole slab metates resting face-up on a narrow ridge top, as though waiting for the occupants to return and resume their grinding tasks. There were no other obvious cultural remains at this site such as flakes or burned rock; this was not the result of post-abandonment processes because there was absolutely no sediment deposition on site and no slope to account for erosional loss of small artifacts. Two metates and no other evidence of occupation qualifies as a logistic foraging locus—two sisters hulling pinyon nuts in the shade on a ridge top with an expansive view of the upper Escalante River basin and Boulder Mountain.

Hunting Camps

Logistical camps for hunting purposes are expectable no matter what the overall pattern of residential mobility might have been. The one exception could be groups so heavily reliant on hunting that residential camp movements were governed by meat procurement (Folsom groups might be an example). The positioning of most forager residential camps on the Kaiparowits Plateau was likely predicated upon the distribution and seasonal ripening of local floral resources. There are at least three important reasons that this was likely so: floral resources comprised a major portion of the diet; most plant foods are bulky with respect to nutritional value; and most plant foraging was done by females whose travel range and length of absence from the temporary residences were kept to a minimum. The second point concerns transportation costs, which to be minimized require locating the consumers close to the resource. The opposites of these three points are commonly applicable to faunal resources, especially big game, and provide reasons why logistical hunting camps exist, even for foragers. Not only did meat likely make up less of a forager diet than plants, but meat comes in highly nutritious and comparatively low bulk packages that can be moved to consumers. Hunting is also predominantly a male activity, so there are fewer constraints on making overnight forays well beyond the radius of the family camp.

The identification of hunting camps was based principally upon the occurrence of debitage from late-stage biface reduction and projectile point bases and other fragments. The point bases commonly are snapped across the notches (bending breaks); larger portions exhibit tip impact fractures. The occurrence of such basal fragments is expectable at camp locations where hunters would repair gear and rearm foreshafts by removing the fragments and affixing new points (they are also expectable at temporary residential camps). Point tips and midsections can come from production mistakes in fabricating replacement points, but also from cleaning game and cutting up animals for transport back to the home base. In this process, portions snapped off in the animals would be removed and discarded. Most sites classified as hunting camps also have bifaces in various stages of reduction, but they tended to lack heavy-duty cobble choppers or pounders and grinding tools. Flake waste is relatively sparse at some sites but at other sites it is very abundant, with well over 500 flakes at densities of 10–20 per sq m. Especially at some Formative period hunting camps, pressure flakes are exceedingly abundant, and most are of colorful heat-treated chert, chalcedony, and agatized wood. This was also true for some of the Formative habitations; indeed at the largest of these (Gag House), flake waste reached a density of 200 flakes per sq m, and nearly all of this was from biface reduction.

Hearths occur on a few of these sites, and in rarer instances there are burned bone fragments. Hearth presence is not essential for inclusion in this class, though it is likely that fires were used at hunting camps. The lack of hearths at most hunting camps is either a preservation or a visibility problem. In this regard, it is of interest that both of the tested Post-Formative (Paiute) hearths that had been used for roasting big game (Feature 2 at 42KA4662 and Feature 3 at 42KA4797) evidently were surface features (see Chapter 5). Fires were built directly upon the ground surface rather than within some sort of basin; thus the features consist of a surface pile of burned rock mixed with charcoal and bone. The reason these surface features are still intact is their recent age, indeed the hearth at 42KA4662 likely dates to the late 1800s (the believable portion of the two-sigma calibrated date range is A.D. 1805–1935). This is sufficient cause to infer that surface cooking fires at hunting camps just 1000 years old (Formative period), let alone many thousands of years old (Archaic period), have long since disappeared.

NNAD archaeologists identified 212 Native American components as hunting camps, the most abundant site type of the Kaiparowits Plateau Survey (29% of all Native American components). The type is perhaps even more common given that many of the sites identified as reduction loci (discussed next) might actually be examples of hunting camps. As expected, there are hunting camps from early Archaic through Post-Formative times. Overall more sites of this class are assigned a temporal affiliation than processing camps and reduction loci, because the occurrence of projectile points is a principal attribute for placement in this site type and these tools form the core criterion for temporal assignment of sites.

Two good examples of Archaic hunting camps are sites 42KA4561 and 4564 located on a dissected and cobble-covered slope on the northeast portion of Long Flat that leads up to Horse Mountain (Figure 7.12). The characteristics of these two sites are listed in Table 7.6, along with those of a Formative hunting camp and two Post-Formative hunting camps. They present obvious contrasts with nearby sites identified as residential or processing camps. Principal among these is the occurrence of many projectile points, including points broken in manufacture, a good example of which occurs at 42KA4564. The other stone tools at the site are principally bifaces and there are no examples of flaked cobble tools and no grinding tools. The debitage assemblage reflects an emphasis on bifacially thinned tools, consisting almost entirely of biface reduction debris; material types are mainly local high-quality chalcedony and chert. It is worthy of note that deer antler sheds are a common occurrence on the cobble-covered slope where these sites are located.

Several good examples of Formative hunting camps were identified. Two of the best examples occur on Paradise Bench, sites 42KA4756 and 42KA4813. These sites have a somewhat different character than the Archaic hunting camps just discussed, though this is not as apparent from the site form attributes (see Table 7.6) as it is from actually seeing the site assemblages. The chief differences between the Archaic and Formative hunting camp assemblages are the vastly greater quantity and density of remains at the latter and the lithic raw materials. The Formative hunting camps have numerous pressure flakes and late stage biface percussion flakes occurring at high densities (20 per sq m at 42KA4813) and there is a preponderance of nonlocal, brightly colored, often semitranslucent, high-quality silicates. Not all Formative hunting camps are necessarily characterized by heavy nonlocal material use, but in general it seems that Archaic groups relied far more on the local materials and because of this their assemblages represent earlier reduction stages. The numerous pressure flakes produced a high artifact density at the Formative hunting camps, but postdepositional dispersion over a larger time interval may be a factor in lowering artifact density at Archaic sites. A good example of a likely hunting camp used during the Formative period is Rose Shelter (see testing results in Chapter 5). Both the artifactual remains and the faunal remains recovered in a limited test of this small rockshelter are consistent with such an interpretation. There are arrow point fragments broken in production and by impact and abundant pressure flaking debris from point production as well as burned and fragmented large mammal bone. At least three discrete depositional layers at this site contain similar types of remains, suggesting repeated use of the shelter as a hunting camp.

Post-Formative hunting camps such as 42KA 4592 and 4662 present an even greater contrast to Archaic hunting camps (Figure 7.13, Table 7.6). These are small scatters of remains concentrated around hearths. Both hearths at 42KA4662 contain burned animal bone, and unburned and burned bone is scattered around these features. There is evidence of arrow point manufacture at both sites, perhaps best represented at 42KA4662, as discussed in Chapter 6 under point production and in Chapter 5. The comparable scarcity of lithic artifacts at Post-Formative hunter camps is not simply because they were using arrow points, the production of which can result in little debris. Formative hunters also used arrow points, yet their camps contain abundant flaking debris. One important difference seems to be the use of expedient flakes and unifacial tools rather than bifaces at Post-Formative hunting sites. Simple core reduction to detach a few useable flakes will result in substantially less debris than the production and maintenance of bifacial tools. The testing results from 42KA4662 reveal that flake density can be quite high (>100 per sq m), but only in tiny areas where the flaking occurred (an adjacent test unit had <30 flakes per sq m). Moreover, nearly all of the flakes recovered from testing are tiny debris from pressure flaking with nearly all less than 1/4" (ca. 6.5 mm) in maximum dimension and an average weight of 0.2 g.

This contrast between the sparseness of remains on Post-Formative hunting camps and those

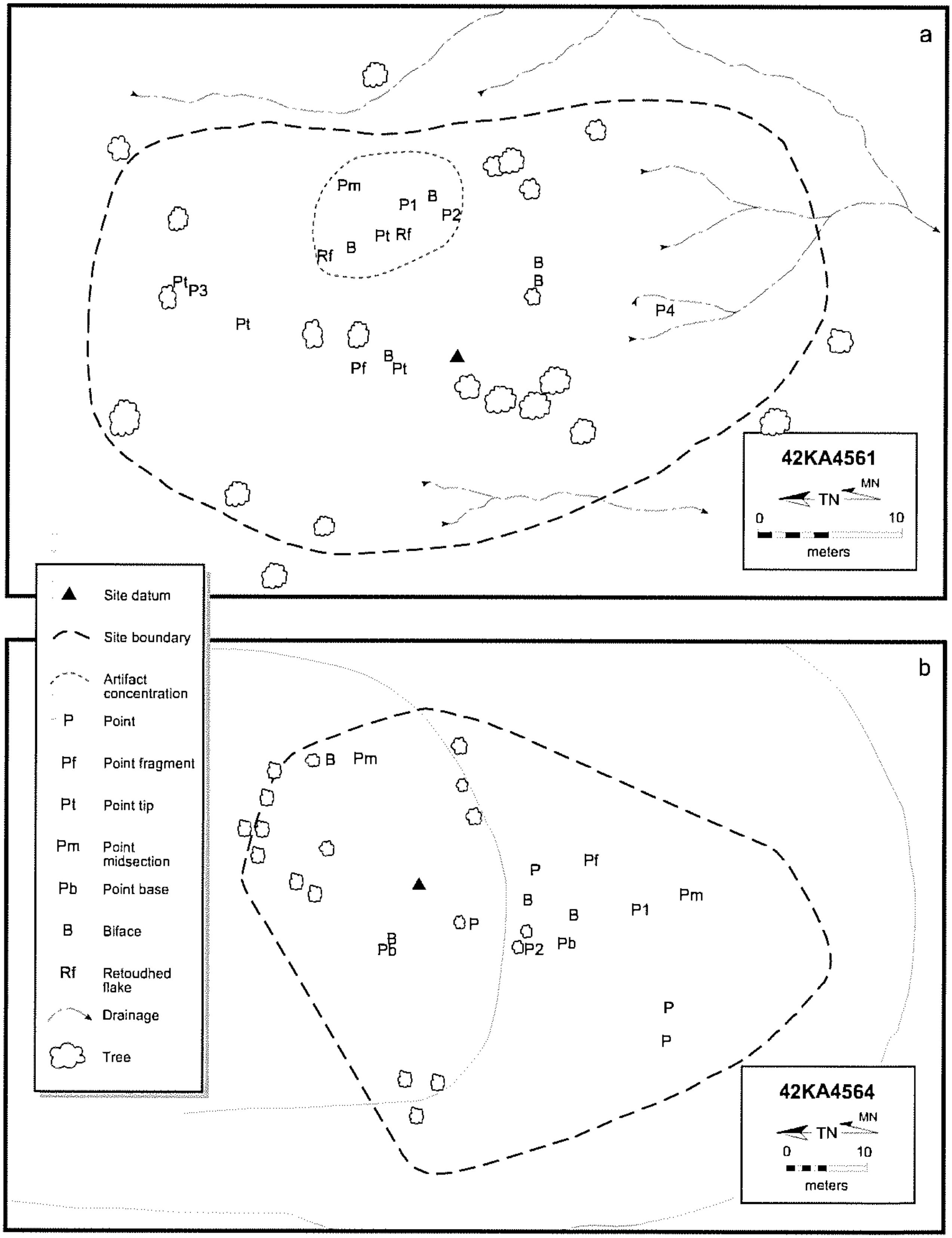


Figure 7.12. Examples of single-component late Archaic sites identified as hunting camps: a) 42KA4561; b) 42KA4564.

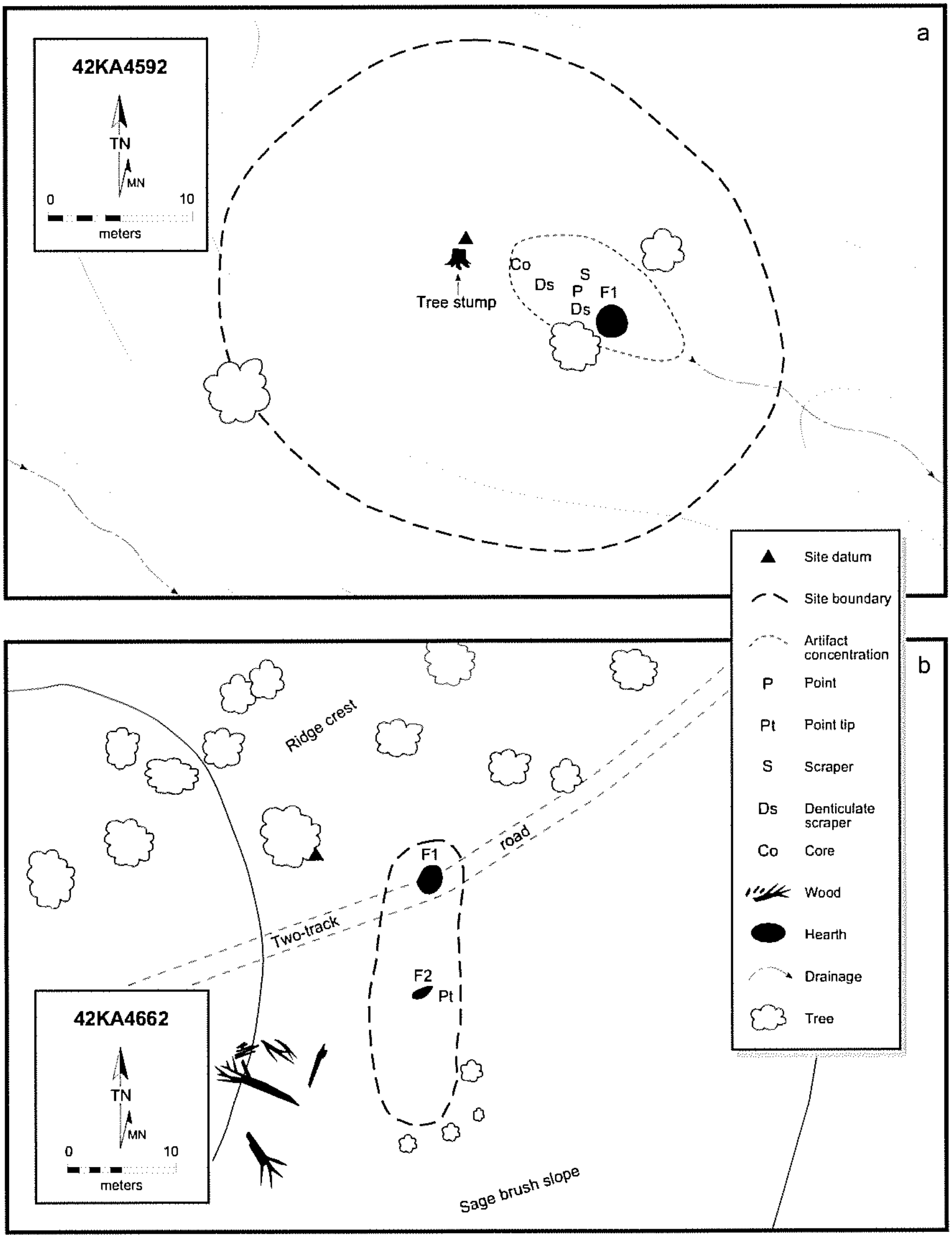


Figure 7.13. Examples of single-component Post-Formative sites identified as hunting camps: a) 42KA4592; b) 42KA4662.

Table 7.6. Attributes of single-component sites identified as hunting camps.

	Late Archaic		Formative	Post-Formative	
Attributes	42KA4561	42KA4564	42KA4813	42KA4592	42KA4662
Site size	1500	4015	2400	320	250
Projectile points	10	11	6	1	1
Bifaces	5	7	9	0	0
Unifaces	1	1	2	2	0
Other facial flaked tools	3	1	7	1	1
Flaked cobble tools	0	0	0	0	0
Grinding slabs	0	0	0	0	0
Mano	0	0	0	0	0
Debitage	100–500	100–500	500+	25–100	25–100
Decortication	rare	rare	none	rare	none
Secondary	rare	common	rare	dominant	common
Tertiary	dominant	dominant	dominant	dominant	common
Hearths	0	0	1	1	1

of other periods is evident on the multiple component site 42KA4787 (see Figure 7.16). This site has late Archaic and Post-Formative components; the components are spatially discrete for the most part, consisting of two small loci of debitage and flaked stone tools. A general diffuse scatter surrounds the loci and is the reason that they were recorded as part of the same site. The Post-Formative component consists of two Desert Side-notched point bases and several obsidian pressure flakes, but little else. In contrast, the late Archaic component contains considerably more remains, including two Gypsum points. There is a moderate density of mainly percussion biface reduction flakes (coded as tertiary dominant) as well as several bifaces.

Other Site Types

Reduction Loci

NNAD archaeologists identified 113 Native American components as reduction loci. The least ambiguous cases of reduction loci are sites where the debris is derived from a single nodule or tool. At 42KA4605 there are 15 or so biface thinning flakes scattered over a 20 by 60 sq m area and despite this dispersion all are of identical chalcedony and are likely derived from resharpening a single tool. Two examples that are even more clear-cut are 42KA4655 and 4808. The latter is a concentration of about 20 flakes from the reduction of a single quartzite cobble—production or modification of a flaked cobble tool, likely a cobble chopper. Site 42KA4655 has two loci of remains dating to different times. Locus A consists of the flakes from intensive biface reduction of a single tool of a reddish yellow chert of unknown source. The flakes occur in a very small area, about 1–2 m in diameter. Most large flakes are classic biface thinning, but there are many alternate flakes and edge preparation flakes from setting up appropriate platform surfaces. When looking at the collection as a whole it is clear that the debris comes from the percussion thinning of a middle stage biface (ca. Stage 3), with the item likely turned into a Stage 4 biface. The reduction had nothing to do with refurbishing worn edges because none of the flake platforms exhibited use-wear traces. Judging from the size of the flakes the biface would have been roughly 4 cm wide. The flakes are covered with caliche on at least one face; this deposit is up to 1 mm thick and suggests at least several hundred years of burial. This site was tested, so Chapter 5 provides further details.

One interesting reduction locus is 42KA4721 on Paradise Bench (Figure 7.14). The main focus of this site is a very old looking fallen pinyon tree on the southern side of which there is a dense concentration of about 45 flakes in a 1 m diameter area. Most of the flakes are derived from middle to late stage biface reduction from perhaps a single piece of Paradise chert/chalcedony. A couple of Canaan Peak cobble chert flakes also occur in the debitage pile. A few meters to the southeast under a standing dead juniper trunk is a handful of flakes of similar material. The only associated tool is a Stage 4 biface base of chalcedony, the same material as the debitage, which was found near the southern site boundary. The fallen log is quite rotted and

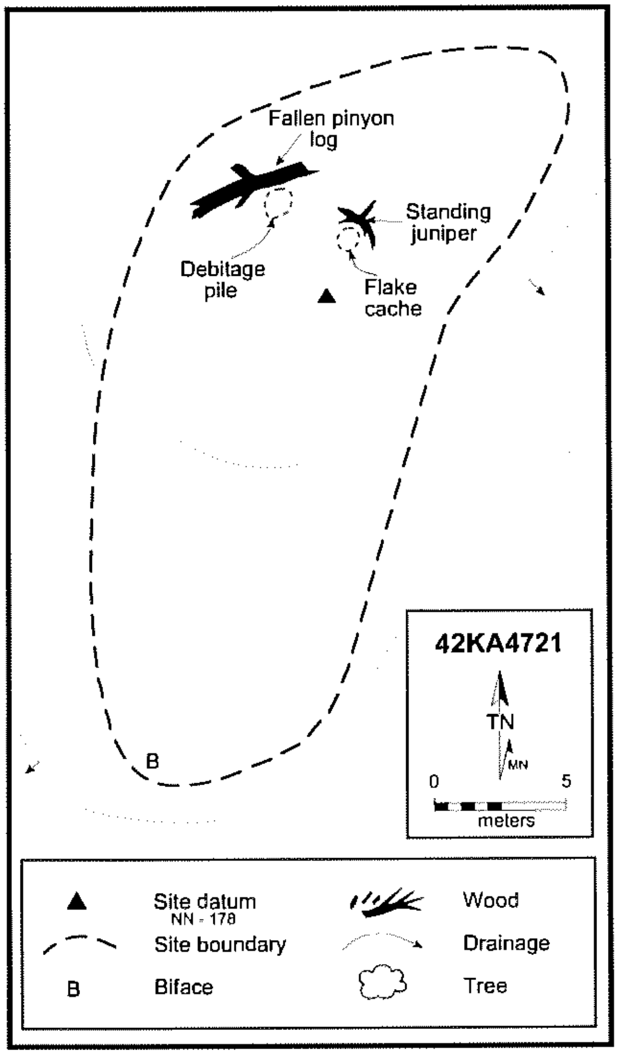


Figure 7.14. Example of a probable Post-Formative reduction locus (42KA4721).

hollowed, and may be a couple of hundred years old or more. The patterning of remains suggests that a single individual reduced an already roughed out biface, set aside some useable flakes for potential future retrieval, and tossed, perhaps in frustration, one fragment of a tool that he probably broke during production. The individual probably sat on the log when reducing the biface, enjoying the sunny south-facing slope.

Each of these four sites was likely occupied for only the briefest of times, maybe even less than an hour. In terms of occupation duration and activity diversity they are archetypal limited-activity sites. Not all sites classified as lithic reduction loci fit this simple pattern. Some have debris from more than single tools or nodules and it is usual in these instances that some of the debris seems to be derived from tool resharpening, as indicated by use-wear polish and rounding on flake platforms. Additionally, at some of these sites there is a greater number and diversity of tools and raw materials. Having more raw material diversity and tool fragments does not necessarily imply a longer duration stay or activities other than a quick stop for tool reduction. Simply increasing the number of flintknappers using a location will increase both raw material diversity and tool number: each person flakes separate nodules or tools and more people means potentially more production mistakes or discarded worn tools. Some of these sites, however, may have functioned more as hunting camps, especially those that have point bases and tools such as used flakes. In hindsight, it would have been useful to differentiate single tool or nodule reduction scatters from scatters that resulted from the reduction of several tools or nodules, especially those that seem to contain the byproduct of tool resharpening. Basically this is a segregation of reduction loci into those of tool fabrication or production from those of tool resharpening or modification.

Storage or Cache Loci

NNAD archaeologists identified nine Native American components as storage or cache loci. The storage sites consist of masonry and mortar granaries and several slab-lined cists, at least one of which was lined with clay. Most of the granaries and cists fit a pattern that seems common to the Kaiparowits Plateau, one of isolated hidden storage features well away from any habitations. The feature discussion of Chapter 6 provides more information about these sites.

The one tool cache is site 42KA4649 on Horse Flat. It consists of a cluster of large processing tools: a couple of one-hand sandstone manos and three flaked cobble tools (a cobble flake chopper, a cobble chopper or scraper plane, and a cobble chopper or pounder). Only four flakes were found associated with the tools. Based on the thick caliche crusts formed on the artifacts and the extent of their deterioration, the site may be Archaic in age. The site is near a major drainage (approximately 90 m to the south) and it is possible that the location served as a place where large tools were cached as part of an established foraging route.

Quarry/Stone Procurement

Two sites were identified as "quarries," places where raw materials for stone tool production were procured and initially reduced. Both occur

on the northern edge of the Fourmile Bench stratum. The largest of these sites is not actually situated on Fourmile Bench proper but is on the far southern terminus of the cobble-draped Horse Mountain. The chief resource being exploited at this large site was the Paradise chert/chalcedony, nodules of which occur here and there as a lag deposit across much of Horse Mountain and the northern part of Paradise Bench, as well as in the washes draining south from these features. The flaking debris on the quarry site indicates that nodules were tested, leaving a widely dispersed scatter of largely cortical flakes. Some nodules deemed of sufficient quality were initially reduced, resulting in small concentrations of core and early stage biface reduction flakes within the larger background scatter of nodule testing flakes. This site was also located on what was doubtless an important travel corridor leading from the southern lowlands to the higher elevations around Canaan Peak and beyond.

Indeterminate or Unknown

In any typology it is useful to have a category for sites that do not seem to fit the criteria of the other types. Some of the sites included in this class are those found in the chained areas of Collet Top and Horse Flat. Interpreting the remains at these sites was often impossible because of the extent of disturbance. Other sites in this class seemed compromised by natural erosion. Postdepositional disturbance is not to blame in all cases, for there are sites that simply did not correspond, even roughly, to the definitions for the above site types. The most common of these were small scatters of remains where every artifact was different from the other. For example, site 42KA5352 on Smoky Mountain consisted of two Stage 5 biface fragments of different materials (a base and a tip portion), a cobble chopper, and three flakes all from different nodules and none from the three tools. These artifacts occurred in a level 7 x 8 m area near a canyon rim, in an area devoid of a background artifact scatter and where no adjacent sites existed that could account for the odd assortment as a byproduct of erosion. In the field we took to calling these sorts of sites "tool-kit-guy" scatters, a place on the landscape where it seemed that someone had cleaned out their tool bag, discarding the items of no further interest. Except for this admittedly speculative scenario, it is difficult to envision what activity would result in such scatters.

Site Type Distributions and Temporal Patterns

Site Types Within Sampling Strata

Having reviewed the site types identified during the survey, it is time to examine potential patterns in the distribution of these types across the sampling strata of the Kaiparowits Plateau. We also examine temporal patterns in the site types to determine changes in the use of the region. Table 7.7 presents the data for site type by sampling stratum. This table includes a listing of the inferred functions for all prehistoric temporal components (n = 744) rather than simply all prehistoric sites (n = 689). Row percents are the most meaningful way to look at the data, given the large differences in the number of sites among strata: from 6 to 160. The sampling strata are organized top to bottom according to approximate elevation, which also happens to coincide with a north-south gradient. Collet Top is the northernmost survey area and the highest along with Horse Mountain, whereas East Clark Bench is the southernmost and lowest. As is readily apparent from this table, site count increases dramatically with the first upward step in elevation from East Clark Bench to Nipple Bench. This trend was previously discussed in the sampling discussion of Chapter 4. The important point regarding the topic at hand is that there are too few sites in the East Clark Bench sample at present to have confidence that the observed site types are representative. It is of interest that we documented only hunting camps and reduction loci. This differs from the findings from approximately similar elevation benches above Glen Canyon, where sites identified as temporary residential or processing camps are well represented (Geib 1989:47–49; Collette and Spurr 2001).

The other eight sampling strata have adequate site numbers for examining patterns. Except for the small concentration of semi-permanent residential sites on Collet Top, there are few glaring differences at this level of comparison among the eight sampling strata; each has residential camps, processing camps, hunting camps, and reduction loci. The higher percentage of storage or cache sites on Collet Top is doubtless directly related to the frequency of Anasazi habitations in this area.

On both the Horse Flat and Collet Top sampling strata chaining programs had disturbed many sites. Unfortunately, we did not know that these areas had been chained until we started the survey, at which point it was too late to redesign the sampling strategy. Chaining no doubt is a fac-

Table 7.7. Site types by sampling stratum; includes all 744 prehistoric components at 689 Native American sites.

	Semi-Permanent Habitation		Residential Camp		Processing Camp		Hunting Camp		Reduction Locus	
Sampling Stratum	n	%	n	%	n	%	n	%	n	%
Collet Top	11	6.9	34	21.3	33	20.6	45	28.1	6	3.8
Horse Mountain	0	0.0	19	17.3	12	10.9	30	27.3	28	25.5
Long Flat	0	0.0	18	14.2	45	35.4	30	23.6	23	18.1
Horse Flat	0	0.0	1	2.8	8	22.2	6	16.7	10	27.8
Fourmile Bench	1	0.7	14	9.7	30	20.8	47	32.6	19	13.2
Smoky Mtn.	0	0.0	6	7.4	16	19.8	33	40.7	3	3.7
Brigham Plains	1	2.3	1	2.3	9	20.9	13	30.2	14	32.6
Nipple Bench	0	0.0	2	5.4	10	27.0	6	16.2	6	16.2
East Clark Bench	0	0.0	0	0.0	0	0.0	2	33.3	4	66.7
Total	13	1.7	95	12.8	163	21.9	212	28.5	113	15.2

(Table 7.7, Part 2)

	Storage/ Cache		Unknown Function		Other		Total	
Sampling Stratum	n	%	n	%	n	%	n	%
Collet Top	6	3.8	25	15.6	0	0.0	160	100.0
Horse Mountain	0	0.0	21	19.1	0	0.0	110	100.0
Long Flat	1	0.8	9	7.1	1	0.8	127	100.0
Horse Flat	1	2.7	10	27.8	0	0.0	36	100.0
Fourmile Bench	0	0.0	31	21.5	2	1.4	144	100.0
Smoky Mtn.	1	1.2	22	27.2	0	0.0	81	100.0
Brigham Plains	0	0.0	5	11.6	0	0.0	43	100.0
Nipple Bench	0	0.0	13	35.1	0	0.0	37	100.0
East Clark Bench	0	0.0	0	0.0	0	0.0	6	100.0
Total	9	1.2	136	18.3	3	0.4	744	100.0

tor in producing enigmatic collections of remains, ones that were classified as "unknown function." It is perhaps no coincidence that Horse Flat has a high proportion of sites of this unknown group. Site 42KA4653, a small sparse lithic scatter within the chained area, is typical of many sites on Horse Flat placed in the unknown type category. The entire site area has been chained, causing a dispersal and probably burial of artifacts; large piles of dead trees are scattered across the site. The lithic assemblage consists of an odd assortment of fewer than 25 flakes and a single tool, and makes little sense as a coherent, behaviorally meaningful set of remains. There are several flakes from heavy-duty cobble tools, there are several flakes from the reduction (probably resharpening) of late stage bifaces, and there are several chert core reduction flakes. The one tool at the site is a side scraper. There is no evidence of cultural features, and temporal affiliation is unknown. This site may have been from just a single episode of activity, but the types of artifacts do not give a cohesive view of the type of activity that took place. It is difficult to know whether the nature of the assemblage is the result of chaining or actually reflects prehistoric activity.

Another trend that is evident from Table 7.7 is for sites identified as residential bases to occur more frequently within the sampling strata that are higher in elevation. Collet Top and Horse Mountain are the highest strata and they have the highest proportion of residential bases, 21 and 17 percent respectively, compared to just 7 percent for Smoky Mountain and 2 percent for Brigham Plains. Elevation is not the only aspect of this trend: Horse Flat is essentially as high in elevation as Long Flat, yet just a single residential site was recognized in the sample units for this frame, as

compared to 14 percent of the sites on Long Flat. Differences among the sampling strata in accessibility along commonly used travel corridors and the availability of water might be important considerations. Long Flat is more centrally located along the north-south travel corridors provided by Wahweap Creek and its large tributaries such as Tommy Smith Creek. Permanent springs are also more numerous on Long Flat.

Hunting and processing camps are fairly evenly distributed across the four sampling strata with Long Flat having the highest incidence. We are not sure why there are fewer comparable processing camps on Horse Mountain. The one odd pattern is for reduction loci to have a proportionally greater representation in the two areas that essentially lack local knapping resources—Brigham Plains and Horse Flat. It is not surprising that both Horse Mountain and Long Flat have these sites, because Paradise chert/chalcedony and Canaan Peak cobble chert are available in both areas. If the 32 percent of the Brigham Plains sites identified as reduction loci are truly identified correctly, then the reduction must have been with tools or nodules brought in from elsewhere. Many of these sites could be those discussed above under this site type, which consist of debris from resharpening bifaces and other tools rather than the intensive reduction of a single tool or nodule during the fabrication stage. Drawing a sort distinction between fabrication loci and those used for tool resharpening or refurbishment will depend on future surveyors being cognizant of it in the field, because it is difficult to do so after the fact by simply reading the site forms. Smoky Mountain has the percentage of reduction loci (4%) that we might expect to see on a landform that essentially lacks flakeable stone.

Site Types by Temporal Affiliation

Table 7.8 presents the data for site type by temporal affiliation. Again, row percents are given and the table lists the inferred functions for all prehistoric temporal components rather than simply all prehistoric sites. In this table, the temporal intervals are organized top to bottom according to decreasing age. The Archaic general category is, as discussed previously under temporal assignment, a general placement within the Archaic period, usually made on the basis of Elko Series points accompanied by patinated artifacts. We have summed all Archaic sites together to provide an overall comparison between this period and the others. Archaic subperiods doubtless provide a more useful way for looking at trends, but unfortunately, none of the Archaic subperiods has a sample size that begins to be meaningful.

It is not surprising that few of the temporally unknown sites are identified as residential camps, a site type that, along with hunting camps, has the greatest chance of containing diagnostic artifacts or some means for providing a temporal estimate. If we look at the frequency of residential sites within major temporal intervals (Archaic, Formative, and Post-Formative), the Post-Formative period stands out as having fewer examples of this type. Yet, more than 40 percent of the Post-Formative sites are identified as processing camps, compared to far fewer of these for the Formative and Archaic periods. This seems to result because Post-Formative residential sites are sparse in remains compared to those of the Archaic, thus they tend to be identified as processing camps, though they may be functionally equivalent to Archaic residential sites. It seems we need a different measuring stick because the remains from the Post-Formative are quantitatively different from those of the Archaic and Formative. There is further discussion of this trend in Chapter 8 of this report.

All time periods have a good representation of hunting camps, but the early and middle Archaic stand out with greater than 50 percent representation of this site type, with almost half of the late Archaic components identified as hunting camps. In contrast, just 10 percent of the early and middle Archaic sites are represented by processing camps, with just under 14 percent of the late Archaic sites identified as processing related. The high representation of Archaic hunting camps, especially in contrast to processing camps, could well be a result of where diagnostic points occur. Hunting camps by definition contain projectile points and these are the only means to assign open sites to Archaic subperiods. In other words we have a degree of unavoidable circularity because the same evidence that we use for temporal assignments also plays a part in making functional determinations. Archaic processing camps, which typically lack points, may have a low probability of being identified as belonging to some specific Archaic subperiod, barring radiocarbon dates.

Temporal assignment of reduction loci should generally be low if these sites truly fit the ideal case of limited lithic reduction. This is so because there should be a low probability of discarding a temporally diagnostic artifact. Temporally unknown sites have the highest representation within this site type, which fits our expectation;

Table 7.8. Site types by temporal affiliation; includes all 744 prehistoric components at 689 Native American sites.

	Semi-Permanent Habitation		Residential Camp		Processing Camp		Hunting Camp		Reduction Locus	
Temporal Affiliation	n	%	n	%	n	%	n	%	n	%
Unknown	0	0.0	6	2.7	52	23.4	34	15.3	54	24.3
Archaic	0	0.0	42	18.1	44	19.0	82	35.3	27	11.6
Early Archaic	0	0.0	2	7.4	2	7.4	20	74.1	2	7.4
Middle Archaic	0	0.0	2	8.0	1	4.0	16	64.0	2	8.0
Late Archaic	0	0.0	9	24.3	5	13.5	18	48.6	3	8.1
Archaic total	0	0.0	55	17.1	52	16.2	136	42.4	34	10.6
Formative	12	10.3	29	24.8	25	21.4	21	17.9	9	7.7
Formative/Post-Formative	0	0.0	0	0.0	14	36.8	8	21.0	10	26.3
Post-Formative	0	0.0	6	13.0	20	43.5	13	28.3	6	13.0
Total	13	1.7	95	12.8	163	21.9	212	28.5	113	15.2

(Table 7.8, Part 2)

	Storage/ Cache		Unknown Function		Other		Total	
Temporal Affiliation	n	%	n	%	n	%	n	%
Unknown	0	0.0	75	33.8	1	0.4	222	100.0
Archaic	1	0.4	34	14.7	2	0.9	232	100.0
Early Archaic	0	0.0	1	3.7	0	0.0	27	100.0
Middle Archaic	0	0.0	4	16.0	0	0.0	25	100.0
Late Archaic	1	2.7	1	2.7	0	0.0	37	100.0
Archaic total	2	0.6	40	12.5	2	0.6	321	100.0
Formative	7	6.0	14	12.0	0	0.0	117	100.0
Formative/Post-Formative	0	0.0	6	15.8	0	0.0	38	100.0
Post-Formative	0	0.0	1	2.2	0	0.0	46	100.0
Total	9	1.2	136	18.3	3	0.4	744	100.0

moreover, almost half (48%) of all reduction loci are within the temporally unknown group.

Site Types Within Sampling Strata by Temporal Affiliation

A more cumbersome but likely more informative method to look at the distribution of site types across the Kaiparowits Plateau sampling strata is to partition them by temporal period as in Table 7.9. This should especially be true when the sample of sites within specific periods increases. As it currently stands, there are too few sites in many of the table cells to be certain whether trends in the data are real. It will be particularly important to increase the number of sites that are assigned to specific intervals based on chronometric methods or other means. This is the one sure way to partially circumvent the circularity of using projectile points as both temporal diagnostics and functional indicators. Likely there will always be some circularity between temporal and functional assignments, even when using radiocarbon dates because some site types have a greater chance to yield carbon samples than other sites.

By partitioning the data this way, some previously undisclosed patterns are evident. For the sites identified as residential camps, we see that most of those of the Archaic period are located at the higher elevations on Collet Top, Horse Mountain, and Long Flat. Few examples of Archaic residential camps are located on lower elevation sampling frames, with none on Brigham Plains and just 5 percent on Smoky Mountain. In contrast, Formative age residential camps occur more equally within all sampling strata. Admittedly sample sizes are very low, but the same trend is seen with processing camps. As argued earlier (also below and in Chapter 8), many examples of processing camps might be functionally no different than residential camps, simply scaled-down

Table 7.9. Site types by temporal affiliation within each sample stratum; includes all 744 prehistoric components at 689 Native American sites.

Temporal Affiliation	Sample Stratum	Semi-Permanent Habitation n	Semi-Permanent Habitation %	Residential Camp n	Residential Camp %	Processing Camp n	Processing Camp %	Hunting Camp n	Hunting Camp %	Reduction Locus n	Reduction Locus %	Storage/Cache n	Storage/Cache %	Unknown n	Unknown %	Other n	Other %	Total
Unknown	CT	0	0.0	2	6.7	5	16.7	8	26.7	2	6.6	0	0.0	13	43.3	0	0.0	30
	HM	0	0.0	1	3.6	8	28.6	2	7.1	10	35.7	0	0.0	7	25.0	0	0.0	28
	LF	0	0.0	2	4.0	23	46.0	5	10.0	14	28.0	0	0.0	5	10.0	1	2.0	50
	HF	0	0.0	0	0.0	0	0.0	0	0.0	5	45.5	0	0.0	6	54.5	0	0.0	11
	FB	0	0.0	0	0.0	6	14.3	6	14.3	11	26.2	0	0.0	19	45.2	0	0.0	42
	SM	0	0.0	1	4.3	6	26.1	1	4.3	1	4.3	0	0.0	14	60.9	0	0.0	23
	BP	0	0.0	0	0.0	3	13.0	10	43.5	6	26.1	0	0.0	4	17.4	0	0.0	23
	NB	0	0.0	0	0.0	1	8.3	2	16.7	2	16.7	0	0.0	7	58.3	0	0.0	12
	ECB	0	0.0	0	0.0	0	0.0	0	0.0	3	100.0	0	0.0	0	0.0	0	0.0	3
Archaic (general)	CT	0	0.0	15	28.3	11	20.8	19	35.8	1	1.9	0	0.0	7	13.2	0	0.0	53
	HM	0	0.0	11	26.2	2	4.8	12	28.6	10	23.8	0	0.0	7	16.7	0	0.0	42
	LF	0	0.0	9	26.5	9	26.5	12	35.3	4	11.7	0	0.0	0	0.0	0	0.0	34
	HF	0	0.0	0	0.0	6	40.0	2	13.3	3	20.0	1	6.7	3	20.0	0	0.0	15
	FB	0	0.0	5	9.6	11	21.2	22	42.3	3	5.8	0	0.0	9	17.3	2	3.8	52
	SM	0	0.0	1	5.5	2	11.1	11	61.1	1	5.6	0	0.0	3	16.7	0	0.0	18
	BP	0	0.0	0	0.0	0	0.0	1	33.3	2	66.7	0	0.0	0	0.0	0	0.0	3
	NB	0	0.0	1	7.7	3	23.1	2	15.4	2	15.4	0	0.0	5	38.4	0	0.0	13
	ECB	0	0.0	0	0.0	0	0.0	1	50.0	1	50.0	0	0.0	0	0.0	0	0.0	2
Early Archaic	CT	0	0.0	1	25.0	0	0.0	3	75.0	0	0.0	0	0.0	0	0.0	0	0.0	4
	HM	0	0.0	1	20.0	0	0.0	2	40.0	1	20.0	0	0.0	1	20.0	0	0.0	5
	LF	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	1
	HF	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	1
	FB	0	0.0	0	0.0	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	2
	SM	0	0.0	0	0.0	1	7.7	12	92.3	0	0.0	0	0.0	0	0.0	0	0.0	13
	BP	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1
	NB	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	ECB	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Middle Archaic	CT	0	0.0	0	0.0	0	0.0	3	100.0	0	0.0	0	0.0	0	0.0	0	0.0	3
	HM	0	0.0	0	0.0	0	0.0	1	25.0	1	25.0	0	0.0	2	50.0	0	0.0	4
	LF	0	0.0	2	40.0	0	0.0	2	40.0	1	20.0	0	0.0	0	0.0	0	0.0	5
	HF	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	1
	FB	0	0.0	0	0.0	1	16.7	4	66.7	0	0.0	0	0.0	1	16.7	0	0.0	6
	SM	0	0.0	0	0.0	0	0.0	4	80.0	0	0.0	0	0.0	1	20.0	0	0.0	5
	BP	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	NB	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	1
	ECB	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Late Archaic	CT	0	0.0	1	20.0	2	40.0	1	20.0	0	0.0	1	20.0	0	0.0	0	0.0	5
	HM	0	0.0	2	22.2	0	0.0	6	66.7	1	11.1	0	0.0	0	0.0	0	0.0	9
	LF	0	0.0	2	33.3	0	0.0	4	66.7	0	0.0	0	0.0	0	0.0	0	0.0	6
	HF	0	0.0	1	25.0	1	25.0	0	0.0	1	25.0	0	0.0	1	25.0	0	0.0	4
	FB	0	0.0	2	25.0	2	25.0	4	50.0	0	0.0	0	0.0	0	0.0	0	0.0	8

Table 7.9 (cont.)

Temporal Affiliation	Sample Stratum	Semi-Permanent Habitation n	%	Residential Camp n	%	Processing Camp n	%	Hunting Camp n	%	Reduction Locus n	%	Storage/ Cache n	%	Unknown n	%	Other n	%	Total
(Late Archaic continued)	SM	0	0.0	1	33.3	0	0.0	2	66.7	0	0.0	0	0.0	0	0.0	0	0.0	3
	BP	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	1
	NB	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	1
	ECB	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Archaic total	CT	0	0.0	17	26.2	13	20.0	26	40.0	1	1.5	1	1.5	7	10.8	0	0.0	65
	HM	0	0.0	14	23.3	2	3.3	21	35.0	13	21.7	0	0.0	10	16.7	0	0.0	60
	LF	0	0.0	13	28.3	9	19.6	18	39.1	6	13.0	0	0.0	0	0.0	0	0.0	46
	HF	0	0.0	1	4.8	7	33.3	4	19.1	4	19.1	1	4.8	4	19.1	0	0.0	21
	FB	0	0.0	7	10.3	14	20.6	32	47.1	3	4.4	0	0.0	10	14.7	2	2.9	68
	SM	0	0.0	2	5.1	3	7.7	29	74.4	1	2.6	0	0.0	4	10.3	0	0.0	39
	BP	0	0.0	0	0.0	1	20.0	1	20.0	3	60.0	0	0.0	0	0.0	0	0.0	5
	NB	0	0.0	1	6.7	3	20.0	4	26.7	2	13.3	0	0.0	5	33.3	0	0.0	15
	ECB	0	0.0	0	0.0	0	0.0	1	50.0	1	50.0	0	0.0	0	0.0	0	0.0	2
Formative (general)	CT	11	20.0	14	25.5	11	20.0	8	14.5	1	1.8	5	9.1	5	9.1	0	0.0	55
	HM	0	0.0	3	42.9	0	0.0	3	42.9	0	0.0	0	0.0	1	14.3	0	0.0	7
	LF	0	0.0	1	10.0	2	20.0	2	20.0	1	10.0	1	10.0	3	30.0	0	0.0	10
	HF	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	FB	1	5.3	5	26.3	3	15.8	6	31.2	3	15.8	0	0.0	1	5.3	0	0.0	19
	SM	0	0.0	3	23.0	4	30.8	1	7.7	1	7.7	1	7.7	3	23.1	0	0.0	13
	BP	1	20.0	1	20.0	1	20.0	1	20.0	1	20.0	0	0.0	0	0.0	0	0.0	5
	NB	0	0.0	1	12.5	4	50.0	0	0.0	2	25.0	0	0.0	1	12.5	0	0.0	8
	ECB	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Formative/Post-Formative	CT	0	0.0	0	0.0	1	33.3	0	0.0	2	66.7	0	0.0	0	0.0	0	0.0	3
	HM	0	0.0	0	0.0	1	12.5	2	25.0	2	25.0	0	0.0	3	37.5	0	0.0	8
	LF	0	0.0	0	0.0	3	50.0	1	16.7	1	16.7	0	0.0	1	16.7	0	0.0	6
	HF	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	FB	0	0.0	0	0.0	5	55.6	2	22.2	2	22.2	0	0.0	0	0.0	0	0.0	9
	SM	0	0.0	0	0.0	1	33.3	1	33.3	0	0.0	0	0.0	1	33.3	0	0.0	3
	BP	0	0.0	0	0.0	1	16.7	1	16.7	3	50.0	0	0.0	1	16.7	0	0.0	6
	NB	0	0.0	0	0.0	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2
	ECB	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	1
Post-Formative	CT	0	0.0	1	14.3	3	42.8	3	42.8	0	0.0	0	0.0	0	0.0	0	0.0	7
	HM	0	0.0	1	14.3	1	14.3	2	28.6	3	42.9	0	0.0	0	0.0	0	0.0	7
	LF	0	0.0	2	13.3	8	53.3	4	26.7	1	6.7	0	0.0	0	0.0	0	0.0	15
	HF	0	0.0	0	0.0	1	25.0	2	50.0	1	25.0	0	0.0	0	0.0	0	0.0	4
	FB	0	0.0	2	33.3	2	33.3	1	16.7	0	0	0	0.0	1	16.7	0	0.0	6
	SM	0	0.0	0	0.0	2	66.7	1	33.3	0	0	0	0.0	0	0.0	0	0.0	3
	BP	0	0.0	0	0.0	3	75.0	0	0.0	1	25.0	0	0.0	0	0.0	0	0.0	4
	NB	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0
	ECB	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Total		13	1.7	95	12.8	163	21.9	212	28.5	113	15.2	9	1.2	136	18.3	3	0.4	744

versions with fewer remains due to no reoccupation or smaller social groups. As concerns the Formative period, the southern tip of Jack Riggs Bench may offer limited farming opportunities in small alluviated drainages. The one semipermanent residential site that we recorded on this bench and an unrecorded example located outside a survey unit attest to more intensive residential use of this area than for most other periods. Small farming niches perhaps allowed for more intensive settlement of lower elevation settings than was possible for foraging groups.

The near lack of processing camps for the Archaic subperiods may be real, but we tend to think that it is the result of our necessary reliance on projectile points to assign sites to the Archaic subperiods. The large quantity of processing camps of unknown temporal affiliation probably includes some dating to the Archaic period. Formative and Post-Formative processing camps occur in all of the sampling strata except for East Clark Bench, a pattern that mirrors the residential bases.

Problems and Prospects with Site Type Assignments

Examining computer printouts of artifact and feature data for each site type, grouped by temporal period and other means, reveals a few disconcerting patterns that seem at odds with our site type definitions. The subjective or intuitive nature of NNAD's site classification is not the root of the problem, because even multivariate statistical grouping of site data does not guarantee results that are any more interpretable or problem free. The formal attributes of any site typology can be defined and operationalized on paper in a neat and tidy fashion, but seldom is the archaeological record correspondingly neat, tidy, and easily fit within the pigeonholes of a site typology. A confounding tangle of unknowns prevents a simple straightforward reconstruction of both the general roles of sites in subsistence-settlement systems and the specific activities that were performed. There is the bemoaned linkage problem between archaeological remains and past behavior (Thomas 1983: 20–23, 70–87), exacerbated by the complex accretional history of most sites and various postdepositional processes.

The ability to decipher the complicated texts of surface archaeological remains is, in large part, dependent upon the field methods used. The more exact, consistent, and fine grained these can be, the better the chances of controlling for the sources of variability that are responsible for the formation of the archaeological record. Although detailed mapping and recording of sites may allow individual occupations to be separated (see Sullivan 1992), the utility of making observations at the smallest definable scale of spatial integrity is readily apparent. In this regard, some archaeologists advocate making individual artifacts and features, rather than sites, the basic units of archaeological observation and analysis (e.g., Dunnell and Dancey 1983; Ebert 1988, 1992; Ebert and Kohler 1988; Foley 1981). There are potential benefits to such an approach, but there are drawbacks too, not the least of which is the greater cost per unit of land to document the archaeological record (per acre cost).

Regardless, NNAD was contracted to conduct a site-based survey. This does not mean that we blindly forged ahead assuming that sites are inherently useful units of analysis, because in many cases they are not. It is especially important to differentiate between sites with potentially simple or potentially complex use histories. Sequential reuse of certain localities on the Kaiparowits Plateau is likely because the environmental factors that influence the choice of specific settlement location, particularly water, are spatially restricted. It is therefore expectable that a great deal of variability in the archaeological record could result from the reuse of places, particularly locations that were preferred for residential camps (see Binford 1982). Several locations on the Kaiparowits Plateau present the most problematic expressions of reuse, where entire ridgetops or other broad areas are blanketed with remains at varying densities, left at various times during prehistory. The central portion of Paradise Bench represents a good example of this, not only because of what was clearly intensive use resulting in multiple overlapping artifact scatters, but also because vast areas are deflated and sheetwashed, creating an almost unpartitionable scatter (see the Chapter 1 discussion of site definition problems). Lumping spatial loci of remains together under the unifying site concept is a common field recording procedure, but the site is then usually interpreted based on the sum of remains, which often yields a different picture than interpreting the parts individually. The sum is not only greater than the parts, but misinforms. Geib and Bremer (1996) illustrated some of the problems with making functional assignments for sites that consist of multiple artifact or feature loci; Kearns (1982:289) discussed similar problems for the Escalante Project.

Grappling with Multicomponency

One critical aspect of field recording is recognizing multiple-component sites, so that the remains of different periods can be evaluated separately. Field crews on the Kaiparowits Plateau Survey did their best to keep this in mind, and observation of artifact patina eventually became a useful indicator of potential situations of site reoccupancy. Of the 689 Native American sites that NNAD recorded, 55 (8%) were identified as clearly containing multiple prehistoric components. At least 3 of 55 have three components,[7] but because the IMACS site form does not allow coding for more than two, our site database does not tally them—there are a minimum of 744 components rather than 747. For the 55 cases, we attempted to evaluate site function individually for each component and to list these on the site forms. For example, 42KA5228 on Fourmile Bench is classified as a late Archaic processing camp and a Formative camp probably also used for processing. Gypsum points and patinated flaked stone artifacts provided evidence for the late Archaic component, whereas sherds and unpatinated flakes provided evidence for Formative use. These remains occupied somewhat different loci.

Fifty-five sites have identifiable dual components. There are six sites with multiple Archaic components (early with middle and late and middle with late), but most of the multiple-component sites consist of Formative or Post-Formative reoccupation of Archaic sites: 24 cases of combined Formative and Archaic components, 11 cases of combined Post-Formative and Archaic components, and 7 cases of combined Formative/Post-Formative and Archaic components. Two examples of these dual-component sites are illustrated (Figures 7.15 and 7.16) and briefly characterized to provide the reader with a notion of their nature. The case of 42KA4756 (Figure 7.15) was mentioned under alternative dating methods, because differential patina suggested the possibility of two temporal components; the finding of temporal diagnostics confirmed the validity of the patina evidence. The Formative component consists of a small but dense concentration of abundant pressure flakes and percussion thinning or shaping flakes from very late stage bifaces (more than 500 flakes at densities of 20 per sq m). Most of this debris appears to be heat treated and consists of many exotic looking, colorful, high-quality silicates such as agatized wood and colored chalcedony. This flake concentration occurs within the middle of a diffuse but extensive scatter of debitage, flaked stone tools, grinding tools, and fire-cracked rock. Debitage across the rest of the site is patinated and derived from a mixture of simple core reduction and biface reduction, with comparatively little emphasis on pressure flaking. The core reduction debris is mainly derived from cobble choppers and scraper planes made of coarse materials such as quartzite and metasediment; much of it is encrusted with carbonate. The Archaic remains appear to result from sequential reuse of the location as a residential camp and perhaps other uses as well; the Formative remains appear to result from use of the location as a hunting camp. If we had not observed that a Formative component was present, our interpretation of the site as an Archaic residential camp would not have changed. We would, however, have been impressed by how much pressure flaking debris there was and by the unusually high incidence of nonlocal raw materials. Not observing the Formative component would have been a more significant loss to the record for that period. This and similar Formative hunting camps and their lithic assemblages are a fascinating piece of Kaiparowits Plateau prehistory and illustrate one type of specialized use of the study area.

The second example of a two-component site (42KA4787, Figure 7.16) has a Post-Formative hunting camp and a late Archaic hunting camp. The components are spatially discrete, consisting of two small loci of debitage and flaked stone tools. Because of a general diffuse scatter that surrounds the loci they were recorded as part of the same site. The only remains assuredly associated with the Post-Formative component are two Desert Side-notched point bases and several obsidian pressure flakes. In contrast, the late Archaic component contains two Gypsum points, three bifaces, and a moderate density of mainly percussion biface reduction flakes. In this case the functional interpretation of the site as a hunting camp applies to both components, but important differences between the components are lost in the aggregate. The Archaic component contains no obsidian, whereas the Post-Formative component contains no clearly associated bifaces. The flaking debris is different, as is the overall quantity of remains. The site form reads that there are 100–500

[7] For example site 42KA4797 on Jack Riggs Bench (Brigham Plains sampling stratum) is described in the Site Type field on the IMACS form as Multicomponent: Archaic reduction locus; Formative processing camp; Post-Formative residential camp.

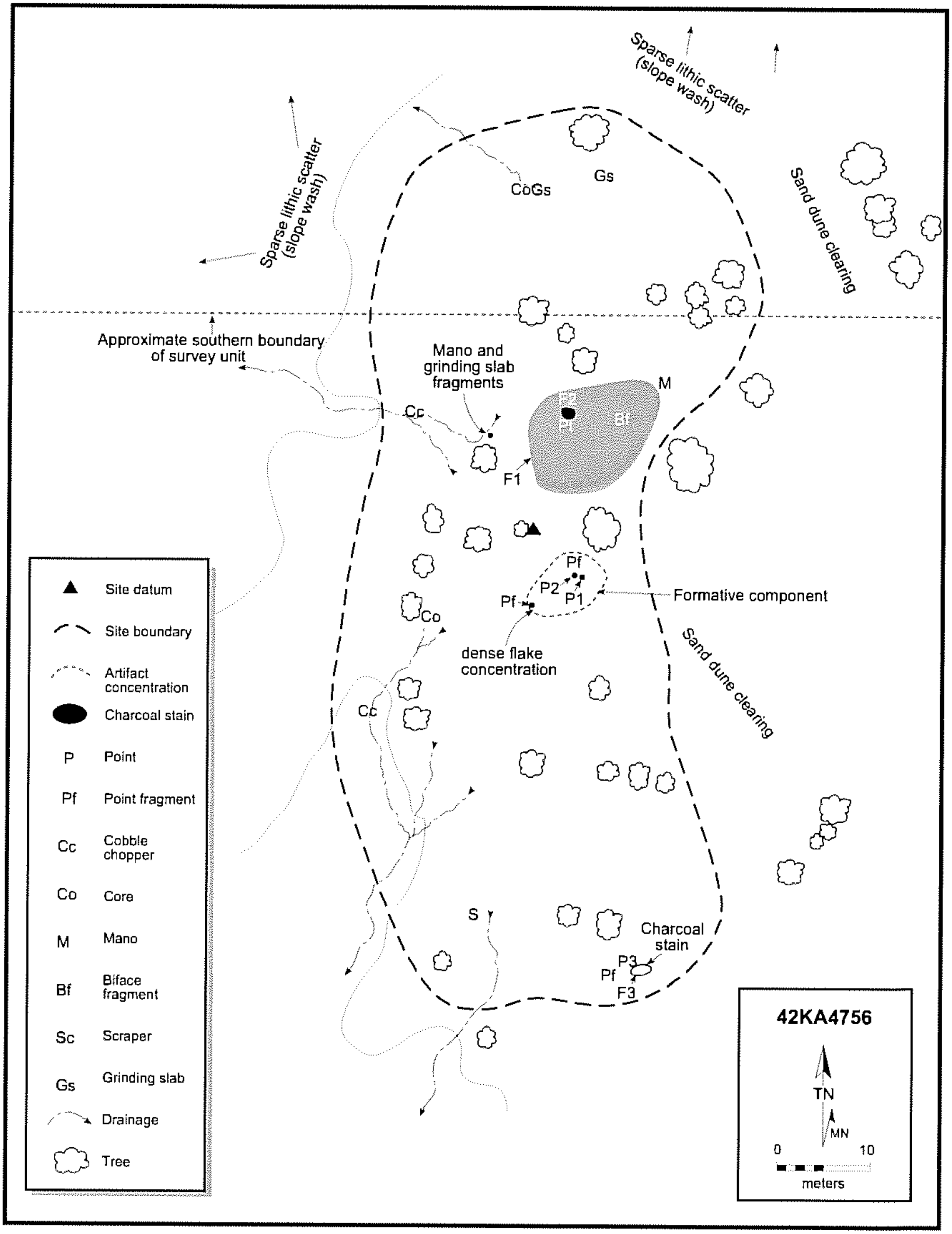


Figure 7.15. Plan map of 42KA4756, a two-component site on Paradise Bench.

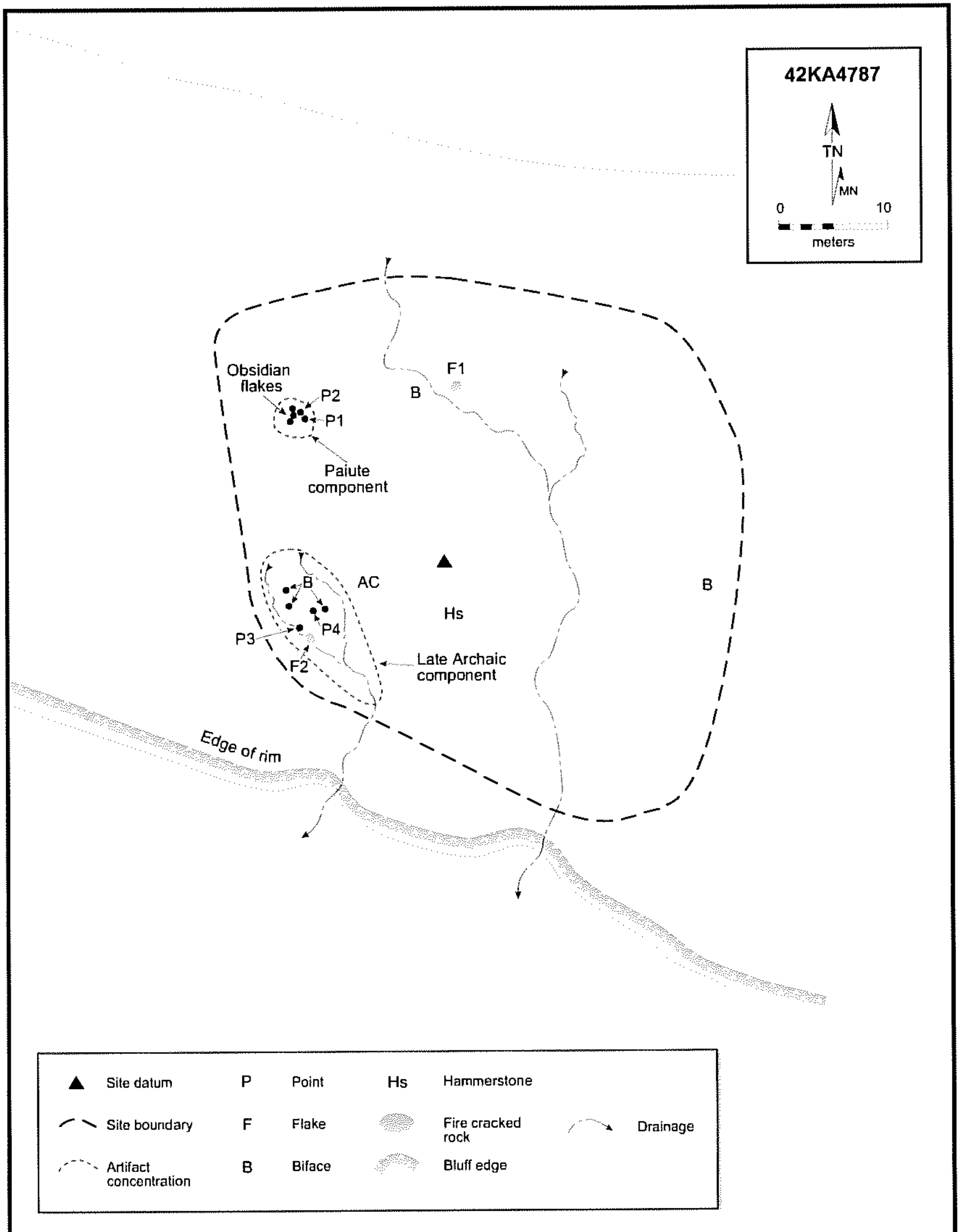


Figure 7.16. Plan map of 42KA4787, a two-component site on Paradise Bench.

flakes and that Paradise chert/chalcedony is predominant (this from the late Archaic component), yet the Post-Formative component consists of just three obsidian pressure flakes.

During the Phase 1 effort NNAD archaeologists recognized three sites with three components: 42KA4567 on Horse Flat, 42KA4689 on Paradise Bench (Horse Mountain Stratum), and 42KA4797 on Jacks Riggs Bench (Brigham Plains stratum). These are described here because they are representative of what is perhaps a common situation on the Kaiparowits Plateau. The first of these is an extensive scatter of lithic artifacts covering a large ridge at the southern edge of Horse Flat; the entire site area as mapped is roughly 279,000 sq m. Within this area NNAD archaeologists documented 40 projectile points, 14 bifaces, and many other stone tools. Diagnostic projectile points indicate use of the ridge during the three commonly recognized Archaic subperiods: early, middle, and late. The site may have been used during other intervals was well, though no firm evidence for this was found at the time of recording. Determining which remains might be associated with which time periods will require far more detailed mapping and analysis than was possible under the time constraints of our initial documentation. Further research at this site should even allow it to be partitioned into smaller entities, either as separate sites or as multiple loci that should more closely correspond with functional or temporal episodes. Because the artifacts and debitage distributed across the ridge seem hunting related and largely the same (the production and maintenance of projectile points and bifacial tools), we assume that the site principally functioned as a hunting camp throughout time.

The second site, 42KA4689, is a large scatter of lithic artifacts covering about 20,000 sq m on the slopes and crest of a sand-covered ridge on Paradise Bench; four hearths are within the site boundary, including a slab-lined hearth. Artifacts are generally diffusely scattered with occasional concentrations, which tend to occur in shallow deflation basins and may not represent loci of particularly greater reduction activity. Temporally diagnostic dart points indicate early and late Archaic occupancy; the occurrence of an arrow point preform, "freshly flaked" obsidian, and at least one hearth with surface charcoal chunks suggests a Post-Formative occupation as well. Again, the remains at this site are not easily differentiated as to which belong to which component. Such assignments might be possible with additional study, but as it is we have documented a moderately diverse and large assemblage of remains with features, which has the appearance of a residential camp. Perhaps the site did function for this purpose or perhaps the diversity is the result of reuse of the location for more limited activities, creating the appearance of a large and diverse assemblage of remains.

Site 42KA4797 on Jack Riggs Bench presents a different situation, one where the temporal components are separable and functional assignments can be suggested for each component. This site consists of an extensive scatter of cultural remains covering an area of roughly 15,000 sq m on a low bedrock ridge next to a drainage with sandstone outcrops providing slight shelters (Figure 7.17). There are several discrete concentrations of remains with a generally diffuse scatter of materials in between; temporally diagnostic artifacts allowed the field crew to identify separate loci of remains corresponding to separate intervals of occupancy and to suggest possible functions. Formative and Post-Formative remains are clustered along the base of a low sandstone scarp around two small shelters that face southeast onto a small sage-covered alluviated drainage. Other remains, some of which are likely Archaic in age, are scattered on the sandy flat above (north of) the sandstone scarp. The eastern portion of the site, focused around rockshelter B, is designated the Paiute Locus; here there are several hearths with surface charcoal and bone (Features 2 and 3), a general scatter of burned rock and bone, and flaked and ground stone artifacts including Desert Side-notched points. Most of the remains are clustered close to the small shelter. Based on the features and types of remains, it seems likely that this locus was used as a temporary residential camp. One of the hearths (Feature 3) probably associated with the Paiute locus was tested, but not radiocarbon dated because no high-quality radiocarbon samples were recovered. Burned and unburned artiodactyl bone and fragments of large mammal bone occurred in and around the feature.

Southwest of the Paiute locus along the base of the sandstone scarp is the Anasazi locus, a generally diffuse scatter of sherds, flakes, flaked stone tools, and some burned rock. One area of charcoal-stained soil and burned rock might be a light-density midden and there are two possible hearths. Other remains are likely buried in this area or obscured by the dense sage cover. It is conceivable that the Anasazi occupied this location because they were farming the drainage bottom

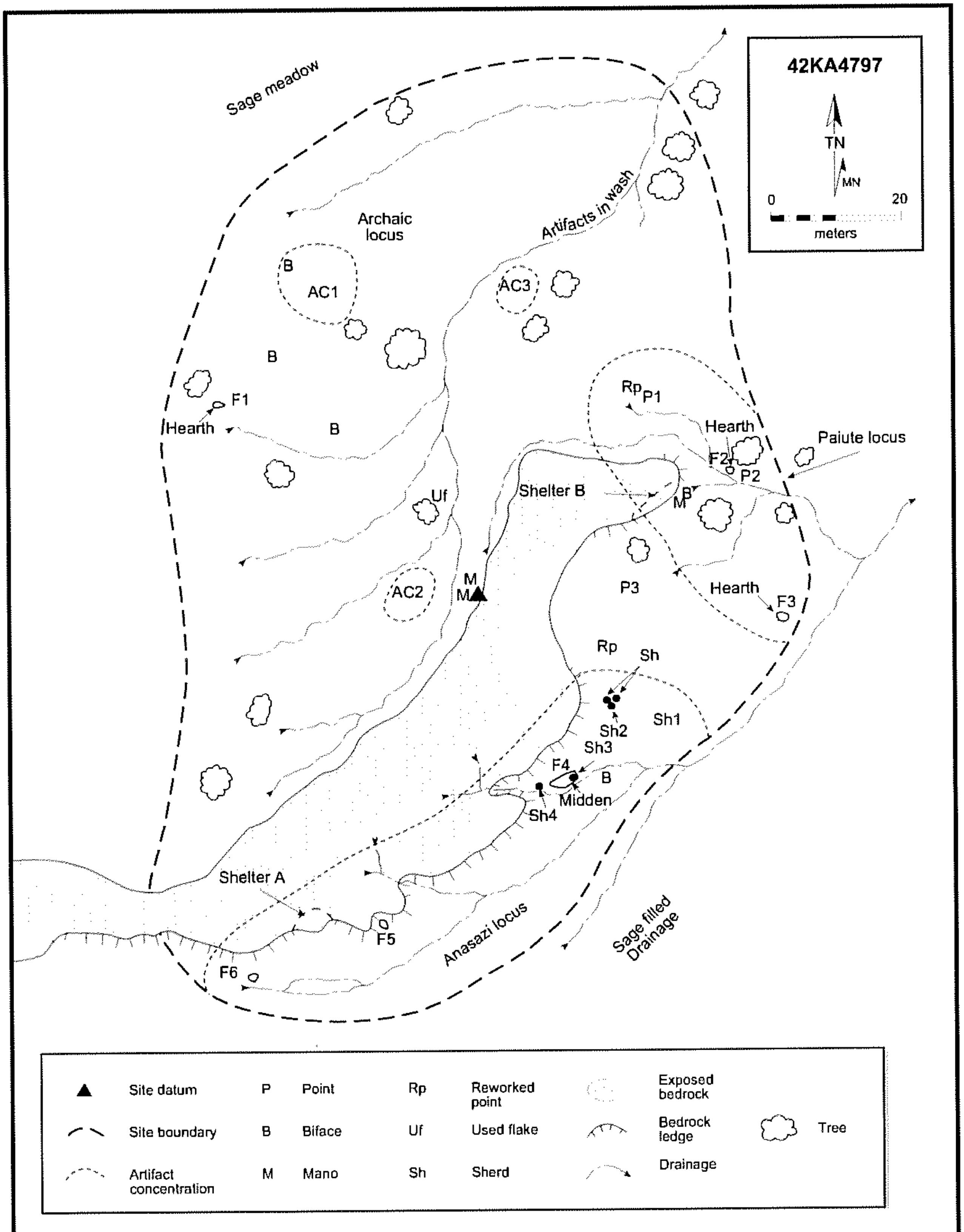


Figure 7.17. Plan map of 42KA4797 a three-component site or Jack Riggs Bench.

immediately southeast of the site; the Anasazi remains are likely associated with two close-by Anasazi habitations: 42KA4733 and one outside the survey unit.

On the flat above the sandstone scarp are three concentrations of flaked stone artifacts surrounded by a sparse scatter of flakes and some stone tools. The densest of the scatters is artifact concentration 2 (AC2), containing about 200 flakes at a density of 15 per sq m. Most of the flakes appear to have come from two or three nodules or flakes of Paradise chert that were entirely reduced on the location to produce late stage bifaces (at least Stage 4). The nodules were heat treated early in the reduction process because many of the cortical flakes were removed after heating. Mixed with the white chert are general biface reduction flakes of other materials. None of the flakes at AC2 are patinated; all look freshly flaked and are probably part of the Paiute or Anasazi occupations. Artifact concentrations 1 and 3 are at the northern edge of the site; both are slope-washed scatters of mostly white chert core and biface reduction debris. Most of the debitage appears somewhat patinated and older than the flaking debris at AC2. These concentrations and the surrounding diffuse scatter of remains might be Archaic in age and related to hunting in the area.

Site Size and Functional Inference

Site size is clearly an important variable in any analysis of site function. Size does not provide unambiguous functional insights (i.e., small size equals limited-activity sites and large size equals habitations), but size is important for differentiating between sites that have potentially simple and potentially complex use histories. Site size is substantially different among sites lacking obvious evidence of multiple components and those with a minimum of two components (Table 7.10). It makes intuitive sense that open sites will increase in size the more times they are occupied, especially if there are no natural geophysical constraints such as a narrow ridgetop or a rock outcrop that provides shelter. The tabulation of size data for the 689 Native American sites clearly shows that as field crews were able to identify cases of multiple occupancy, site size also increased, from a mean of 3632 sq m for reputed single-component sites to a mean of 14,334 sq m for multi-component sites. Because site size is directly related to the number of observed temporal components, it provides a method to help segregate the 634 sites identified as single component into groups with different probabilities of truly being single component. At these 634 sites, NNAD archaeologists found no firm evidence to argue for multiple occupancy. It is unlikely, however, that sites as large as those within the upper interquartile range (upper hinge) of the box-and-whisker plot of site size (Figure 7.18) are single component. These are sites greater than ca. 3500 sq m (an artifact scatter measuring roughly 59 by 59 m). More than half of the two-component sites are greater than 3500 sq m in size; at this dimension multiple componency is likely for scatters generated by foragers. Large sites could also result from situations such as single-use, multiple-family camps, as documented for communal hunting drives and festivals among the Great Basin Shoshoni (Steward 1938:34–35, 38–39, 54). Size can also increase by site reoccupancy within a single temporal period, as the remains of each successive occupation may only partially overlap those of previous times. An ethnographic account of this practice comes from Powell (Fowler and Fowler 1971:53):

> It is very rare that a site for a camp is occupied a second time and though they all go again year after year to camp near the same spring or small stream they invariably seek a new site for their bivouacs each time. When they leave a camp their bivouacs are not destroyed and so on coming to a customary camping place of the Utes, it gives the appearance of having been occupied by a very large tribe, and persons are easily led to suppose that thousands have been encamped there when in fact perhaps a small tribe of a dozen families have been the only persons who have occupied the ground for many years.

Site reoccupation can also result in very diverse and mixed assemblages if the reason for site use shifts from one season to the next. Small sites generally have artifact assemblages and features that are more clearly related to single-use episodes or noncomplex multiple-use episodes. As such, inferences about the settlement context of most small sites and the specific activities performed there have a greater degree of reliability.

Site size provides a method for partitioning the presumed single-component prehistoric sites of the Kaiparowits Plateau Survey into groups that might be more informative of general settlement roles and specific functions. On the small side are sites with a high probability of truly being single component and having simple use histories. On the large side are sites that no doubt are multicomponent and perhaps had changing settlement roles within a given temporal period—a residential camp one season, a hunting camp at a different season. Between these extremes are sites that may

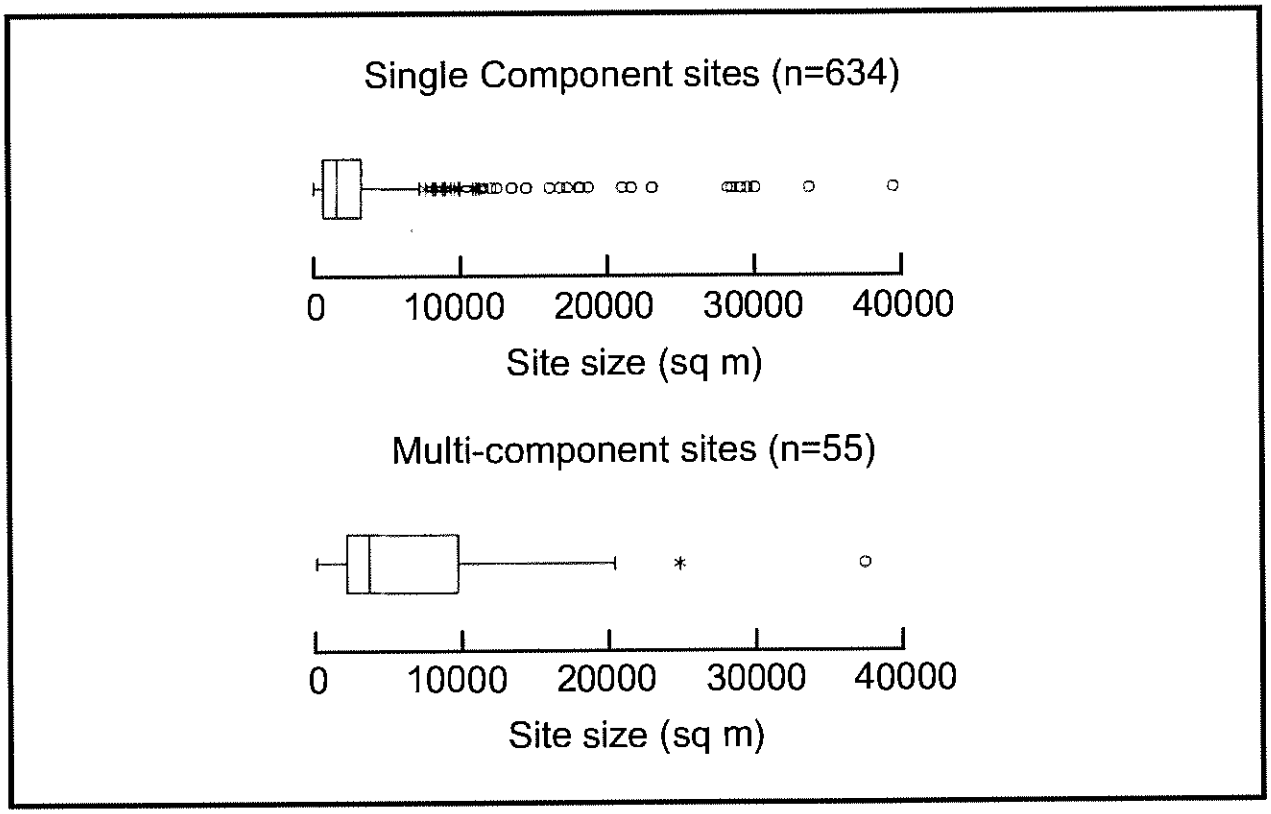


Figure 7.18. Box-and-whisker plots of site size (in square meters) for sites with one and two temporal components identified. Each plot has outlying values deleted; single-component sites 42KA4814 (70,000 sq m), 42KA5250 (60,515 sq m), 42KA5461 (61,605 sq m), and 42KA5544 (288,750 sq m); multi-component sites 42KA4567 (279,000 sq m), 42KA4572 (89,600 sq m), and 42KA5391 (55,180 sq m).

represent either single components or multiple components. Single-component sites of moderately large size can result from simple dispersion through time, the nature of activities and their spatial requirements, larger than normal social groups (multifamily camps), or multiple reuse over several seasons or years.[8] Deciding which of these possibilities actually pertains to a particular site is dependent upon a detailed analysis of the remains, one that is difficult to accomplish in most standard survey situations. The size groups that we created from the Kaiparowits Plateau Survey data set are shown in Table 7.11, along with which proportion of each group has two identified components. More than 30 percent of the sites in the largest group evidently contain remains from multiple occupations, as indicated by temporal diagnostics and other evidence of different temporal intervals. In contrast, just one site in the smallest group contains such evidence. Two sites of size group 2 are listed as having two components, but reevaluation of both, discussed below, indicates that they are likely single component.

The smallest size group (1) consists of 72 sites that are smaller than 300 sq m; this represents a site that measures less than 18 by 18 m. Tabulation of site type by size group, excluding sites that are identified as multiple component (Table 7.12), reveals that almost half of the small sites are processing camps and reduction loci, with hunting camps accounting for another 15 percent. Just six of the size group 1 sites are residential. Sites this small are believable cases of single-component and relatively briefly occupied settlements (i.e., ones with simple use histories). One of these sites is the single example of a Formative habitation found in the Brigham Plains stratum—the small two-room

[8]Recall that our use of the term component refers to major temporal intervals such as late Archaic and Post-Formative, and not reuse episodes within these intervals.

Table 7.10. Descriptive statistics for site size among single and multiple component sites.

	Total Sites	Sites with 1 Component	Sites with 2 or More Components
Number of sites (n)	689	634	551
Minimum size	3	3	114
Maximum size	288,750	288,750	279,000
Mean size (x)	4,486	3,632	14,334
Standard deviation	16,781	12,868	39,232
Median size	1,760	1,600	3,784
Skewness	14.0	17.9	6.0

Table 7.11. Tabulation of overall site count and count of multiple component sites by six site size groups.

Size Group	n	Percent	Count >1 Comp	Percent
<300 sq m	72	10.5	1	1.8
300–1205 sq m	201	29.2	4[a]	7.3
1206–2005 sq m	105	15.2	6	10.9
2006–4005 sq m	154	22.4	18	32.7
4006–8000 sq m	93	13.5	8	14.5
>8000 sq m.	64	9.3	18	32.7
Total	689	100.0	55	100.0

[a]Two of these are likely single component, as discussed in text.

Table 7.12. Site type by site size group for single-component sites.

Size Group	Semi-Permanent Habitation n	R%	C%	Residential Camp n	R%	C%	Processing Camp n	R%	C%	Hunting Camp n	R%	C%
1	1	1.4	7.7	5	7.0	7.1	19	26.8	12.9	11	15.5	6.7
2	3	1.5	23.1	14	7.1	20.0	42	21.3	28.6	39	19.8	23.6
3	1	1.0	7.7	8	8.1	11.4	21	21.2	14.3	26	26.3	15.8
4	7	5.1	53.8	13	9.6	18.6	34	25.0	23.1	47	34.6	28.5
5	1	1.2	7.7	16	18.8	22.9	23	27.1	15.6	24	28.2	14.5
6	0	0.0	0.0	14	30.4	20.0	8	17.4	5.4	18	39.1	10.9
Total	13	2.1	100.0	70	11.0	100.0	147	23.2	100.0	165	26.0	100.0

(Table 7.12, Part 2)

Size Group	Reduction Locus n	R%	C%	Storage/ Cache n	R%	C%	Unknown unction n	R%	C%	Other n	R%	C%	Total n	C%
1	16	22.5	15.2	6	8.5	66.7	12	16.9	9.8	1	1.4	33.3	71	11.2
2	47	23.9	44.8	3	1.5	33.3	49	24.9	40.2	0	0.0	0.0	197	31.1
3	18	18.2	17.1	0	0.0	0.0	24	24.2	19.7	1	1.0	33.3	99	15.6
4	16	10.3	13.3	0	0.0	0.0	21	15.4	17.2	0	0.0	0.0	136	21.5
5	10	11.8	9.5	0	0.0	0.0	11	12.9	9.0	0	0.0	0.0	85	13.4
6	0	0.0	0.0	0	0.0	0.0	5	10.9	4.1	1	2.2	33.3	46	7.3
Total	105	16.6	100.0	9	1.4	100.0	122	19.2	100.0	3	0.5	100.0	634	100.0

masonry pueblo on Jack Riggs Bench (see Figure 6.55). Two other examples are also Formative in age and consist of small shelters (sites 42KA4750 and Rose Shelter, 42KA4794). During survey there was no way to know whether Rose Shelter actually had a more complex history of use than was apparent from surface remains, but testing (see Chapter 5) revealed this not to be the case despite stratified cultural deposits. For each of these three small sites,[9] but especially the latter, the presence of natural constraints on space use, combined with physical features that promote site reuse, has served to limit the spread of remains.

Size group 2 consists of 201 sites between 300 and 1205 sq m, of which 197 are thought to be single component and 4 are perhaps multiple component. The largest sites in size group 2 are 1200 sq m. One of these (42KA4605) is a reduction locus that measures 20 by 60 m; it consists of 15 or so biface thinning flakes of identical chalcedony that are likely derived from resharpening a single tool. Another is one of the tested Archaic temporary residential camps (42KA4552) that measures 40 by 30 m (see Figure 7.10, with attributes listed in Table 7.4). Despite its small size, this site has a diversity of tools, a midden deposit, and hearths; it is one of the best examples of an Archaic residential camp because it is quite intact and contains buried cultural remains.[10] Other residential sites in size group 2 include the other Archaic residential sites (42KA4549) discussed and illustrated with site 42KA4552, and two on Paradise Bench: 42KA 4749 and the nearby site 42KA4750, both of which were tested (see Chapter 5). The latter site consists of a dense scatter of artifacts and fire-cracked rock (midden deposit) on a slope below a bedrock ledge that provides a sunny exposure and protection from the wind. This last site is another example of site setting serving to artificially confine the scatter of remains.

Most of the single-component sites in size group 2 are reduction loci (24%), processing camps (29%), or hunting camps (20%, see Table 7.12). Reduction loci occur most commonly within this size class (45%), which along with their occurrence in size group 1 and perhaps group 3 makes sense if the sites are truly limited-activity reduction locations. Note that this would not apply for raw material source areas with reduction, because these can be immense and used over the entire span of prehistory. For some reason, 40 percent of the sites of unknown type are within this size group. Perhaps the assemblages seemed enigmatic because some of these belong to an unidentified site type or even to some of the designated types but minus a few key tool types. It could be that scatters of this size frequently have so few remains that it is difficult to interpret them. The probabilities that specific tool types will be deposited at given locations should be factored in, though this is rarely done. Size group 3 is the one with the next largest representation of sites of indeterminate type (20%).

There are four recognized multiple-component sites in size group 2, but two of these appear anomalous (42KA4760 and 42KA4769). These two sites are actually toward the small end of this size group, measuring 378 sq m and 300 sq m in size respectively. The largest of these is a scatter just 21 by 18 m. It is perhaps telling that the next site recognized as multiple component (42KA4655) is more than three times larger in size, at 1210 sq m. Reexamination of the site forms reveals that there is no certain evidence for two components at either site. 42KA4760 consists of a small, moderately dense scatter mainly of unpatinated percussion and pressure flakes from the reduction of late stage bifaces or projectile points. Nonlocal agatized wood and other brightly colored chert and chalcedony are well represented. This assemblage is similar to that seen at the nearby Formative hunting camps of 42KA4756 and 4813, also on Paradise Bench, resulting in a tentative Formative/Post-Formative temporal assignment. Although most flakes are unpatinated, there are some patinated flakes along with a probable Elko Side-notched point base—consequently, the assigned Archaic affiliation. The problem in this case is that a sparse scatter of flakes blankets the entire central area of Paradise Bench, which likely accounts for the patinated flakes and tools on the site. The Formative/Post-Formative component

[9]Testing demonstrated that Rose Shelter had functioned as a hunting camp and should not be considered a residential site in the sense used here. We did not change the survey-based functional assignment because testing data are only available for a few sites.

[10]Testing revealed that the intact midden at this site contains an abundance of artifactual and non-artifactual remains; it also revealed that the site actually has two components separated in time by about 2200 radiocarbon years. Again we have not changed the component status, temporal affiliation, or site function of this site based on this new evidence. The midden deposit that provided the reason for classifying the site as a residential camp dates to the late Archaic so the designation of the site as an Archaic residential camp remains unchanged from the testing results. The site was subsequently reoccupied during the Archaic-Formative transition and used for some sort of limited activity processing (processing camp).

was designated for the concentration of probably younger remains, not the sparse scatter of probably older remains that occur everywhere in this portion of Paradise Bench.[11]

The other potentially anomalous small two-component site, 42KA4769, has a simpler explanation. It consists of a small, moderately dense scatter of remains, including a worked sherd, around a hearth. An Elko Eared point is the reason for a suggested Archaic temporal affiliation in addition to a Formative affiliation. As should be obvious from the point illustration (Figure 6.18e), this is a large artifact, in the size range of hafted knives. It is made on a flake of petrified wood that was percussion thinned and then heat treated and pressure flaked to its final form, plus the addition of notches. The pressure flake scars are unpatinated and not weathered—the flaking looks fresh. This artifact is insufficient evidence to suggest that the site had two occupations. Even if the artifact had been heavily patinated, the better assumption would be that it had been recycled or that it represents an isolated occurrence on a ridge used by later occupants.

In hindsight, it appears that both of the small sites were misidentified as having two components. It seems probable that most flaked stone artifact scatters in open settings less than about 600 sq m in size (24.5 by 24.5 m) are single component. Exceptions to this might occur under the presence of some natural constraint on the spread of remains combined with a physical feature or attribute that promotes site reuse—a cave or shelter are obvious reasons. Open sites above 600 sq m may have remains of multiple occupancy, but in the Kaiparowits Plateau sample the smallest certain example of a two-component site is 1210 sq m in size; it represents the first case of the next site size group.

The two middle size groups (3 and 4) are similar in the distribution of functional types (Table 7.12) with hunting camps and processing camps of comparable frequency among the groups and accounting for more than half of the single-component sites in both size groups. Reduction loci comprise another significant portion of size group 3, with this and residential camps each comprising about 10 percent of size group 4. The 105 sites of size group 3 (see Table 7.11) range from 1210 sq m to 2000 sq m, with several sites of this maximum size. Four of these sites measure 50 by 40 m, another 44 by 22 m. This size group is large enough that multiple-component sites or those with more complex use histories are possible and 6 percent of the group 3 sites (n = 6) are identified as having two components. Most of the rest of the sites in this group appear likely to be truly single component. The 154 sites of size group 4 range in area from 2010 sq m to 3900 sq m. The largest site in this group measures 65 by 60 m and is identified as a reduction locus. More than 10 percent (12%) of the group 4 sites contain evidence of multiple components.

It seems likely that time plays a role in making single-component sites larger. Tabulating temporal affiliation by size groups (Table 7.13) shows that significantly more of the Archaic sites occur in the larger size groups, whereas Formative and more recent age sites are mostly in the smaller size groups. For example, more than 60 percent of the sites in size groups 5 and 6 (4006–8000 sq m and > 8000 sq m) are Archaic in age compared to less than 10 percent of Formative age and less than 5 percent of Post-Formative age. Not only are Archaic sites larger in size on average, but they also have lower flake densities. Dispersion would result in both characteristics. More than 70 percent of Archaic single-component sites (72%) occur in size group 3 and above, with just 28 percent in groups 1 and 2 (sites < 1205 sq m). In contrast, more than half of the single-component Formative sites (56%) are in groups 1 and 2; of the most recent sites, those of Post-Formative age, just under 70 percent are in the two small size groups (69%). Forty-one percent of the single-component Archaic sites are in groups 3 and 4. Because of artifact dispersion with age, sites of groups 3 and 4 might still be readily interpretable (single component and of simple use history), especially if the sites are Archaic in age. It should be useful to evaluate each site in the field as to whether, and in what manner, natural forces have dispersed or concentrated remains so that this information can be factored in when inferring site function.

On the large end of the scale are sites that no doubt are multicomponent and perhaps had changing settlement roles within a given temporal period—a residential camp one season, a hunting camp in a different season. We created two large size groups, the largest consisting of 64 sites that

[11] In a real sense this problem arose from trying to partition the extensive blanket of flaked stone artifacts across the central portion of Paradise Bench into smaller, potentially more behaviorally meaningful pieces. Partitioning was done by concentrating on areas of comparatively greater artifact density and concentration and ignoring the background noise. In this case, the noise added a second component to the site.

Table 7.13. Temporal affiliation by site size groups for single-component sites.

Size Group	Unknown n	Unknown R%	Unknown C%	Archaic n	Archaic R%	Archaic C%	Formative n	Formative R%	Formative C%
1	33	46.5	14.9	10	14.1	3.7	16	22.5	18.6
2	74	37.6	33.5	66	33.5	24.7	32	16.2	37.2
3	36	36.4	16.3	43	43.4	16.1	11	11.1	12.8
4	44	32.4	19.9	67	49.3	25.1	17	12.5	19.8
5	21	24.7	9.5	52	61.2	19.5	7	8.2	8.1
6	13	28.3	5.9	29	63.0	10.9	3	6.5	3.5
Total	221	34.9	100.0	267	42.1	100.0	86	13.6	100.0

(Table 7.13, Part 2)

Size Group	Formative/ Post-Formative n	Formative/ Post-Formative R%	Formative/ Post-Formative C%	Post-Formative n	Post-Formative R%	Post-Formative C%	Total n	Total C%
1	6	8.5	19.4	6	8.5	20.7	71	11.2
2	11	5.6	35.5	14	7.1	48.3	197	31.1
3	5	5.1	16.1	4	4.0	13.8	99	15.6
4	7	5.1	22.6	1	0.7	3.4	136	21.5
5	2	2.4	6.5	3	3.5	10.3	85	13.4
6	0	0.0	0.0	1	2.2	3.4	46	73
Total	31	4.9	100.0	29	4.6	100.0	634	100.0

measure more than 8000 sq m (e.g., a site that measures more than 89 by 89 m), and the second largest consisting of 93 sites that measure between 4000 and 8000 sq m (see Table 7.11). Almost 30 percent of the sites (n = 18) in the largest group (29%) were identified as multi-component; this includes at least three sites with remains from at least three different time periods. There are 46 sites greater than 8000 sq m in size for which field crews found no certain evidence of multiple use; these are therefore listed as single component (Table 7.12). In the majority of cases (72%) diagnostics of a single temporal period were found, varying from Archaic to Post-Formative, with more than 60 percent of the sites in this size group assigned to the Archaic (Table 7.13). Problems arise when the remains used to assign site function do not date to the same period as the diagnostics.

Consider for example site 42KA4585, upon which surveyors found two Desert Side-notched points and some freshly flaked obsidian (Figure 7.19). Based on the points and obsidian the site is assigned a Post-Formative temporal affiliation, and no doubt the site was occupied during that interval. Because of the other tools observed, including several different flaked cobble choppers, pounders, and scraper planes, the site was identified as a processing camp. But are the cobble processing tools associated with the Desert Side-notched points? The setting of this site, on a prominent mesa visible from a large area in the central portion of Long Flat, is one that is likely to promote site reuse. The mesa is easily relocated on the landscape—it is a memorable topographic feature that foragers would likely use as a geographical reference point. The mesa also provides a prime vantage for scanning the local terrain and may have served as an excellent location for monitoring game. The artifact scatter covers much of the south half of the small mesa, an area that measures about 21,600 sq m. It may well be that the mesa was principally used during the Post-Formative period, but this will need further study to eliminate the possibility of there being multiple components. It is probably a safe assumption (perhaps a rule of thumb?) that flaked stone scatters larger than four digits in size (i.e., 9999 sq m) should be considered multiple component unless proven otherwise. Even if all remains are from one general temporal period, creation of a site as large as 42KA4585 is most likely the result of sequential reuse. If such reuse was repetitive, meaning the same settlement context and activities, then perhaps a functional site type is justifiable. An

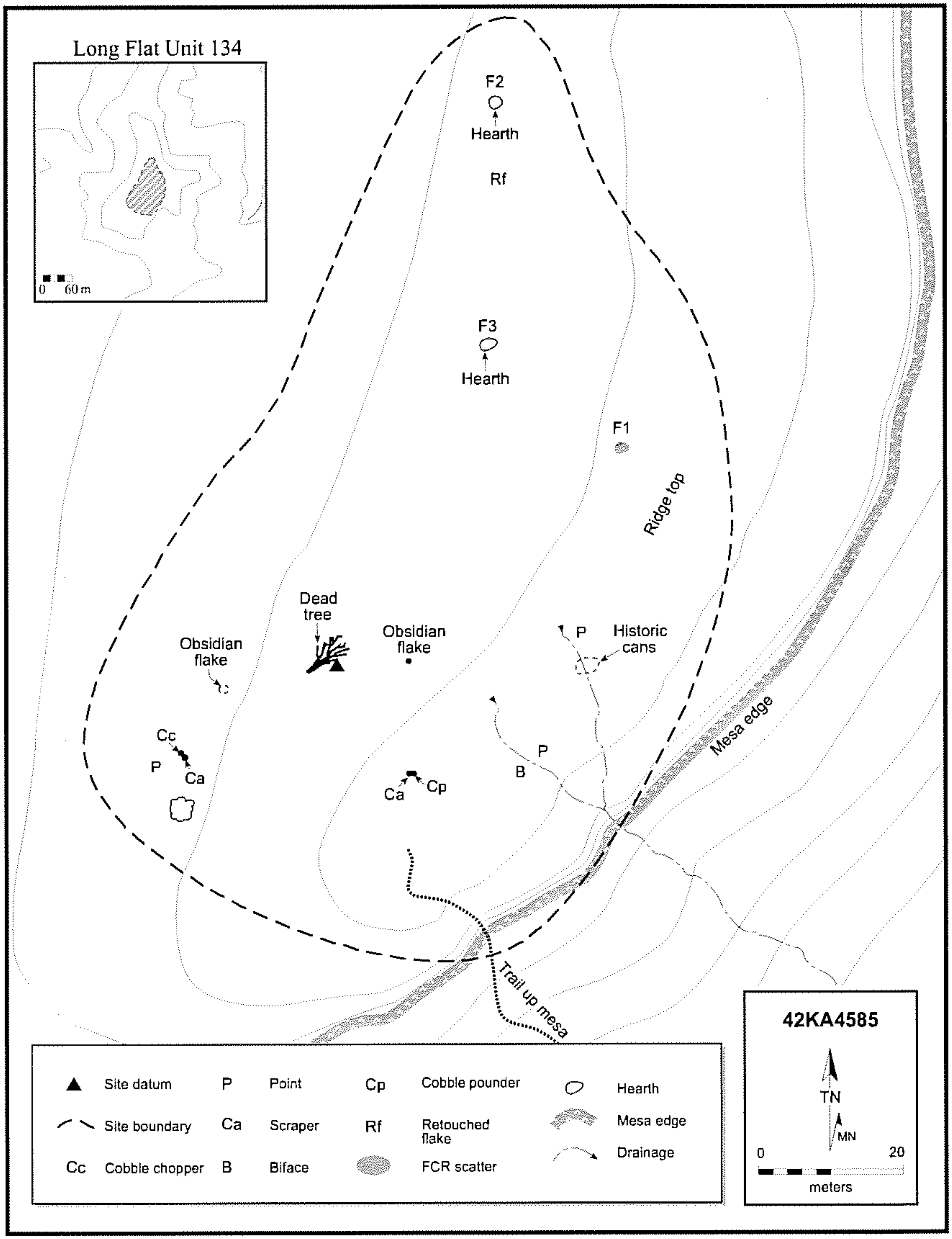


Figure 7.19. Plan map of 42KA4585, a site identified as single-component, along with its topographic setting (inset) within the 160 acre survey unit; contour intervals are 40 feet for the inset.

example of this is the previously mentioned three-component Archaic site that covers a large ridge-top on the south end of Horse Flat (42KA 4567). If reuse was nonrepetitive, with changing settlement contexts and activities, then no single site type is warranted. If separate use episodes could be isolated, their settlement roles could be identified, but doing this might require more effort and monetary investment than is possible on a survey project.

Table 7.12 shows that more than 40 percent of the single-component sites identified as residential camps occur in the largest two size groups (43%). Assignment of large sites to this functional class might be correct or it might be the simple result of the greater number and diversity of remains that invariably get included as sites become large. Even if sites of size groups 5 and 6 actually functioned as residential camps, they must also have a complexity of different use episodes and may well have multiple unrecognized components. The most conservative course would be to exclude presumed single-component sites of size groups 5 and 6 from settlement pattern studies because they are likely to misinform. Restudy of these sites might reveal ways to partition them into definable loci or temporal components with more functional meaning.

To sum up the major points of this exploration we offer the following conclusions. First, any sites of size groups 5 and 6 should be considered multiple component or at least of such complex manifold uses during a single temporal interval that assigning a single functional site type is folly. When recording sites of this sort every reasonable effort should be made to define temporal components or loci that might be interpretable on a separate basis. If spatial loci and components are not discernible within the parameters of a survey situation, then perhaps a principal landscape use type might be postulated if site reuse appears to have been mainly of the same settlement context and activities. Examples might include a ridge continually used as a hunting camp or one continually used for temporary camps. If such repetitive reuse is not evident then an indeterminate category is probably warranted. One should not assume that such sites are residential base camps, because the great diversity and abundance of remains is most likely the simple result of sequential reuse and unrecognized multiple temporal components.

Second, sites of the smallest size categories are most easily interpreted because they are likely single component and have the simplest use histories. The artifact assemblages and features have been less affected by multiple reuse, especially with changing settlement roles or activities. Whether this is entirely true depends upon the geographical setting of the site. If the site is situated where natural terrain features constrain the activity or use space as well as promote site reuse, then multiple componency or complex use histories may result. The best example of this in the current project is the small rockshelter recorded as 42KA 4794. Fortunately this site has intact stratified deposits, so different episodes of use can theoretically be excavated individually and analyzed separately. Such vertical separation of remains from different intervals is unlikely to be found at any of the open sites recorded so far on the Kaiparowits Plateau Survey. Horizontal separation of remains is, however, readily possible in many cases and provides the means for studying site parts separate from the whole.

Third, sites in the middle size range can result from a complexity of possibilities that are best to have in mind when recording the site so that various alternatives can be considered. Eliminating some of these possibilities must be done in the field when appropriate observations can be made, because doing so back in the laboratory with just the site form in hand is improbable.

CHAPTER 8

DISCUSSION OF NATIVE AMERICAN TEMPORAL/CULTURAL PERIODS

In 1934 Isabel Kelly wrote that the Kaiparowits band of the Southern Paiute "held an arid, barren, deeply dissected district where subsistence for even a small nonagricultural population must have been an acute problem" (Kelly 1934:551). There is no doubt that she correctly characterized the topography, despite her limited personal experience in the area, but we did not find the plateau wanting in subsistence opportunities during the Phase 1 survey and thought her assessment of the region's subsistence potential was overly pessimistic. In the summer of 1998, we observed desirable grasses such as ricegrass and dropseed in abundance in many areas. The ricegrass harvest was over by the time we started the Phase 1 survey in late July, but it clearly had been a productive one. By the end of survey in September, four different species of dropseed were ready for harvest or nearly so. These were especially prolific on East Clark Bench and along the sandy floodplain deposits of Wahweap Creek. Banana yucca is also common on the plateau and during the survey fruits were prolific and obtainable from July extending through September. Most benches and mesas are thickly covered with pinyon and the following year (1999) saw a bumper nut crop. We saw deer tracks daily and found antler sheds in many areas, indicating that the region was also good winter range. Water, too, was not in short supply. In sum, the arid and barren part of Kelly's characterization seemed off the mark.

During the second phase of survey in the summer of 2000, NNAD archaeologists experienced the hostile end of the environmental continuum. It was one of the worst droughts in many summers, following upon an extremely dry winter and spring. There was virtually no monsoon rain, and the only storm that soaked the ground occurred in September. Lacking winter or spring moisture there was no ricegrass harvest—the few plants that put forth seed heads (panicles) had sterile florets or ones where the seeds never matured. The drought also affected other important fruits and berries that depend upon winter moisture such as banana yucca, for none of the abundant plants of this species had fruit during the Phase 2 fieldwork. Prickly pear cactus had either failed to flower or the fruits had shriveled and fallen off. Even most squawbush were devoid of berries, and this is a shrub that can fruit under poor conditions. In short, the Phase 2 year would have been a time of great hardship for foragers, a true season of discontent. The one resource that we saw in abundance consisted of rabbits and hares, and many of these seemed so lethargic from lack of water or forage that a person experienced in wielding a rabbit stick could have dined on lagomorphs every night.

During two phases of fieldwork separated by a single year NNAD archaeologists observed the extreme ends of cyclical fluctuation between salubrious and inimical conditions: a time of plenty and a time of famine. The concentration of cultural remains found during our survey came as no surprise against the backdrop of our Phase 1 observations about the environment. Clearly, many prehistoric people considered the Kaiparowits Plateau home for at least part of the year. The environment during Phase 2, however, perhaps exceeded Kelly's negative appraisal, presenting a subsistence challenge for even the most skilled foragers, and giving cause for us to ponder how people survived in this setting, how they coped with such wild fluctuations in fortune.

THE ARCHAIC PERIOD

Archaeologists have defined the Archaic as a socioeconomic adaptation of fairly broad spectrum gathering and hunting that developed in response to postglacial environmental change and the extinction of the Pleistocene megafauna. Caves within the greater region that embraces the Kaiparowits Plateau contain the archetypal residue of Archaic foragers dating to almost 9000 years ago. The evidence consists of generalist subsistence remains such as small seeds of diverse plants and small game (rabbits and rodents), and the technology for processing those resources, most notably

numerous grinding slabs and manos. How these early foragers relate to those of the Paleoindian stage remains unknown, as does whether or not there was an occupational hiatus between the stages (see Schroedl 1991). The only evidence for pre-Archaic use found by the Kaiparowits Plateau Survey consists of three possible Paleoindian point bases (see Chapter 6). The points are not definitely Paleoindian, and even if they were, none were positively associated with any other remains.

The end of the Archaic is subject to definitional debate, and identifying sites from this interval is problematic for the Kaiparowits Plateau. To some archaeologists, the appearance of pottery marks the end of the Archaic (and start of the Formative), but to others it is the appearance of agriculture. We favor ending the Archaic with the appearance of corn and squash and using a separate designation (Archaic-Formative Transition) for the preceramic interval when crops were initially adopted and used. We acknowledge that the shift to an agricultural economy did not happen everywhere at the same time, and that a generalized hunting-gathering adaptation may have persisted up to the historic period in many areas. The crop criterion is also impossible to employ in survey situations, and even with excavation, sites in marginal farming areas such as much of the Kaiparowits Plateau might not contain domesticates. Most of the Formative sites in the area seem to have been used for hunting and gathering rather than farming. Minus some definitive diagnostic stone artifacts or some other temporal indicator[1] that correlates with the arrival or adoption of farming, identifying sites that date to the Archaic-Formative Transition in an area like the Kaiparowits Plateau may always be problematic.

The archaeological record left by Archaic foragers on the Kaiparowits Plateau is believed to correspond in general outline to the current summary of evidence from the greater Glen Canyon region, of which it forms a part (Geib 1996). The Archaic prehistory of this region has considerably more in common with the northern Colorado Plateau than with developments reconstructed for the southern Colorado Plateau. More than 20 years ago Schroedl (1976) claimed that the Colorado Plateau was not a unified region in terms of Archaic prehistory despite being a distinct physiographic province. He perceived clear differences between northern and southern portions of the plateau in material culture, population, and perhaps environmental fluctuations. More than 20 years of additional research have only added to the impression that basic differences exist in Archaic culture history for northern and southern portions of the plateau. Exactly where one draws the division between north and south is somewhat subjective but it certainly lies south and east of the Kaiparowits Plateau.

Projectile points provide a principal basis for making a north-south distinction. The Archaic projectile points recovered from the Kaiparowits Plateau (see Chapter 6) have little in common with the Oshara Sequence points (Irwin-Williams 1973) of the San Juan basin and parts of central and northern Arizona, but are virtually indistinguishable from any assemblage of Archaic points from central Utah. The chief difference in Archaic projectile points between northern and southern portions of the Colorado Plateau is that notched points predominate from almost the beginning of the Archaic sequence. One heavily reworked long-stemmed point resembling Jay or Lake Mohave was found as an isolated occurrence during Phase 2, and Kearns (1982:Figure 70) also pictured at least one Jay or Lake Mohave point. No long-stemmed points like these have been recovered from the early Archaic layers of such sites as Sudden Shelter, Joe's Valley Alcove, Cowboy Cave, or Dust Devil Cave. The several shorter stemmed points found during the Kaiparowits Plateau Survey resemble those classified as Pinto on the northern Colorado Plateau and eastern Great Basin rather than San Jose points.

Identification of Archaic Sites

We attributed an Archaic affiliation to 321 of the 744 Native American components (43%), a proportion that leaves little doubt that remains left by Archaic foragers comprise a significant proportion of the archaeological record on the Kaiparowits Plateau. Our results are somewhat comparable to those for Tract II of the Escalante Project. Kearns (1982:Table 42) reported 51 Archaic sites out of 134 (38%) for this northwest portion of the Kaiparowits Plateau. Table 8.1 presents a comparison of results from these two surveys. The somewhat higher proportion of Archaic components that we report is likely the result of using alternative dating methods such as patina to make some

[1]For example, on the Rainbow Plateau immediately southeast of the Kaiparowits Plateau south of the Colorado River, concentrations of burned limestone on a preceramic site are a near-certain indication of a Basketmaker II habitation or residential camp. The same is true for Cedar Mesa to the east of the Kaiparowits Plateau (R.G. Matson, personal communication 1993).

Table 8.1. Temporal assignments for the 321 Archaic components recorded during the Kaiparowits Plateau Survey and the same data for Tract II of the Escalante Project (NW portion of the Kaiparowits Plateau) for comparison, with both results then combined.

	Kaiparowits Plateau Survey				Escalante Project, Tract II[1]				Total		
Temporal Affiliation	n	%	Adj. %	% of Pop.[2]	n	%	Adj. %	% of Pop.[3]	n	%	Adj. %
Archaic general	232	72.3	—	31.2	24	47.1	—	17.9	256	68.8	—
Early Archaic	27	8.4	30.3	3.6	9	17.6	33.3	6.7	36	9.7	31.0
Middle Archaic	25	7.8	28.1	3.4	10	19.6	37.0	7.5	35	9.4	30.2
Late Archaic	37	11.5	41.6	5.0	8	15.7	29.6	6.0	45	12.1	38.8
Total	321	100.0	100.0	43.2	51	100.0	100.0	38.1	372	100.0	100.0

[1]Gleaned from Kearns 1982:Table 22.
[2]n = 744 (Native American site total = 689).
[3]n = 134.

of the assignments to the "Archaic general" category. This also means that the percentage of components that we assigned to specific Archaic subperiods is lower than Kearns reported because the alternative methods do not allow such specificity. By excluding those components of the Archaic general designation (adjusted percent) the proportions of sites within each Archaic subperiod are more comparable between projects.

We assigned sites or components thereof to the Archaic period based on a combination of attributes, with traditional temporal diagnostics (projectile points) used in about half of the cases. The probability of correctly identifying Archaic components with dart points was bolstered when these diagnostics were accompanied by heavily patinated flakes and other tools. The co-occurrence of diagnostic Archaic dart points with patinated artifacts may provide the best indication that an entire assemblage has considerable antiquity and that the points were not recycled into a later context. Points classified as one of several types with relatively well known temporal spans allowed us to place a site or component within one of the three commonly recognized Archaic subperiods: early, middle, and late. These three intervals roughly track changes in projectile point types (Holmer 1978, 1986); they might also correspond to adaptive shifts and changes in other aspects of material culture. The early Archaic extends from about 9000 to 6000 B.P. (ca. 8000–4880 cal. B.C.), the middle Archaic from 6000 to 4000 B.P. (ca. 4880–2500 cal. B.C.), and the late Archaic from roughly 4000 B.P. up to the adoption of agriculture sometime perhaps around 2000 B.P. (ca. 0 cal. A.D.) on or around the Kaiparowits Plateau. The extent of synchronicity between point type changes and other aspects of material culture or lifeways is debatable, but points are the only viable means during survey to provide some temporal subdivision of the long Archaic sequence.

Eighty-nine components (12% of the 744 total Native American components) are assigned to specific Archaic subperiods, with nearly equal representation for each of these: 27 early Archaic, 25 middle Archaic, and 37 late Archaic. The relative number of sites assigned to each Archaic subperiod is closely similar to the findings of the Escalante Project: we recorded more late Archaic components and fewer middle Archaic, whereas the Escalante Project recorded more middle Archaic and fewer late Archaic. Combining the results of both projects (last three columns of Table 7.1) perhaps provides the clearest picture. Certainly there is no indication that one period is better represented than another. The slight increase in late Archaic sites from previous Archaic subperiods may be spurious, perhaps a factor of greater erosional loss of earlier sites combined with the common use of Elko Series points during the early Archaic, resulting in many early Archaic sites lumped into the "Archaic general" category. Of course component count really says very little about the intensity of use or population size, especially when the sample sizes for each of the Archaic subperiods is so low.

Limited sample size is a common problem faced by archaeologists. To obtain an informative sample of sites within Archaic subperiods, we probably would need to record well over 1000 sites. It took a survey of 17,280 acres and the recording of 744 Native American components to identify 25 middle Archaic sites. Extrapolating from our current sample and assuming that we

would like a minimum of 50 sites per subperiod, then we would have to record about 1488 sites or components to identify 50 middle Archaic sites. This means that roughly another 17,280 acres would need to be surveyed. Real results of course would vary, depending on many factors, including how successful field crews are in finding temporal diagnostics. Moreover, 50 sites per subperiod may not be an adequate sample size for some purposes, especially if one was interested in examining how different middle Archaic site types were distributed across the nine sampling strata. For such a comparison to be meaningful we might need at least 25 middle Archaic sites for each stratum, or 225 total. The implications are obvious for how much survey would be needed and conversely for how poor our sample size currently is. If Elko series points could be partitioned into meaningful groups that correlate with Archaic temporal subdivisions this would no doubt help. There might also be other means for making such assignments; testing features to obtain radiocarbon dates is one sure method, though one that can also introduce both temporal and functional biases (older sites less likely to contain preserved hearths and certain site types irrespective of temporal placement unlikely to contain hearths).

The largest proportion (n = 232) of the Archaic components lack subperiod placement (72% of all Archaic components, or 30% of all 744 components; see Table 8.1). In many cases, the general Archaic period designation was based on the occurrence of Elko Series points often co-occurring with patinated flakes and tools. Though likely Archaic in age, more specific temporal placement of these sites is not possible. Holmer (1986) analyzed the possibility of separating Elko Series points into temporal groups but was unable to find any reliable morphological distinctions. This is unfortunate given how common the point style is during the Archaic period for the northern Colorado Plateau. The Escalante Project likewise used Elko points to place sites into a minimal Archaic age category. Kearns (1982:265) cautioned, though, that "Archaic occupation may be somewhat over-represented by the use of Elko Series projectile points as an Archaic indicator." We did not automatically assume an Archaic age for sites with Elko points, but instead usually used flake and tool patination to evaluate the potential relative antiquity of the assemblages associated with the points. As detailed earlier in this report, we believe that patination of both points and flakes provides a convincing case for an Archaic temporal assignment. We discounted Elko points as Archaic diagnostics in many instances, sometimes because they occurred with Formative or Post-Formative age artifacts, but also because they occurred on sites with "fresh" looking unpatinated flaking debris. Some of these sites might well be Archaic in age, but some certainly are not, and this method ensures that sites classified as Archaic have a high probability of actually belonging to that period.

The utility of patina for relative temporal placement of Kaiparowits Plateau sites is a topic well worth further research. Our preliminary findings indicate its value, especially because in several situations it alerted field crews to the possible presence of multiple components, which were subsequently confirmed by detailed searches for diagnostics (see Chapter 7). We tentatively assigned a proportion of the Kaiparowits Plateau sites or components to the Archaic period based on alternative dating methods alone in the absence of projectile points. Usually, field crews relied on a triangulation of evidence such as heavy flake patination combined with Archaic-looking manos, extensive fragmentation and weathering of grinding slabs, and thick carbonate crusts on grinding tools and flaked cobble tools. There are many cases where all these indicators occur together; at numerous sites with this alternative evidence we also found temporally diagnostic dart points. Table 8.2 presents our degree of confidence in the Archaic temporal assignments. Sites that contain diagnostic projectile points in firm spatial association with other remains are in the "probable" category. Some sites contain diagnostic points but these occur at site peripheries and association is less certain; these are listed in the tentative column. Sites assigned only on the basis of patina and other alternative evidence alone are also listed in the tentative column.

Table 8.2. Confidence in the temporal assignments for the 321 Archaic components of the Kaiparowits Plateau Survey.

Temporal Affiliation	Tentative	Probable	Total
Archaic general	145	87	232
Early Archaic	2	25	27
Middle Archaic	3	22	25
Late Archaic	5	32	37
Total	155	166	321
Percent	48.3	51.7	100.0

The Archaic Archaeological Record

The archaeological record left by foragers is generally sparse and dispersed. Carrying little and living in no one particular place for long, foragers leave few localized debris concentrations. With large territorial ranges, the meager remains deposited in a given year by a hunter-gatherer group are widely scattered. With low population densities, any particular chunk of territory is infrequently used. Most of what is deposited is perishable; thus archaeologists usually observe only a fraction of an already meager forager trace. Then come the ravages of time—thousands of years of erosion and deposition, and disturbance by rodents, roots, and other causes. Erosion has the benefit of allowing us to find Archaic remains, but usually at a cost: we end up with thousands of years of accumulation mixed together on a single surface, often without any datable features or subsistence remains. Although burial has the benefit of preservation and the potential for stratigraphic separation of discrete temporal intervals, it has its own penalty: remains are lost from view, thus rarely encountered, and costly to study if found.

Much of the record produced by Southwestern hunter-gatherers probably occurs below the threshold of what normally gets classified as a site. Documenting onsite scatters of remains to aid in the interpretation of Archaic prehistory has just begun. Thus, most of what we currently know about the Archaic comes from debris concentrations called sites. NNAD's Kaiparowits Plateau Survey was site based, though we documented nonsite scatters of remains as isolated occurrences. Unfortunately, it is currently impossible to place most such finds within a temporal framework; thus they provide only the grossest level of information about past land use.

Most Archaic sites on the Kaiparowits Plateau appear to be mainly surface phenomena, and overall there appears little chance for buried remains. Many sites are deflated, with artifacts occurring as a lag deposit (see the Chapter 5 testing results). The clearest indications of this are with grinding slabs or other sandstone slabs, which often occur on slight pedestals of sediment. These larger rocks function as a small cap that slows the removal of underlying sediment. As sites erode they become more dispersed; likely this is partially why Archaic sites as a group are larger than Formative or Post-Formative sites (Archaic mean site size = 6103 sq m, Formative mean site size = 2285 sq m, Post-Formative mean site size = 1894 sq m). Recent sand has accumulated over portions of some Archaic sites, but in most cases this appears to have occurred after sites had deflated. The testing results reported in Chapter 5 clearly support these assertions. The three tested Archaic sites that we thought were deflated were indeed deflated, whereas the one tested Archaic site that seemed to have intact deposits (not deflated) was in fact quite well preserved. Many of the deflated Archaic sites, despite this lack of vertical integrity, appear to retain much horizontal integrity and informative spatial patterning of remains. Kearns (1982:297) reached a similar conclusion: "The fact that so many of the Escalante Project sites retain strong evidence of internal structural integrity enhances their importance and utility as repositories of the material correlates of past human behavior." Even with a loss of both vertical and horizontal integrity, Archaic sites can retain much information about stone tool raw material use, production technology, and function. Indeed, the only Archaic sites of limited scientific value are those with lithic assemblages badly damaged by wildfires, where flakes are fragmented into small undiagnostic pieces and use-wear traces have been obscured.

Site Types

Tables 8.3 and 8.4 present data about Archaic site types identified during the Kaiparowits Plateau Survey. Table 8.3 lists site types for the three Archaic subperiods, the general Archaic category, and the sum of these; Table 8.4 presents the count, density, and proportion of Archaic site types within each sampling stratum. The density is the average number of a given site type per sample unit for each stratum and might provide a more realistic means to compare the results across strata of widely different sample sizes (7 units examined on Horse Flat vs. 18 units on the adjacent Long Flat). Column percent is another useful means for examining differential use of the sampling strata, except when the number of Archaic sites identified for a stratum is exceedingly low such as with Brigham Plains and East Clark Bench; the 15 Archaic sites on Nipple Bench are barely adequate. In Table 8.5 the survey strata are arranged from left to right in roughly decreasing elevation, with Collet Top (CT) the highest and most northern sampling stratum and East Clark Bench (ECB) the lowest in elevation and the southernmost.

Many of the Archaic debris concentrations that we recorded as sites likely resulted from the residential use of particular places. Foragers used and reused places on the landscape as temporary

Table 8.3. Site types for Archaic subperiods and the Archaic period overall.

Site Type	Early Archaic n	Early Archaic C%	Middle Archaic n	Middle Archaic C%	Late Archaic n	Late Archaic C%	Archaic General n	Archaic General C%	Total n	Total C%
Residential Camp	2	7.4	2	8.0	9	24.3	42	18.1	55	17.1
Processing Camp	2	7.4	1	4.0	5	13.5	44	19.0	52	16.2
Hunting Camp	20	74.1	16	64.0	18	48.7	82	35.3	136	42.4
Reduction Locus	2	7.4	2	8.0	3	8.1	27	11.6	34	10.6
Other[1]	0	0.0	0	0.0	1	2.7	3	1.3	4	1.2
Unknown	1	3.7	4	16.0	1	2.7	34	14.7	40	12.5
Total	27	100.0	25	100.0	37	100.0	232	100.0	321	100.0

[1]Consists of two storage/cache sites and two lithic source areas.

Table 8.4. Count, density (count per unit), and proportion of Archaic site types within each sampling stratum of the Kaiparowits Plateau Survey.

Site Type	Variable	CT (n = 18)	HM (n = 8)	LF (n = 18)	HF (n = 7)	FB (n = 15)	SM (n = 10)	BP (n = 11)	NB (n = 12)	ECB (n = 9)	Total (n = 108)
Residential camp	count	17	14	13	1	7	2	0	1	0	55
	density	0.9	1.8	0.7	0.1	0.5	0.2	0.0	0.1	0.0	0.5
	col. %	26.2	23.3	28.3	4.8	10.3	5.1	0.0	6.7	0.0	17.1
Processing camp	count	13	2	9	7	14	3	1	3	0	52
	density	0.7	0.3	0.5	1.0	0.9	0.3	0.1	0.3	0.0	0.5
	col. %	20.0	3.3	19.6	33.3	20.6	7.7	20.0	20.0	0.0	16.2
Hunting camp	count	26	21	18	4	32	29	1	4	1	136
	density	1.4	2.6	1.0	0.6	2.1	2.9	0.1	0.3	0.1	1.3
	col. %	40.0	35.0	39.1	19.1	47.1	74.4	20.0	26.7	50.0	42.4
Reduction locus	count	1	13	6	4	3	1	3	2	1	34
	density	0.1	1.6	0.3	0.6	0.2	0.1	0.3	0.2	0.1	0.3
	col. %	1.5	21.7	13.0	19.1	4.4	2.6	60.0	13.3	50.0	10.6
Other	count	1	0	0	1	2	0	0	0	0	4
	density	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	tr.
	col. %	1.5	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	1.2
Unknown	count	7	10	0	4	10	4	0	5	0	40
	density	0.4	1.3	0.0	0.6	0.7	0.4	0.0	0.4	0.0	0.4
	col. %	10.8	16.7	0.0	19.1	14.7	10.3	0.0	33.3	0.0	12.5
Total	count	65	60	46	21`	68	39	5	15	2	321
	density	3.6	7.5	2.6	3.0	4.5	3.9	0.5	1.3	0.2	3.0
	col. %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

residences for a variety of economic, comfort, and social reasons. NNAD crews identified 55 sites as temporary residential camps (Table 8.3). As discussed in Chapter 7, residential sites served as the focal points of numerous activities necessary for the day-to-day maintenance of families. Important identifying attributes of temporary residential camps are an abundant and diverse set of stone artifacts, with the presence of grinding tools of special significance. A few of the Archaic residential camps appear to result from extended stays during just one or a few use episodes; these are small dense scatters of artifacts and features. One of the best examples is 42KA4552, located on the northeast portion of Long Flat (see Chapter 7). Most of the Archaic residential camps, however, are sprawling affairs that doubtless represent multiple use episodes extending over decades or centuries or even millennia, with no necessary links or affinity between the groups. A good camping location at 5000 B.C. was also good at 2000 B.C. and is still good today—witness the several instances where cowboy camps are superimposed on Archaic camps.

Table 8.5. Comparison of tool type occurrence at single-component Archaic residential camps (n = 41) and processing camps (n = 49).

	Residential Camps		Processing Camps	
Tool Types	n	%	n	%
Projectile points	35	85.4	25	51.0
Bifaces	37	90.2	37	75.5
Unifaces	10	24.4	11	22.4
Other facial flake tools	25	61.0	24	49.0
Flaked cobble tools	30	73.2	33	61.2
Metates	25	61.0	25	61.0
Manos	25	61.0	25	61.0

Archaic residential camps are best represented on the higher elevation benches of Collet Top, Horse Mountain, and Long Flat, with Fourmile Bench having a modest representation. Horse Mountain has the highest density of this site type (1.8 per unit) but the highest proportion of this site type occurs on Long Flat (28%). The lower elevation benches have few sites identified as residential camps, but limited activity camps and reduction loci account for a substantial proportion of the sites for these strata. As discussed next, processing camps might simply be scaled-down residential camps, but even so there is still a preference for the higher elevation settings. It could be that these offered more of everything that the Archaic foragers found most essential to living: more water, more fuel wood, more large and small game, and a greater diversity of plant resources. In contrast, the lower elevation benches contain a greater abundance of essential economic grasses (various species of dropseed and ricegrass) plus various weedy annuals (blazing star, sunflower, tansymustard) and bulbs (onions and sego lilies). Perhaps the Archaic foragers exploited the resources on the lower elevation benches from camps that were situated in the best areas, thus there were fewer of them with more repetitious use. Broken Arrow Cave (Talbot et al. 1999) appears to be an example of just such a site located on East Clark Bench. As discussed in Chapter 4 on sampling results, the outcome of camping in one location versus another on the high-elevation benches like Long Flat with their abundant and scattered amenities (trees for shade and firewood, various widely scattered water sources, handy rock for tools) is nearly equal because one place is about as good as the next. This is not true on Nipple Bench and East Clark Bench with their extensive open grasslands and bare shale badlands lacking water. Residential camps in the latter areas are perhaps more likely to be clustered in the few select locations where there is water, wood, and shelter, especially around the few permanent springs and seeps or along the major washes such as Wahweap Creek.

Residential camps account for more late Archaic sites than the preceding two Archaic periods (24% vs. 7% early Archaic and 8% middle Archaic). Exactly why this might be the case remains unknown. A majority of both early and middle Archaic sites were identified as hunting camps (74% and 64% respectively). There is the evident loss of grinding tools through time (see Chapters 5 and 7), so perhaps the disappearance of these tools from many of the earliest forager sites has led to misidentification. This is not a very satisfying explanation and likely accounts for only a small proportion of the cases because sites were not classified as hunting camps simply from a lack of grinding tools. It is certainly possible that late Archaic foragers located more residential camps on the Kaiparowits Plateau than had previous foragers. Reasons for this might include environmental change or greater population density prompting more intensive use of the plateau. Further survey and testing will be required to determine if this is indeed the case.

Fifty-two of the Archaic sites are identified as processing camps. The validity of this site type for Archaic foragers on the Kaiparowits Plateau is debatable, because they perhaps rarely had logistic camps for gathering plant foods, or at least not ones that are readily visible in the archaeological record. It seems likely that the identified Archaic processing camps are actually residential camps used briefly or used by small social groups (single families); thus, the amount of debris and features is far less and occurs in more circumscribed space. Table 8.5 shows the number and percentage of single-component Archaic residential and processing camps that have various stone tool classes. Table 8.6 presents this information in a different way, listing for each type the number of single-component sites that contain various frequencies of tools. Residential sites clearly have more of everything than processing camps, but it appears to be simply more of the same—nothing greatly different in character. It is probably still worth distinguishing between these types of sites because they are telling us something about the archaeological record, in most instances how frequently a site was reused.

Table 8.6. Frequency of single-component Archaic residential camps (n = 41) and processing camps (n = 49) that contain from 0 to more than 6 examples of various stone tool types.

	0	1	2	3	4	5	6+
Residential Camps							
Projectile points	6	10	7	7	6	4	1
Bifaces	4	4	6	8	8	3	8
Unifaces	31	7	1	1	1	0	0
Other facial flaked tools	16	13	6	3	1	0	2
Flaked cobble tools	11	4	8	4	1	4	9
Metates	16	9	11	4	0	1	0
Manos	16	9	9	3	2	1	1
Processing Camps							
Projectile points	24	15	4	3	2	0	1
Bifaces	12	15	11	5	1	1	4
Unifaces	38	9	1	0	1	0	0
Other facial flaked tools	25	10	6	2	5	1	0
Flaked cobble tools	16	20	4	2	2	3	2
Metates	24	20	2	1	2	0	0
Manos	24	18	6	1	0	0	0

To the extent that this is true, it appears that some benches of the Kaiparowits Plateau saw far more site reuse and perhaps intensive use as residential camps than did other portions of the plateau. Consider, for example, the contrast in the density of residential camps and processing camps between the Horse Mountain and Horse Flat strata. Horse Mountain has 1.8 residential camps per survey unit but just 0.3 processing camps, whereas on Horse Flat nearly the exact opposite is true: 0.1 residential camps but 1.0 processing camps. Two factors might account for this. First, Horse Mountain might have been preferable for residential camps because of the resources that it offered, including proximity to the high elevations of Canaan Peak and surrounding ridges. Second, and perhaps more significant, much of the Horse Mountain stratum consists of a moderately narrow and dissected ridgeline (as well as one small-sized bench known as Paradise), thus there is a high probability for site reoccupation. In other words, there are natural constraints working to concentrate campsites to many well-used locations. This stands in contrast to Horse Flat, which has expanses of equally suitable camping terrain, where one location is little different from another. In such a setting, there are perhaps fewer tendencies for site reuse and thus less likelihood for the generation of the sorts of debris accumulations that we identified as residential camps.

Hunting camps comprise the largest portion of the Archaic sites (42%), and the proportion is likely even greater because some of the reduction loci probably also served as hunting camps. Doubtless much reduction activity took place on hunting excursions. The density of reduction loci is greatest on those strata where chert and chalcedony (Paradise chert and Canaan Peak cobble chert) occur naturally—namely Horse Mountain and Long Flat. The other strata have exceedingly low densities of reduction loci. That a high proportion of the sites for both Brigham Plains and East Clark Bench were identified as reduction loci (50% and 60% respectively) likely has much to do with the limited number of identified Archaic sites (5 and 2 respectively). The occurrence of reduction loci on East Clark Bench is expected given that chert and cobbles of coarse material occur in the gravels of Wahweap Creek which crosses this stratum, thus there is a local source of raw material for exploitation. No raw material sources occur on Nipple Bench, so the Archaic sites identified here as reduction loci no doubt result from the resharpening and perhaps recycling of worn and broken tools.

Much of the Kaiparowits Plateau appears to be good deer habitat and NNAD crews observed abundant deer sign in all strata except those with the lowest elevation (Nipple and East Clark Benches). Nonetheless, it is somewhat surprising to see that Smoky Mountain has the highest density of hunting camps, because this stratum did not necessarily seem like the best hunting habitat compared to Horse Mountain or Collet Top. It could be that on Smoky Mountain there was less

settlement reuse for other tasks, thus the hunting signature is quite evident. In contrast, there might have been extensive settlement reuse on Horse Mountain and Collet Top, such that the sites used as hunting camps were subsequently reused as residential camps with the hunting signature lost as a result.

Archaic Foragers vis-à-vis Post-Formative Foragers

Great Basin and Southwestern archaeologists have commonly used the rich ethnography of the Paiute, Ute, and Shoshone as a source of models and inspiration for understanding the archaeological record left by foragers of the more remote past (e.g., Thomas 1983, 1985). The Escalante Project provides a convenient local example of this practice: "the interpretation of the hunter-gatherer use of the study tracts draws heavily on Southern Paiute ethnographic data (Kelly 1964; Steward 1938; Stewart 1942). A basic assumption is that the Archaic use of the tracts was similar to that documented for the Paiute" (Kearns 1982:405). It is not idle curiosity, therefore, to contemplate why the record left by Archaic foragers on the Kaiparowits Plateau should appear different from that of Post-Formative Paiute foragers of this same region. Do differences in the records result from contrasts in the length of time that post-depositional processes have transformed them? Alternatively, do the differences reflect important contrasts in behavioral dimensions? No doubt historical particulars exerted influence that is difficult to disentangle, but there is a good chance that the selective environments of Archaic hunter-gatherers differed from those of the Paiute. A population of foragers expanding into terrain once heavily populated by farmers (or farmer-foragers) had no analogue during the Archaic. Gross climatic characteristics might not have been greatly different, but the environment experienced by the Paiute after thousands of years of human use and manipulation certainly differed from that experienced by Archaic foragers.

Several of the contrasts between the record left by Archaic foragers and that of Post-Formative foragers are presented in different portions of Chapters 6 and 7, but here we review and add to the contrasts. The first of these has to do with raw material usage. The best data for this comparison are provided by collected projectile points. Examining the point materials used by foragers at the two different ends of the temporal spectrum reveals clear differences in the proportion of local and nonlocal materials (see Table 6.8). This may imply some important distinctions in the settlement-subsistence strategies or settlement territories (size of annual range). Kelly's (1964:149–150) report and accompanying map indicate that the Kwaguiuavi (Seed Valley) economic unit resided within the study area and restricted most of their subsistence travels to other portions of the Kaiparowits Plateau. This would have limited direct access to raw materials for projectile point production to the locally occurring Paradise chert/chalcedony and Canaan Peak cobble chert. More than 80 percent of Post-Formative arrowheads are made of Paradise chert/chalcedony. Archaic dart points overall, and within general subperiods, also show a heavy reliance on local materials (54% or greater). Nonetheless, materials from outside the study area were used for 36 to 43 percent of the Archaic points. This difference may be reflective of annual settlement ranges during the Archaic that were more extensive than those documented ethnohistorically. Alternatively, settlement territories may have been configured differently, so that the Archaic foragers included more environmental diversity. For example, Archaic groups using the study area may have also taken regular trips to the Escalante River basin, the Colorado River, or the Vermilion Cliffs. The common materials used for Post-Formative points is likely a manifestation of groups resident within the study area who generally restricted their travel to this territory. This pattern in raw material use appears to fit quite well the territorial area of the Kwaguiuavi economic unit.

In seeming contradiction to the above is the common occurrence in low frequencies of obsidian at Post-Formative sites. The obsidian, except for a few cases, occurs as flakes, some retouched, both used and unused. Flake attributes suggest that most obsidian flakes were detached from simple cores by hard hammer percussion. Archaic use of obsidian is rare, but the material does occur as projectile points, several examples of which were collected during the Kaiparowits Plateau Survey. Few examples of obsidian flakes were observed at Archaic sites. These differences in obsidian use suggest that not only did the nature of extra-regional contacts vary between Archaic and Post-Formative foragers, but so did the reduction behavior for this exotic material. It appears that Archaic use of obsidian was mainly restricted to bifacially thinned tools that were perhaps exchanged in finished form or at least were produced off the plateau closer to the source. Post-

Formative foragers, however, appear to have acquired prepared cores and nodules of obsidian and to have reduced these on the plateau, principally for simple flake production. That nodules were brought in is evidenced by the partial cortical flakes from 42KA4585 on Long Flat.

The Paiute also used chert and chalcedony to produce expedient flake tools detached from simple cores. This stands in marked contrast to the Archaic lithic assemblage, where percussion thinned bifaces played a prominent role. Archaic lithic assemblages commonly consist of two contrasting reduction strategies—the production and maintenance of thinned bifaces as multipurpose tools and the production and maintenance of heavy-duty flaked cobble tools such as choppers and scraper planes. Bifaces occur at 82 percent of presumed single-component Archaic sites (90 of 110) and the flaking debris from biface manufacture and resharpening is abundant at most of these. In contrast, just 45 percent (9 of 20) of presumed single-component Post-Formative sites contain bifaces. Unfortunately, we have no way at present to control for cases of recycled old bifaces on Post-Formative sites. We know that patinated bifaces with fresh flake scars occur at several Post-Formative sites (indeed, recycled patinated tools of various sorts were represented at many Post-Formative sites). Another way to examine the data is by biface frequency: 44 percent of the Archaic sites have three or more bifaces (48 of 110) whereas just 15 percent of the Post-Formative sites have three or more bifaces (3 of 20).[2] The occurrence of projectile points is also quite similar, though there is greater tendency for Archaic sites to contain more. This is perhaps largely a result of more frequent settlement reuse during the Archaic. Aside from the tools directly related to subsistence pursuits, there are marked differences both in the number of sites at which given tools, such as bifaces, occur, and in the frequency of various tools on sites. For example, whereas only 18 percent of the Archaic sites lack bifaces, 64 percent of the Post-Formative sites lack this tool class.

The Archaic emphasis on bifacial technology contrasted with the Post-Formative emphasis on expedient core-flake technology provides a likely reason that sites of the two temporal intervals have different flake frequencies (Table 8.7). Forty percent of the single-component Archaic sites have more than 100 flakes compared to just 21 percent of the Post-Formative sites. The production and resharpening of bifaces should result in far more flaking debris per nodule or use episode than expedient flake production. The comparable scarcity of flaking debris at Post-Formative sites is not simply because they used arrow points rather than dart points, the production of the former resulting in comparably less debris than production of the latter. Formative hunters also used arrow points, yet many of their sites contain abundant flaking debris. This contrast is most evident when examining sites of the same inferred functional class, such as the hunting camps summarized in Table 7.6. Perhaps a more informative comparison could result from examining the incidence of percussion biface thinning flakes. Unfortunately the data on site forms do not allow for easy comparison at this level. We anticipate, however, that Post-Formative sites contain far less percussion biface thinning debris than Archaic sites.

It is perhaps worth mentioning that some of the patterns in Post-Formative reduction activity might relate to the age of a site. There is every reason to believe that contact with Euro-Americans and especially the acquisition of metal knives affected the production of stone tools, just like it did on a worldwide basis. It is easily conceivable that metal knives quickly reduced the need for percussion thinned bifaces but there may not have been a simple replacement for stone arrow points.

Table 8.7. Number of single-component Archaic and Post-Formative sites containing various frequencies of flakes; flake frequency categories are those on the IMACS form.

Flake Frequency Categories	Archaic n	Archaic %	Post-Formative n	Post-Formative %
None	1	0.4	1	3.4
0–9	8	3.0	5	17.2
10–25	44	16.5	8	27.6
25–100	107	40.1	9	31.0
100–500	86	32.2	4	13.8
500+	21	7.9	2	6.9
Total	267	100.0	29	100.0

[2]One of these (42KA4781) is anomalous in that it contains 12 bifaces; this prompted a reexamination of the site form to determine how the temporal assignment was made. We discovered that it was the presence of a recent-looking mano cache under the roots of a juniper tree that prompted the crew chief to hypothesize a Post-Formative temporal affiliation. The cache might well date to this interval, but probably not the rest of the remains on the site. Plausibly, a Post-Formative group passing through the area gathered up useful manos exposed on the surface of a preexisting site and stowed them away under the tree roots for later retrieval. This would be a useful site to revisit to see if the question of temporal affiliation could be resolved.

Consequently, there could be a span of time during which the percussion thinned biface industry had essentially vanished or greatly diminished while pressure flaked arrow points continued in common production. In such a scenario, a Paiute hunting camp or residential site dating to the 1400s might have a flaked stone assemblage that differed greatly from that present on similar sites dating to the 1800s. Whether or not this is the case on the Kaiparowits Plateau and surrounding region will require analysis of collections that are well dated.

We can also contrast Archaic and Post-Formative residential and processing camps (Table 8.8). One obvious difference is how few Post-Formative sites are identified as residential camps compared to those identified as processing camps (23% vs. 77%). In contrast, the ratio of these sites types for the Archaic period is roughly equal (51% vs. 49%). As discussed previously, there might not be a true functional difference between these site types, but rather a difference in the incidence of settlement reuse (common during the Archaic, rare during the Post-Formative) or size of the occupying social units (several families during the Archaic, single families during the Post-Formative). Archaic foragers likely reoccupied sites time and time again, perhaps with changing settlement function adding to the diversity of remains. But if this is true for Archaic foragers, then why not for Paiute foragers? Was their settlement round so different from that of Archaic hunter-gatherers that they seldom reused the same location? Kelly (1964) suggested that settlement reuse was common at winter bases (also Powell as cited in Fowler and Fowler 1971:53), but that for the Kaiparowits Plateau band most of their winter camps may have been located at low elevations outside much of our project area. Kelly (1964:148) even made the statement that there were "no permanent camps on Kaiparowits Plateau." It must be realized that the Kaiparowits Plateau to Kelly was restricted to just the high portion immediately adjacent to the Straight Cliffs, which to us means Collet Top and Fiftymile Mountain. Perhaps then, the difference is with a change in the position of winter bases, with Archaic foragers frequently occupying areas of the Kaiparowits Plateau that the Paiute used on only a seasonal basis, and therefore with little settlement reuse. As Table 8.8 demonstrates, Archaic residential camps are preferentially located on the high-elevation benches of Collet Top and Horse Mountain with few at lower elevations such as on Smoky Mountain and Nipple Bench. The sample size of Post-Formative residential camps is inadequate, though few occur on Collet Top and Horse Mountain, but processing camps or the combined category tend to be distributed across somewhat lower elevation benches. Long Flat and Fourmile Bench were evidently key for both periods, and it is interesting that Kelly's (1964) map of Southern Paiute Bands shows that the Kwaguiuavi economic unit of the Kaiparowits Band is centered on Fourmile Bench and Long Flat.

The tool assemblages at residential and processing camps from the two time periods are also somewhat different (Table 8.9). Some of these differences relate to those previously mentioned,

Table 8.8. Comparison of the distribution of Archaic and Post-Formative residential and processing camps and both combined for the nine sampling strata.

	Residential Camps				Processing Camps				Combined Camps			
	Archaic		Post-Form.		Archaic		Post-Form.		Archaic		Post-Form.	
Sampling Stratum	n	%	n	%	n	%	n	%	n	%	n	%
Collet Top	17	30.9	1	16.7	13	25.0	3	15.0	30	28.0	4	15.4
Horse Mountain	14	25.5	1	16.7	2	3.8	1	5.0	16	15.0	2	7.7
Long Flat	13	23.6	2	33.3	9	17.3	8	40.0	22	20.6	10	38.5
Horse Flat	1	1.8	0	0.0	7	13.5	1	5.0	8	7.6	1	3.9
Fourmile Bench	7	12.7	2	33.3	14	26.9	2	10.0	21	19.6	4	15.4
Smoky Mountain	2	3.6	0	0.0	3	5.8	2	10.0	5	4.7	2	7.7
Brigham Plains	0	0.0	0	0.0	1	1.9	3	15.0	1	0.9	3	11.5
Nipple Bench	1	1.8	0	0.0	3	5.8	0	0.0	42	3.7	0	0.0
East Clark Bench	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	55	100.0	6	100.0	52	100.0	20	100.0	107	100.0	26	100.0
Row %	51.4		23.1		48.6		76.9		100.0		100.0	

Table 8.9. Frequency of single-component Archaic residential and processing sites (n = 90) and Post-Formative residential and processing sites (n = 16) that contain from 0 to more than 3 examples of various stone tool types.

	None		1		2		3+	
	n	%	n	%	n	%	n	%
Archaic Sites								
Projectile points	30	33.3	25	27.8	11	12.2	24	26.7
Bifaces	16	17.8	19	21.1	17	18.9	38	42.2
Unifaces	69	76.7	16	17.8	2	2.2	3	3.3
Other facial flaked tools	41	45.6	23	25.6	12	13.3	14	15.6
Flaked cobble tools	27	30.0	24	26.7	12	13.3	27	30.0
Grinding slabs	40	44.4	29	32.2	13	14.4	8	8.9
Manos	40	44.4	27	30.0	15	16.7	8	8.9
Post-Formative Sites								
Projectile points	5	31.2	7	43.8	1	6.3	3	18.8
Bifaces	9	56.3	4	25.0	0	0.0	3	18.8
Unifaces	13	81.3	2	12.5	0	0.0	1	6.3
Other facial flaked tools	9	56.3	3	18.8	3	18.8	1	6.3
Flaked cobble tools	8	50.0	4	25.0	2	12.5	2	12.5
Grinding slabs	5	31.3	3	18.8	6	37.5	2	12.5
Manos	10	62.5	3	18.8	2	12.5	1	6.3

such as differences in the occurrence of bifaces (over 80% of the Archaic camps contain this tool class compared to 44% of the Post-Formative camps) and cobble tools (70% of the Archaic camps contain this tool class compared to 50% of the Post-Formative camps). It is not just a matter of presence/ absence but also quantity, because Archaic camps usually contain way more of everything than Post-Formative camps. The exception to this is with grinding tools. Manos and metates are common to camps of both time periods, but more Post-Formative sites contain them. As discussed in previous chapters, this is largely a preservation issue—many Archaic grinding tools have simply been lost to the elements. By factoring in this loss, the seed processing tools may therefore be comparable. This is expectable based on what we know of the Paiute diet from ethnography and from what we know of the Archaic diet from fecal analyses. Both relied heavily on small seeds; thus residential camps of both periods should contain seed processing tools.

Another obvious contrast concerns site size. Single-component Post-Formative sites are invariably quite small. The average size of Post-Formative sites is less than 2000 sq m, compared to almost 5000 sq m for Archaic sites. Another way of looking at this is by the proportion of sites that are smaller, or larger, than a given value. For this comparison we use 1200 sq m, which is a site that measures about 40 by 30 m. Seventy percent of the Post-Formative sites are this size or smaller, whereas just under 20 percent of the Archaic sites are this small. In many cases the small Post-Formative sites are even more compact than indicated by their recorded size because most remains are concentrated in tiny central areas. On Archaic sites remains are always more equally and widely scattered.

Erosional dispersion through time might seem a plausible explanation for site size differences. Archaic sites, after all, have been subject to erosion for more than quadruple the time of Post-Formative sites. Nonetheless, Archaic sites are not just larger but they usually contain far more artifacts. For example, almost 60 percent of the Archaic sites have more than 200 surface artifacts compared to just 20 percent of the Post-Formative sites. Moreover, some of the Archaic sites contain several orders of magnitude more remains than any of the Post-Formative sites. The tested Archaic site 42KA4549, for example, which covers an area of 1000 sq m, contains thousands of artifacts, plus a great abundance of burned rock. The limited testing revealed flake densities of more than 300 per sq m. A few of the Post-Formative sites have several hundred surface artifacts and flake densities up to 100 per sq m (the tested site 42KA4662 for example), but the remains are always concentrated in small areas, rarely more than several square meters. At the Archaic site 42KA4549 the area with high flake counts is at least 100 sq m in size and the three scattered test units had artifact counts that ranged from a low of 97 to a high of

313. In contrast, at the Post-Formative site 42KA 4662 one test unit had an artifact count of 111 but the adjacent unit had a count of just 27, a precipitous drop (the next adjacent unit likely would have had even less). Thus, the contrast is one of big and artifact-cluttered Archaic sites versus small and tidy Post-Formative sites.

It is unlikely that several thousand years of erosion would turn a small and tidy Post-Formative site into a large and trashy Archaic-like site. Indeed, several thousand years of erosion is likely to have the opposite effect—that of site eradication. It is our impression that with enough time many of the Post-Formative sites might become isolated occurrences, if they get registered at all. No doubt, erosion has eliminated small, ephemeral Archaic sites, but of the many substantial ones that remain, there are few comparable Post-Formative examples.

Frequent settlement reuse, as previously mentioned, is one factor that could have made Archaic sites big and cluttered. Another possible reason for the difference in site size and artifact abundance could be contrasts in the size of social units. Although Kelly's (1964) information is scant in this regard for the Kaiparowits band, it appears that their winter bases harbored far fewer families than the adjacent Kaibab Band, which might have had 10. For the Kaiparowits band Kelly (1964:148) noted that "the aboriginal population was sparse ... In the mid 1870s, Mormon settlers met only four or five families in Potato Valley (Gregory and Moore 1931:27), and a 'communal drive' with five or six participants suggests very limited numbers." For the Seed Valley economic unit in particular, the group of the Kaiparowits band that resided locally on the Kaiparowits Plateau, she stated: "both resources and population scant" (Kelly 1964:149). Likewise, John Wesley Powell's brief account of the Kaiparowits Paiute stated that "there was nominally but one tribe, but as the members of this tribe were in very small parties and separated by wide distances" (Powell 1895:84, cited in Fowler and Fowler 1971:9). This suggests that Paiute exploitation of the Kaiparowits Plateau most commonly involved dispersed individual families rather than multifamily groups. The latter would have a greater chance of generating the larger types of debris scatters that more commonly typify Archaic sites.

Archaeological research is always a work in progress, but this small examination of forager remains from different temporal intervals is perhaps more in the embryonic stage than most. We thought that one potentially useful way to analyze the archaeological record left by foragers on the Kaiparowits Plateau in the distant past was to compare it against the record left by foragers of this same area about which we have some ethnographic knowledge. This is not analogy by another name, but rather a way to explore variability in archaeological remains so that we can ponder the reasons for differences and similarities. Contrasts evident in the nature of Archaic and Paiute sites and assemblages imply that these groups may have had different settlement and subsistence strategies. Certainly their technology was organized differently. Some of the raw material patterns imply that Archaic foragers were perhaps ranging further or that they made residential moves to places infrequently used by the Paiute occupants of the area. We currently have more questions than answers, but that is perhaps a healthy sign.

The Archaic-Formative Transition

This period provides a potentially useful conceptual break to differentiate the interval during which agriculture was first being used within the region from the prior 7000+ years when subsistence on the Kaiparowits Plateau revolved around gathering and hunting. Beginning around 2000 years ago or somewhat before, agriculture began to be included in the subsistence mix, at least for some forager groups. Influences from adjacent populations experimenting with or already committed to farming may have been felt hundreds of years earlier. As Wills (1995:238–242) argued, the presence of farmers in a region can drastically change prior land-use strategies. Berry and Berry (1986:319) made the same point years before when they argued that "hunter-gatherers in symbiosis [or other form of social engagement] with farmers are not analyzable in the same terms as hunter-gatherers in isolation." We know from recent excavations that semi-sedentary farmers were living on the Rainbow Plateau just across the Colorado River from the Kaiparowits Plateau by at least 2200 B.P. (ca. 300 cal. B.C.; Geib and Spurr 2000). Further to the southeast in the Marsh Pass area and to the east on Cedar Mesa and along Butler Wash farmers have an even greater time depth (Smiley 1994; Smiley and Robins 1997).

A temporal estimate for the end of the Archaic and beginning of the Archaic-Formative Transition on the Kaiparowits Plateau is provided by direct dates on maize from the Glen Canyon region (see

Geib 1996). On the Rainbow Plateau southeast of the Kaiparowits Plateau, the oldest direct dates on maize are in the early 2200s B.P. (Geib and Spurr 2000). North of the river in this region, however, maize use appears to be no older than about the time of Christ. As a general estimate, 2000 B.P. (ca. 0 cal. A.D.) seems a useful ending date for the Archaic period on the Kaiparowits Plateau; 2200 B.P. might be even more appropriate given the presence of preceramic farmers at this time on the adjacent Rainbow Plateau. Even if the populations habitually using the plateau were not actively involved with farming at the start of the Christian era, they were likely in contact with farmers or were at least experiencing changes resulting from the presence of nearby farmers.

The Kaiparowits Plateau Survey did not specifically identify any sites as belonging to this interval, principally because temporal diagnostics for it are not well demonstrated. Limited site testing and radiocarbon dating, however, revealed that at least three sites belong to this interval. One of these (42KA4749) was considered Formative because of a Rose Spring Corner-notched arrow point, but the radiocarbon date (see Table 5.9) places the site just prior to the introduction of pottery.[3] The two other sites were tentatively considered Archaic based on alternative dating methods (see Chapter 7). A radiocarbon date for hearth charcoal from one of these, 42KA4547, is 2200 B.P., which might be considered terminal Archaic, but given age overestimation from burning old wood this date could well apply to an event several hundred years later in time. The other site, 42KA4552, turned out to contain two components, with most of the remains associated with late Archaic use of the location (ca. 3930 B.P.) but with a slab-lined hearth radiocarbon dated to 1730 B.P.

This serves to highlight how difficult it still is to correctly identify sites that belong to the Archaic-Formative Transition. Doing so is problematic for several reasons. One of the largest problems is that no preceramic farming sites have been excavated on the plateau so we do not know what they actually might look like. In contrast, enough Basketmaker II open sites have now been studied on the adjacent Rainbow Plateau that we can confidently identify sites of this period, even in the absence of commonly used temporal diagnostics. White Dog Basketmaker II dart points might be distinguished from earlier Elko points in ideal cases (see Geib 1996:62–64), but these may not occur on the Kaiparowits Plateau if the early Agricultural period social boundary hypothesized by Geib (1996:73–74) has merit. We know from testing that some of the Kaiparowits Plateau sites assigned to the Archaic based on survey evidence actually date to the Archaic-Formative Transition and there are doubtless many more examples. Rose Spring Corner-notched points evidently occur during the transitional interval, so some of the sites that we assigned to the Formative based on this point type might actually be preceramic in age. Unfortunately there is currently no way of knowing this from survey evidence, so we took the conservative route and assumed a Formative age. Again, this could result in unrecognized transitional sites.

Sites in the Escalante River basin that bridge the hunting-gathering and agricultural transition support the notion of the long-hypothesized Fremont development out of an Archaic base (Geib 1996:103–105). Some of the aceramic sites on the Kaiparowits Plateau are also likely ancestral or preceramic Fremont. The excavated and dated sites of Horse Canyon Rockshelter and Casa del Fuego (Tipps 1992), along the Burr Trail, also bridge the Archaic-Formative Transition, but both lacked evidence of agriculture. Instead, "they reflect a totally Archaic subsistence pattern with an emphasis on processing wild seeds" (Tipps 1998:139). This could be due to a time lag in the use of maize at upland sites (both sites were near potentially arable land), functional variability of sites occupied during different seasons of the year, or some other reason. Based on our survey results much of the Kaiparowits Plateau appears to have supported only a spotty agricultural base (discussed below); thus it might be expected that sites of the Archaic-Formative Transition with evidence of agriculture might be quite rare or even nonexistent.

THE FORMATIVE PERIOD

The Formative period began about A.D. 500, when ceramics were in general use on the Colorado Plateau, and continued until A.D. 1300, with Anasazi abandonment of the Four Corners region. The Formative period encompasses two different cultures: the Anasazi (Puebloan) and the Fremont. The former is divided into two recognized branches within the study area: the Virgin Anasazi, primarily occupying the Arizona Strip, southwestern Utah, and southernmost Nevada

[3]The date was on juniper seed, which could overestimate age by 100 years or more, thus the site might actually date to when pottery was in common use.

(Lyneis 1995); and the Kayenta Anasazi, occupying a large portion of northern Arizona and far southeastern Utah (Plog 1979). The Fremont are generally portrayed as a separate entity, observed primarily at sites in Utah north of the Anasazi region (Madsen 1989; Madsen and Simms 1998).

Once believed to be contemporaneous, it is now evident that the Fremont occupied the region for hundreds of years prior to the first Anasazi occupancy (Geib 1996; McFadden 1998). The available dates also reveal a 150-year gap between the latest Fremont and the earliest Anasazi in the monument (McFadden 1998). This gap is not necessarily the result of a hiatus, but could be a reflection of the limited number of dates currently available (Douglas McFadden, personal communication 1999). In fact, McFadden believes that it is possible that Fremont peoples could have remained in the area, but adopted Anasazi traits. There is, however, "little artifactual evidence of co-occupation other than the presence of Fremont sherds on Anasazi sites" (McFadden 2000:157), which in some cases clearly results from the "mixing" of "material remains of temporally discrete depositions from sequential rather than contemporaneous occupancies" (Geib 1996:112; see also McFadden 2000:164–165).

Phase sequences for the area are in the developmental stages, but temporal frameworks still reference the Pecos Classification of Pueblo I, II, and III. McFadden (2000:97 and Figure 59) included chronologies for the Anasazi of the Grand Staircase and the Kaiparowits Plateau, plus the Fremont of the Escalante drainage, but stressed that it is a "working document" to be revised as new dates and data are acquired. In this report we use the Pecos Classification as a convenient and readily understood temporal framework, much as McFadden did for the eastern Virgin Anasazi (see Figure 3.2), but we acknowledge that it must be viewed in context. Pueblo III ceramics, for example, such as Flagstaff Black-on-white, are rarely observed on Anasazi sites in the monument, and yet some sites appear to post-date A.D. 1150 and the introduction of that and other late types (McFadden 2000:Table 25 and Figure 99). There may also be a 25–50 year lag in the appearance of certain Virgin Anasazi analogs, compared to their initial introduction in the Kayenta heartland (e.g., Lyneis 1992:88). We should also note that there is only one named phase on the Kaiparowits Plateau—the late Pueblo II–early Pueblo III Fiftymile Mountain Phase—and that this phase encompasses nearly all of the Anasazi sites observed by NNAD on the plateau.[4] As for Fremont sites recorded by NNAD, we assume that they fall within McFadden's Wide Hollow phase and probably date no later than A.D. 1050, if not before.

Survey Results

The Kaiparowits Plateau Survey documented 116 sites with 117 Formative components (17% of 689 prehistoric sites).[5] Eighty-six of the sites are single component and 30 are multiple-component sites containing evidence of Formative use. The Formative designation is appended with one of two cultural affiliations, when they could be ascertained, viz. Fremont and Anasazi. Forty-five (37%) of the components are considered Formative but with no cultural assignment, which means that we found no artifacts diagnostic of any particular Formative culture. The 62 Anasazi components comprise the largest group of culturally identifiable Formative occupations (53%). There are 10 (9%) Fremont components. Cultural and temporal affiliation was based on associated ceramics, diagnostic and untyped arrow points, and the presence of a granary at some sites. Not included in the above totals are sites that could date to either the Formative or Post-Formative periods (see Post-Formative section below).

Table 8.10 shows the frequency and density of Formative sites by survey stratum. Although Formative sites are present on all strata except East Clark Bench and Horse Flat, the highest frequencies are on Fourmile Bench and Collet Top. Ninety-one of the 117 Formative components are located on the four highest strata, peaking at Collet Top with 55 sites. These figures are not strictly comparable, however, due to the variability in the number of units surveyed per stratum. The density of Formative sites per survey unit is perhaps a more useful measure. Table 8.10 shows that Formative site density is actually the same for Smoky Mountain and Fourmile Bench, and very similar for Nipple Bench and Horse Mountain—two strata on nearly opposite ends of the elevation spectrum. By any measure Collet Top has the most signifi-

[4]There is also a question as to whether the Fiftymile Mountain Phase is applicable beyond Fiftymile Mountain itself. As defined by McFadden (2000), it appears to reflect a Kayenta Anasazi occupation on the eastern edge of the plateau during Pueblo II. Our initial impression is that most Formative sites within the KPS study area are Virgin Anasazi or at least not part of a Kayenta migration, as we discuss, with the remaining sites being Fremont.

[5]One rockshelter (42KA4790) has both an Anasazi and a Fremont component.

Table 8.10. Frequency, percent, and density of Formative components by sampling stratum.

Sampling Stratum	All Sites		Single Comp.	Second Comp.	Formative Sites by Culture: Unknown			Anasazi			Fremont			Site Density Per Unit
	n	C%	n	n	n	C%	R%	n	C%	R%	n	C%	R%	
Collet Top	55	47.0	45	10	13	28.9	23.6	38	59.7	69.1	4	30.0	7.3	3.0
Horse Mtn.	7	6.0	3	4	4	8.9	57.1	2	4.8	28.6	1	20.0	14.3	0.9
Long Flat	10	8.6	8	2	4	8.9	30.0	4	6.5	40.0	2	20.0	30.0	0.6
Horse Flat	0	0.0	0	0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0
Fourmile Bench	19	16.2	11	8	10	22.2	52.6	8	12.9	42.1	1	10.0	5.3	1.3
Smoky Mtn.	13	11.1	11	2	6	13.3	46.2	7	11.3	53.8	0	0.0	0.0	1.3
Brigham Plains	5	4.3	2	3	1	2.2	20.0	3	4.8	60.0	1	10.0	20.0	0.4
Nipple Bench	8	6.8	6	2	7	15.6	87.5	0	0.0	0.0	1	10.0	12.5	0.7
E. Clark Bench	0	0.0	0	0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0
All Strata	117	100.0	86	31	45	100.0	37.3	62	100.0	53.4	10	100.0	9.3	1.1

cant concentration of Formative sites. It contains almost half of the Formative sites (47%), and more than twice the site density of any other stratum, at 3.0 Formative sites per unit.

There are some interesting differences between our findings and those of the Escalante Project and the Southern Coal Project. The Escalante Project did not positively identify any Fremont sites in Tract II, but "five sites ... identified as Fremont/Anasazi ... presumably represent Fremont occupation" (Kearns 1982:268–269). The presence of Fremont groups in the Escalante Valley and Escalante River basin suggests the "probability of Fremont groups at the northern end of the plateau" (Kearns 1982:269). Classification of probable Emery Gray sherds as Coombs Gray and Coombs Gray polished (Kearns 1982: Table 24) is one probable reason for the tentativeness of Fremont identification. Although creation of the Coombs Gray type was evidently called for in dealing with the materials from the Coombs Site (though probably not Coombs Gray polished), use of the type away from the Boulder area is problematic and has created some real quandaries.[6] Three sites were identified as Pueblo II–III Kayenta Anasazi, with the two strongest candidates being near Collet Top. No Virgin Anasazi sites were recorded, hence the inference that "the Virgin-Kayenta interface occurred west of Tract II" (Kearns 1982:270). The Formative sites recorded by ESCA-Tech made up just 6.0 percent of all Tract II components (n = 134).

[6]For example the identification of Coombs Gray at the Bull Creek sites (Geib 1996:105–106).

The AERC Class I survey (Hauck 1979) reported 2 Fremont and 61 Pueblo sites among 354 sites in the Paria planning unit, which encompasses much of the monument. The Escalante planning unit, to the north and east, had 9 Fremont sites and 298 Pueblo sites among 698 total sites. Eighty of the 199 sites (40%) recorded during the Class II survey of this Escalante unit were Formative and were culturally identified as follows: 69 Kayenta (35%), 7 Fremont (4%), 3 Kayenta/Fremont (2%), and 1 Anasazi (<1%). Presumably, the Kayenta designation includes both Virgin and Kayenta Anasazi, as Virgin ceramic types were found in quantity, and the author concludes that "the ... evidence indicates the area as being predominantly Virgin/Kayenta with Fremont trade wares and occasional Fremont affiliated sites" (Hauck 1979:312).

Results from the current survey suggest somewhat less intensive use of this part of the Kaiparowits Plateau by Fremont peoples, or at least ceramic-using Fremont. There is good evidence for a cultural continuum from the Archaic-Formative Transition through the early Formative (ca. A.D. 100 to 900) for the Fremont (Geib 1996:103–105; Geib and Fairley 1998:57–58; Janetski 1993), perhaps arising out of a pure Archaic base. This suggests that some of the aceramic sites on the Kaiparowits Plateau may be ancestral or "proto-Fremont" (coincident with the "Escalante Phase" described in McFadden 2000:151). Pre-pottery Fremont sites on the Kaiparowits Plateau may thus be indistinguishable, at the survey level, from earlier Archaic sites, or lithic scatters classified as temporally unknown. If a lithic site contained

Rose Spring Corner-notched points then it was assigned to the Formative period, although there is the possibility that it could pre-date the use of pottery. An example of this is site 42KA4749, designated as Formative during survey based on a Rose Spring point, but which produced a date of cal. A.D. 255–435 (see the testing results of Chapter 5).

Both Anasazi and Fremont sites occur in much of the project area, but all except 2 of the 10 Fremont sites are on the four highest and northernmost survey strata. The one Fremont site on Brigham Plains was a reduction locus (42KA4794), but the Fremont site on Nipple Bench was a possible residential camp. If the general settlement pattern holds up with additional work, it suggests that Long Flat, Fourmile Bench, Horse Mountain, and Collet Top were within what might be considered Fremont territory, but that the southernmost part of the plateau was at the periphery of their usual range. We suspect that future work might also demonstrate that Fremont use of the plateau was less intensive from east to west and north to south, and that the Cockscomb and Glen Canyon provided effective west and east boundaries for their use territory.

In contrast, Anasazi use of the survey area seems to have been relatively more intensive (at least in portions) and varied than that of the Fremont, including numerous semipermanent residential sites, processing camps, hunting camps, and granaries. We also know that by the end of Pueblo II (ca. A.D. 1150) Anasazi territory encompassed the entire Kaiparowits Plateau, with permanent residential sites established at most (perhaps all) of the best farming locations, especially on Fiftymile Mountain and Collet Top. Because of this, it is likely that Anasazi use of the plateau was structured quite differently than was the case for Fremont use of the plateau.

This was most clearly the case for the Collet Top sampling stratum, particularly the geographic namesake for this stratum—Collet Top proper just south of Lower Trail Canyon, a tributary of Left Hand Collet Canyon. In five units NNAD crews recorded 48 sites, 39 of which—about 80 percent—were Formative. Half of the sites had masonry and jacal structures in the form of single rooms and roomblocks—up to eight rooms in one case (42KA 5435). This concentration of Formative sites on Collet Top mimics that of Fiftymile Mountain. The University of Utah survey on Fiftymile Mountain was reconnaissance-level work on foot and horseback, so site density figures are not strictly comparable, but our highest density—18 Formative sites in one quarter section (Unit 189)—exceeds the average of 10 sites per square mile reported for Fiftymile Mountain (Gunnerson 1959a:359).

As archaeologists who normally work within the cultural heartland of the Kayenta Anasazi, and are familiar with the associated ceramic traditions, we saw no good evidence for Kayenta occupation or use of the Kaiparowits Plateau. Nearly all of the Anasazi ceramics found during the survey are identified as Virgin Anasazi types (Shinarump and North Creek Corrugated, Shinarump Plain, North Creek Gray, Virgin Black-on-white, and North Creek Black-on-gray) with just a few sherds clearly produced in the Kayenta region to the southeast. If Anasazi populations from south and east of the Colorado River (i.e., from the Kayenta region) were using the western and central portions of the Kaiparowits Plateau, it was probably via logistical hunting forays. The supposed Kayenta Anasazi population on Fiftymile Mountain (see McFadden 2000:161–198) could have used the western plateau, but parties would have had to cross a series of extremely rugged, north-south canyons to get there. It would be easier for them to hunt and gather in the adjacent lowlands of Glen Canyon (including Fiftymile Bench) and the Escalante drainage basin. This would also seem to be true for Collet Top, which is a day's walk from Fiftymile Mountain (or less, but over admittedly difficult terrain), but no Kayenta sites were recorded there; the implications of this are discussed at greater length later in this chapter.

Site Types

Table 8.11 shows that Formative residential sites, which include both residential camps and semi-permanent habitations, were the most prevalent site type (n = 41, 35% of all site types). Twenty-five are located on Collet Top, and 33, or ca. 80 percent of the type total, are found in the four uppermost strata. The per-unit density of residential sites on Collet Top is more than four times greater than on any other stratum. The majority (n = 32) are considered to be exclusively Anasazi, specifically Virgin Anasazi on the basis of observed ceramic types, including all but one of the Formative Collet Top sites.

The next most common Formative site type is processing camps (n = 25, 21% of all site types), which occur in most strata but have the greatest presence (n = 11) on Collet Top. Fourteen of the processing camps are Anasazi, but there are Fremont processing camps on Long Flat and Collet Top as well. Processing camp density appears to

Table 8.11. Frequency and density per survey unit of Formative site types by culture and sampling stratum.

Sampling Stratum	Residential Camps and Semi-Permanent Habitations					Processing					Hunting				
	U	A	F	All	DPU	U	A	F	All	DPU	U	A	F	All	DPU
Collet Top	1	24	0	22	1.4	1	8	2	11	0.6	6	1	1	8	0.4
Horse Mtn.	2	0	1	2	0.2	0	0	0	0	0.0	1	2	0	3	0.4
Long Flat	0	1	0	1	0.1	0	1	1	2	0.1	1	0	1	2	0.1
Horse Flat	0	0	0	0	0.0	0	0	0	0	0.0	0	0	0	0	0.0
Fourmile	1	4	1	4	0.3	1	2	0	3	0.2	4	2	0	6	0.4
Smoky Mtn.	1	2	0	3	0.3	2	2	0	4	0.4	0	1	0	1	0.1
Brigham Plns.	1	1	0	2	0.2	0	1	0	1	0.1	0	1	0	1	0.1
Nipple	0	0	1	1	0.1	4	0	0	4	0.3	0	0	0	0	0.0
East Clark	0	0	0	0	0.0	0	0	0	0	0.0	0	0	0	0	0.0
All Strata	6	32	3	41	0.4	7	14	3	25	0.2	12	7	2	21	0.2

(Table 8.11, Part 2)

Sampling Stratum	Reduction					Storage					Unknown				
	U	A	F	All	DPU	U	A	F	All	DPU	U	A	F	All	DPU
Collet Top	0	1	0	1	0.1	4	1	0	5	0.3	1	3	1	5	0.3
Horse Mtn.	0	0	0	0	0.1	0	0	0	0	0.1	1	0	0	1	0.1
Long Flat	1	0	0	1	0.1	1	0	0	1	0.1	1	2	0	3	0.2
Horse Flat	0	0	0	0	0.0	0	0	0	0	0.0	0	0	0	0	0.0
Fourmile	3	0	0	3	0.2	0	0	0	0	0.0	1	0	0	1	0.1
Smoky Mtn.	1	0	0	1	0.1	0	1	0	1	0.1	2	1	0	3	0.3
Brigham Plns.	0	0	1	1	0.1	0	0	0	0	0.0	0	0	0	0	0.0
Nipple	2	0	0	2	0.2	0	0	0	0	0.0	1	0	0	1	0.1
East Clark	0	0	0	0	0.0	0	0	0	0	0.0	0	0	0	0	0.0
All Strata	7	1	1	9	0.1	5	2	0	7	0.1	7	6	1	13	0.1

U = Unassigned Formative; A = Anasazi; F = Fremont; All = total of U, A, and F; DPU = density per survey unit.

co-vary with residential sites on Collet Top. Aside from Collet Top, the lower benches of Nipple and Smoky Mountain have the next highest per-unit densities of processing camps. One possibility is that the lower benches were favored for grass seed collecting and processing (which may have also been the primary function for an outstanding residential Fremont camp, 42KA5411, on Nipple Bench with large quantities of intact and semi-intact groundstone).

Twenty-one Formative hunting camps were recorded, and there appears to be a pattern for hunting camps to be located on higher elevation landforms, perhaps a factor of where certain kinds of big game (e.g., deer) were more likely to be found at certain times of the year. Eight of the camps are on Collet Top, six are on Fourmile, and three were recorded on Horse Mountain; note, however, that the per-unit density is the same for each stratum. Only two examples were found on the lowest five strata. Seven of the camps are believed to be Anasazi, and two may be Fremont. The greatest number (n = 12) are simply designated as Formative, probably because hunting camps are less likely to have culturally diagnostic ceramics.

Only nine Formative reduction loci were observed, distributed nearly evenly across the project area. In most cases, these could only be assigned a general "Formative" affiliation, but one, on Collet Top, was defined as Anasazi, and another, on Brigham Plains, was designated as Fremont.

Storage facilities, in the form of granaries and cists (n = 7), are most plentiful on Collet Top (n = 5)—certainly a factor of the high density of Formative residential sites there. As might be expected, all were found in sheltered contexts. Two of the

sites could be attributed to Anasazi use, but the remaining storage facilities are not associated with diagnostic artifacts, and there is the possibility that some could be Fremont and could pre-date the Anasazi occupation of the plateau.

Anasazi Cultural Identity

That the Anasazi occupied the Kaiparowits Plateau is beyond doubt. Kluckhohn (1993:229–230) made reference to numerous Anasazi ruins on the mesa, as did Beals, Brainerd and Smith (1945: 6), but it was not until the Glen Canyon Project of the late 1950s and early 1960s that adequate documentation of this occupation was made (Aikens 1963; Fowler and Aikens 1963; Gunnerson 1959a). The collected evidence revealed a substantial density of small farmsteads (single or extended family) all dating to a narrow slice of time that corresponds with what today we would refer to as late Pueblo II and early Pueblo III (ca. A.D. 1100 to 1200). There was no evidence for a continuous sequence of local Anasazi development anywhere on the plateau, thus there seemed little doubt that the inhabitants who created the small pueblos had come from somewhere else, but opinions varied. Gunnerson, who conducted the first extensive survey on Fiftymile Mountain, interpreted the Anasazi sites in the following manner:

> The great preponderance of Virgin Series black-on-gray sherds, as compared to sherds of Tusayan white, Tsegi orange, and San Juan red wares, and the probable Virgin affiliation of most of the corrugated and plain gray pottery, justifies the assignment of the Anasazi sites on the Kaiparowits to the *Virgin* branch rather than to the Kayenta branch proper. (1959a:360, emphasis added)

The Virgin cultural affiliation was subsequently replaced by a Kayenta migration hypothesis. Lister laid out this scenario in 1964 based on excavation data reported by Fowler and Aikens (1963), specifically an analysis of sherds. In her summary, Lister has parties of Kayenta Anasazi migrating "north and west," including a "sizable force" pushing up the Escalante drainage and "around and up the Kaiparowits Plateau" (1964:77). What they left behind on Fiftymile Mountain, according to Lister, were plain wares dominated by Tusayan Gray, Tsegi series, and Tusayan White Wares, Kayenta Series (Fowler and Aikens 1963:46–48).

The biggest differences in their analyses, in regard to Anasazi wares and types, are nearly opposite interpretations of plain gray ceramics, with Gunnerson seeing Tusayan Gray Ware, Virgin Series, specifically North Creek Gray. He also reported far more sherds of Virgin Series Tusayan White Ware (North Creek Black-on-gray) and comparatively few sherds of Kayenta Series Tusayan White Ware (Sosi, Dogoszhi, and Black Mesa Black-on-white) than Lister. In terms of peoples and population movements, Lister contrasted the two viewpoints as follows:

> [Gunnerson] would have Kaiparowits occupation resulting from movements of Kayenta peoples from the west and would see no contact between the Kaiparowits population and the Fremont. We see Kayenta people migrating directly to the Kaiparowits [from Northern Arizona], undergoing slight change because of local conditions, and coming into direct association with the Fremont. (Lister 1964:75)

Lister's notion of a Kayenta migration was carried forward by Jennings (1966:35) in his summary of the Glen Canyon project: "The Kayenta crossed the Glen Canyon and followed up the Escalante River and Boulder Creek to establish ... a large distant outpost deep in Fremont country. They also dominated the Kaiparowits [Plateau]." Later in the same report he observes, "The best example of Kayenta thrust in the northern part of the Glen Canyon area is the Coombs site; Kayenta control of the entire Kaiparowits [Plateau] seems equally clear" (Jennings 1966:55). Jennings and Lister had the last word and the Kayenta migration became an established fact. Indeed, until actually conducting this survey and seeing firsthand some Anasazi sites on the Kaiparowits Plateau, we simply assumed that the traditional argument of a Kayenta Anasazi expansion was correct.

We now wonder if Gunnerson was not right to begin with, in regard to not only the affiliation of the Fiftymile Mountain population, but also their relationship (or lack of) with the Fremont. Our sudden loss of faith in the Kayenta expansion hypothesis derives primarily from observations made on Collet Top. Of the 55 Formative sites on Collet Top, we designated 38 (almost 70%) of them as Anasazi, specifically Virgin Anasazi, based primarily on field and laboratory analysis of ceramics, with supporting evidence from lithic and architectural attributes. We currently believe that the Collet Top settlement, at least, has little or nothing to do with a northward incursion across the Colorado River of Pueblo II Kayentans.

It is our belief that answers to the question of who the peoples were who created the Formative pueblos on the Kaiparowits Plateau are probably lying on the ground where it all began: Fiftymile Mountain. A hint of what future researchers might find there derives from our findings on Collet Top, which forms the centerpiece of this discussion on Anasazi cultural affiliation. The extensive Anasazi presence on Collet Top was not entirely unex-

pected. In 1981, McFadden (1982) surveyed two separate but adjacent areas on Collet Top and Window Sash Bench and recorded 16 prehistoric sites, 7 of which displayed single or multi-room Formative structures. "The moderately dense cluster of Anasazi sites was a surprise," McFadden noted (1982:2), adding that—heretofore—"the only previously recorded architectural surface sites are restricted to ... Fiftymile Mountain ... some 12 miles to the southeast." In 1998, a Weber State University crew recorded eight prehistoric sites on Collet Top (Eaton 1998), situated in general between McFadden's survey area and several units surveyed by NNAD on Collet Top. One of the sites had surface masonry, and had been recently looted.

McFadden (2000:165) noted that the University of Utah survey on Fiftymile Mountain "ended at Basin Canyon on the north because from that point to Collet Top there are no springs and very little arable land. The Collet Top locality, however, is an exception and does have deep soils, springs [and] adequate precipitation." More seeps and springs were observed or known from Collet Top than any other survey stratum, and its elevational setting (6000–6500 ft) is the same as a zone of high residential site density "suitable for dry-farm agriculture" that McFadden (2000:16) observed in the Grand Staircase. In effect, Collet Top is a microcosm of Fiftymile Mountain, albeit at a slightly lower elevation (which may have extended the "range" of local growing opportunities if the Collet Top and Fiftymile Mountain populations were related).

Given the debates on cultural and archaeological identities on the plateau, a natural question is who were the people on Collet Top? In the following section, we consider each line of evidence, in turn, concluding with preliminary thoughts on how the Collet Top settlement may or may not relate to the Formative occupation of nearby Fiftymile Mountain.

Lithics

Throughout the Kaiparowits Plateau Survey, NNAD crews consistently observed that Formative sites on the plateau have a much higher proportion of brightly colored, high-quality, nonlocal siliceous stone (agatized petrified wood, Boulder jasper, Glen Canyon chert) than sites of other temporal periods. Nearly two-thirds of the Anasazi sites on Collet Top contained material of this sort, and all but two of the structural sites had agatized wood. All of these materials are imports, with the agatized wood derived from sources west and northwest of the Kaiparowits Plateau along the Vermilion Cliffs and upper Escalante River, with Boulder jasper from the upper Escalante River basin along the foot of Boulder Mountain.

Far more significant is what the Anasazi on Collet Top did with these high-quality silicates and how this contrasts with what the Kayenta Anasazi living south of the Colorado River did with similar silicates. First, heat treatment was an integral part of the reduction strategy for the Collet Top Anasazi, where virtually every Anasazi habitation site and hunting camp has abundant evidence for heat treatment (see Chapter 6). Heat treatment of siliceous stone to improve its flaking qualities is largely unknown in the Kayenta Anasazi region. Having recently completed the analysis of thousands of flakes from more than 30 Kayenta Anasazi sites, Miranda Warburton (personal communication 2001) found essentially no evidence for heat treatment. Geib (1985) likewise found no evidence for heat treatment at Anasazi sites around Navajo Mountain.

The other key distinguishing aspect is what the Collect Top Anasazi did after cooking their silicate pieces. Biface reduction, both percussion thinning and pressure flaking, was a common strategy, accounting for most of the flaking debris at many sites. Anasazi sites of all types—including permanent habitations—often have discrete, high-density reduction loci of percussion thinning and shaping flakes and pressure flakes. Biface reduction debris, especially from percussion thinning, is seldom found at Kayenta Anasazi habitations south of the Colorado River, rarely accounting for more than a fraction of an assemblage (<2%). Quite in contrast, it is core flakes and bipolar flakes that account for the majority of the reduction debris at Kayenta Anasazi sites. The lack of any evidence for bipolar reduction at the Anasazi sites on Collet Top is a most significant contrast with Kayenta Anasazi sites. Bipolar flakes easily account for 30 percent of the debitage assemblage at most Kayenta habitations; it was a key component of Kayenta reduction behavior, just as biface reduction was a key component of reduction behavior for the Collet Top Anasazi. Unpatterned production of expedient flakes from cores was also practiced on the Kaiparowits Plateau, but flakes from this strategy do not dominate the debitage assemblages as they do in the Kayenta region.

Another point of contrast that relates to stone tool reduction is the ratio of flakes to sherds. At all of the Anasazi sites on Collet Top flakes far outnumber sherds, with ratios that for some sites, such as Gag House, approach 200:1. This is exactly

the reverse of habitations in the Kayenta region, where sherds always outnumber flakes and usually do so by a ratios of 10:1 or greater (sherds to flakes).

Ceramics

Of the 38 Formative sites clustered together on Collet Top, all have pottery that is dominated by Virgin Anasazi types (Shinarump Gray, White, and Red Ware, and Virgin Series of Tusayan Gray and White Ware), with Kayenta ceramic types poorly represented if at all. Identified ceramic types consist of such trademark Virgin Anasazi types as Shinarump Corrugated and Plain, North Creek Corrugated and Gray, North Creek Black-on-gray, Virgin Black-on-white, and the various types of Shinarump Red Ware. Much of the light-colored utility and decorated pottery could have been made from the light-firing Cretaceous clays of the Kaiparowits Plateau, indicating production on and closely around the Kaiparowits Plateau. Nevertheless, some of the Anasazi pottery (Shinarump) is made of darker-firing clays that may derive from the Chinle Formation west of the Cockscomb. Thus, some of the Anasazi pottery used in the area probably came from the west, and perhaps the population did as well.

The design styles of sherds of Shinarump White Ware and the Virgin Series of Tusayan White Ware of the Kaiparowits Plateau are principally North Creek and Hildale. In the Kayenta heartland, sites containing a dominance of the analogous types Sosi and Dogoszhi would be considered late Pueblo II in age (ca. A.D. 1100–1150). Various lines of evidence now indicate a time lag in the introduction of Virgin corrugated and decorated ceramics, compared to their Tusayan analogues (Altschul and Fairley 1989:225) as well as persistence of Pueblo design styles well into Pueblo III (after A.D. 1150). Later types, such as Glendale (cf. Flagstaff) Black-on-white, are completely absent on Collet Top, and evidently none were observed during past surveys of Fiftymile Mountain.

This pattern—the persistence of Pueblo II styles and absence of Pueblo III black-on-whites—has been observed on other Virgin sites as well (McFadden 2000:124). It is a curiosity—the Kaiparowits Anasazi are still in place, into Pueblo III (McFadden 2000:125–126), but they do not or cannot participate in the information or social conduit that transmits late black-on-white and polychrome motifs. This is graphically illustrated in Figure 69 from McFadden (2000), which shows an array of 24 radiocarbon dates from Anasazi sites in the Grand Staircase (excluding rejected dates). Two-thirds of the dates have calibrated midpoints that post-date A.D. 1200.[7] On typical Kayentan sites with such dates we would expect to see a preponderance of Tusayan Black-on-white and late variety polychromes, types that are completely absent on Virgin sites. "The apparent lack of material culture change after A.D. 1150 is an extremely significant comment on both culture contact and internal conservativeness" (McFadden 2000:125).

It is worth mentioning here that Flagstaff and Tusayan Black-on-white and late types of Tsegi Orange Ware occur at Horsefly Hollow phase sites within the Glen Canyon lowlands surrounding Fiftymile Mountain (Lipe 1967, 1970). The closest of these sites is Davis Kiva in Davis Wash, a tributary of the Escalante River that drains the desert below Fiftymile Mountain (Gunnerson 1959b). Cow Canyon, almost directly across from the mouth of Davis Wash, contains a more substantial Horsefly Hollow community (Geib and Fairley 1996). The sites of this community, and others of the Red Rock Plateau, contain the same Pueblo III ceramic types that typify Kayenta sites to the south (Cummings Mesa and Rainbow Plateau) and Mesa Verde sites to the east (Cedar Mesa). The presence of these sites in the lowlands surrounding Fiftymile Mountain makes the lack of Pueblo III ceramic types on the Kaiparowits Plateau all the more inexplicable, unless of course there simply was not any permanent Anasazi occupation of the plateau after about A.D. 1180.

Architecture

McFadden (1996) identified four site or settlement configurations that he links to a Virgin adaptive strategy of what he calls "residential mobility," where sites were occupied, abandoned (sometimes for long periods of time), and re-occupied. We observed two of these site patterns on Collet Top. The first is a Virgin propensity to cluster sequentially occupied habitations on the same landform or microenvironment. There are an average of 24 Virgin Anasazi sites per square mile on Collet Top, which is as high as the Upper Virgin River area of the Grand Staircase, off the plateau to the west (McFadden 1996). By comparison, we located fewer than two Anasazi sites per

[7]Note, however, that "present tree-ring data suggest that the occupation of Fiftymile Mountain was largely restricted to the 2nd half of the 12th century" (McFadden 2000:193 and Figure 97). Ten of 12 tree-ring dates from Fiftymile Mountain fall between A.D. 1100 and 1200, with none later than A.D. 1198v.

square mile on the other eight sampling strata of the Kaiparowits Plateau. The Collet Top settlement appears to be a discrete, topographically bounded entity, unknown on any other part of the Kaiparowits Plateau west of Fiftymile Mountain.

The second pattern is accretional construction of rooms and roomblocks, indicating short-term episodes of sequential occupation. This can rarely be inferred from survey, but a close look at Gag House (42KA5435, Figure 7.9) shows that masonry Room 2 is "slotted" between jacal Rooms 1 and 3—none of which have the same configuration, and that Rooms 4 and 5 are oddly detached; there is also an outlying room situated between the roomblock and the midden. This is likely an example of the kind of Pueblo II Virgin roomblocks that were "accretionally constructed one room at a time," which McFadden (2000:13) attributed to "long histories of site use, abandonment and reoccupation." The construction method was previously identified in the Grand Staircase, but Kaiparowits Plateau Survey results appear to extend its use to the eastern third of the Kaiparowits Plateau.

Regarding architecture, we noted a preponderance of wet-laid masonry—as much as half masonry to half mortar (ca. 50/50 rock and clay). McFadden (2000:182–183) noted a similar construction style among granaries in the Collet Canyon drainages. This type of construction method is also characteristic of Fiftymile Mountain. Gunnerson (1959a:335) was the first to report this:

> The most reasonable interpretation of the evidence of masonry at open sites is that the walls were laid with adobe and that once this was washed out by rain, the structures collapsed. This interpretation is supported by the finding of a few fairly well preserved ... structures in rock shelters. In these construction was of irregular sandstone slabs such as were found in the surface ruins, laid in an abundance of adobe mortar. The volume of mortar, in fact, often was about equal to the volume of rock.

Fowler and Aikens (1963:5) also reported this phenomenon: "the ratio of stone to clay used in laying up the haphazardly coursed walls appeared to have been about 1:1." This wet-laid construction style, especially the great abundance of mortar, is markedly different from that of the Kayenta Anasazi, who typically used a dry-laid and mudded technique with comparatively sparse amounts of mortar.

In sum, the ceramic, lithic, and architectural evidence strongly suggests that Collet Top was not settled by Anasazi inhabitants from the Kayenta region. If Kayenta migrants had settled this area then the Anasazi sites and material remains on Collet Top should closely resemble those from Pueblo II sites on the plateaus immediately south and southeast of the Kaiparowits Plateau, but they do not. If the Anasazi populations on Collet Top did not come from the Kayenta region, then a western source from the Virgin Anasazi region seems likeliest, a possibility that has already occurred to McFadden (2000:196–197). "It is conceivable," he notes, "that the migration to Fiftymile originated not in northern Arizona but on the Grand Staircase." Stylistic similarities in pottery are the only real connection with the Kayenta region, but these similarities were widespread across the entire Virgin Anasazi region during late Pueblo II and are insufficient, especially in the face of the other contradictory evidence, to support a Kayenta migration onto Collet Top.

The Collet Top Settlement viz. Fiftymile Mountain

It appears that the Virgin Anasazi presence on Collet Top is like a wave lapping at the shores of Fiftymile Mountain. On the face of it, we should expect similar artifact and site types, architecture, and settlement patterns in the two areas. At the least, the two populations should share a reasonably close ceramic tradition. If one contrasts the Fiftymile Mountain ceramic assignments made nearly 40 years ago (see Fowler and Aikens 1963 and Lister 1964) with ours for Collet Top, the following dichotomies emerge:

1. Utilitarian ceramics derive from completely different Anasazi regions: those from Fiftymile Mountain are ca. 95 percent Kayenta Anasazi (i.e., Tusayan Gray Ware, Tsegi Series), whereas those on Collet Top are ca. 95 percent Virgin Anasazi (Tusayan Gray Ware, Virgin Series and Shinarump).

2. Collet Top sites virtually lack Kayenta-manufactured white wares (i.e., Tusayan White Ware, Kayenta Series), although sherds so classified make up more than half of the white ware from Fiftymile Mountain.

3. Collet Top sites virtually lack Kayenta-manufactured red wares (i.e., Tsegi Orange Ware), although all of the Fiftymile Mountain red wares were designated as such.

From this evidence it appears that we have two roughly concurrent occupations, as little as 12 miles apart, representing two Anasazi ceramic industries and, perhaps, peoples: Virgin Anasazi

on Collet Top, Kayenta Anasazi on Fiftymile Mountain. Alternatively, we have evidence of archaeologists applying different names to the same pottery, names that have unavoidable implications about cultural affinity or geographical origins. Is it likely, for example, that the sherds Lister identified as Tusayan Gray Ware, Tsegi Series, are ones that we would have classified as North Creek Gray and North Creek Corrugated? Even without examining the collections from Fiftymile Mountain, we are convinced that this is the case based on Beals, Brainerd and Smith's (1945:6) observation that the Anasazi pottery on Fiftymile Mountain differed from that of the Kayenta region. Based on sherds collected from nearly 100 sites on Fiftymile Mountain they concluded that the "collections indicate ... marked differences in the ceramic typology of the region from that of any of the other regions studied by the Expedition" [the other regions were all within the Kayenta area]. This is significant, because the archaeologists who made the statement were quite intimate with Kayenta pottery, having analyzed thousands of excavated and surface-collected sherds from throughout the Kayenta heartland.

Gunnerson's and Lister's classification of pottery from sites on Fiftymile Mountain reveal markedly different results. Gunnerson (1959a) reported a nearly 10:1 ratio of what he called North Creek Black-on-gray to Kayentan whiteware during the first University of Utah survey on this highland. But Lister's subsequent analysis of excavated sherds from some of Gunnerson's sites, as well as sites recorded during a second survey (in Fowler and Aikens 1963:43–48, Table 1; Lister 1964), identified the majority of the decorated whiteware as belonging to the Kayenta Series of Tusayan White Ware. Lister did however identify a large proportion of the whiteware sherds as "Southern Utah Series," which might be largely comparable with Gunnerson's North Creek Black-on-gray. Similarly, it is possible that much of the sand-tempered grayware that Gunnerson defined as North Creek was what Lister later called Kiet Siel Gray, a distinct Pueblo III Kayenta type that dates from around A.D. 1200 and later. Gunnerson (1959a:346) admitted that "North Creek Gray sherds show a great deal of variation," including many "rough" sherds with bumpy and pitted surfaces that Lister may have viewed as Kiet Siel. In the end, Gunnerson defined more than three times as many North Creek Gray sherds as any other gray ware type, yet Lister actually tallied fewer North Creek Gray than Emery Gray. In the Kayenta region (and the Glen Canyon lowlands), Kiet Siel Gray is associated with Tusayan and Kayenta Black-on-white and contemporaneous late orangewares, but this is evidently not the case on the Kaiparowits Plateau because Lister (1964) or Fowler and Aikens (1963) did not report these types, making the Kiet Siel identification highly suspect. Unfortunately, we cannot compare corrugated types as readily, as Gunnerson (1959a:345) did not "separate the ... Tusayan and Moenkopi corrugated sherds from ... such variants as North Creek." We do know that Lister placed more than 2800 corrugated sherds under Tusayan Gray Ware, Tsegi Series, but identified only 87 as North Creek Corrugated.

Disagreements over sherd classification may nonetheless reduce to differences in regional geology that have nothing to do with behavioral differences. Presumably, any migrants to the Kaiparowits Plateau, no matter where they came from, would use local sources for clay and temper (e.g. Arnold 1985); thus geologically induced differences should be expected. Perhaps for this reason Lister (1964) looked past the obvious differences in the clay and temper between the Kaiparowits Plateau pottery and that of the Kayenta region, differences initially mentioned by Beals, Brainerd and Smith, and saw underlying similarity. But, if the Virgin tradition of pottery production was to temper with sand or crushed sandstone then why is the sand-tempered pottery of the Kaiparowits Plateau necessarily derived from the Kayenta region rather than the Virgin region? Why should it be considered Kayenta derived rather than Virgin derived?

All of this calls to mind two issues: first, the need the move beyond ceramics to improve the quality of this sort of discussion by diversifying the data sets examined, and second, if we are looking at ceramics, to include variables that might have real value as social markers rather than just monitoring geologic variability. As to the latter, it would be important to reanalyze the pottery from Fiftymile Mountain with an eye toward such issues as vessel finishing, design layout, vessel form, and forming techniques. Little new can be added here at this time except to note that the practice of finishing utilitarian vessels as plain (lacking surface corrugation) was exceedingly rare in the Kayenta region during late Pueblo II. This aspect provides a marked contrast between the pottery assemblages of Anasazi sites on Fiftymile Mountain and those on Pueblo II Kayenta sites on the Rainbow Plateau immediately

to the south.

Unfortunately, as with ceramics, the types of needed information will require reanalysis of most other material remains. No published data are available on the use of heat treatment or reduction strategies from Fiftymile Mountain, information that might greatly help to infer the origin of the Anasazi populations on the plateau. An emphasis on biface reduction using heat-treated silicates might indicate a western focus, whereas an emphasis on general core and bipolar reduction of raw silicates could signify a southern influence.

A re-examination of Fiftymile Mountain architecture might also reveal patterns with implications for the geographical source of the Anasazi population that occupied this upland. Fortunately, this can be done, at least to some extent, using the sites that the University of Utah excavated during the Glen Canyon Project. Fowler and Aikens (1963:9) saw little similarity between residential sites on Fiftymile Mountain and Virgin sites to the west, such as the lower Virgin River valley and Johnson-Paria drainages. To this we can add that there is little similarity between the residential sites on Fiftymile Mountain and those of the Kayenta region that date to late Pueblo II, when Sosi and Dogoszhi Black-on-white are predominant. Late Pueblo II is the appropriate time for comparison, because this is when the Kayenta thrust to the north would have occurred. One published example of an excavated late Pueblo II residential site close to the Kaiparowits Plateau is Small Jar Pueblo on the Rainbow Plateau (Lindsay et al. 1968). It lies just 30 km southeast from Fiftymile Mountain. This site was evidently part of a late Pueblo II expansion from areas to the south, as there are no middle Pueblo II habitations on the northern part of the Rainbow Plateau around Navajo Mountain (Ambler, Fairley and Geib 1983). A site like Small Jar Pueblo represents the leading edge of a Kayentan population surge that purportedly included Fiftymile Mountain. As such, its architecture and site layout (Figure 8.1) provides a good model of what to expect on the adjacent highland of Fiftymile Mountain. Typical aspects of a late Pueblo II Kayenta residential site are the presence of a kiva (a subterranean circular or D-shaped living and ceremonial structure with formal features), a mealing room (at Small Jar Pueblo it forms part of the room block, but is frequently detached), and living and storage rooms that typically measure about 2.5 m wide and 2.5 to 4 m in length, with the living rooms having slab-lined hearths that occupy about an eighth of the floor space or more. Other examples of late Pueblo II habitations within the Kayenta region are also included in Figure 8.1 for comparative purposes, with all drawn to a common scale.

Plan maps for most of the excavated sites on Fiftymile Mountain are shown in Figure 8.2, all drawn to a common scale. None of these have a striking similarity to presumably contemporaneous sites in the Kayenta region, although some, such as the Bridgette Site (42KA346), are quite nondescript. Perhaps the most significant difference is the lack of kivas and mealing rooms at the Fiftymile Mountain sites. These are ubiquitous features of Kayenta settlements; even the smallest examples usually have them, indeed some settlements consist of little more than a kiva, a mealing room, and ramada-covered activity areas (e.g., Hammer House [Geib et al. 1997]; AZ-J-19-3 [Schroedl 1989]). The 4.6 m diameter circular Structure 3 at The Observatory (42KA368) might be construed as an attempt to make a kiva-like surface room where excavation was impossible. This does, however, seem a stretch because there are none of the usual Kayenta kiva floor features in this structure; indeed the report lists no floor features at all (Fowler and Aikens 1963:34). The two plaza sites, (Aspen Pueblo and Three Forks Pueblo) look nothing like sites excavated in the Kayenta region. Structure 1 of Three Forks Pueblo, measuring 6.4 by 10.1 m, is 2–3 times larger than Kayenta structures. This overly large structure size occurs at other sites such as Mudhole Pueblo (42KA354), where Structure 1 measures 6.4 by 9.1 m, and The Observatory, where Structure 1 measures 6.1 by 7.6 m. Many of the structures lack hearths, and when present they are small basins rather than slab-lined affairs as is common in the Kayenta region. The two central roof support pillars seen in the large rooms at Three Forks Pueblo and Mudhole Pueblo are unprecedented in the Kayenta region. Little wonder that McFadden (2000:197) described the Fiftymile Mountain architecture and site type patterns as "distinctive—they are not known anywhere else in the Southwest."

Perhaps the time is ripe for a reappraisal of the Fiftymile Mountain artifact collections and sites, beginning with this question: Which culture has a long and sustained tradition of material traits that could account for the types of archaeological assemblages that we see on the Kaiparowits Plateau? And we are not speaking simply of raw material traits, but also modes of production that

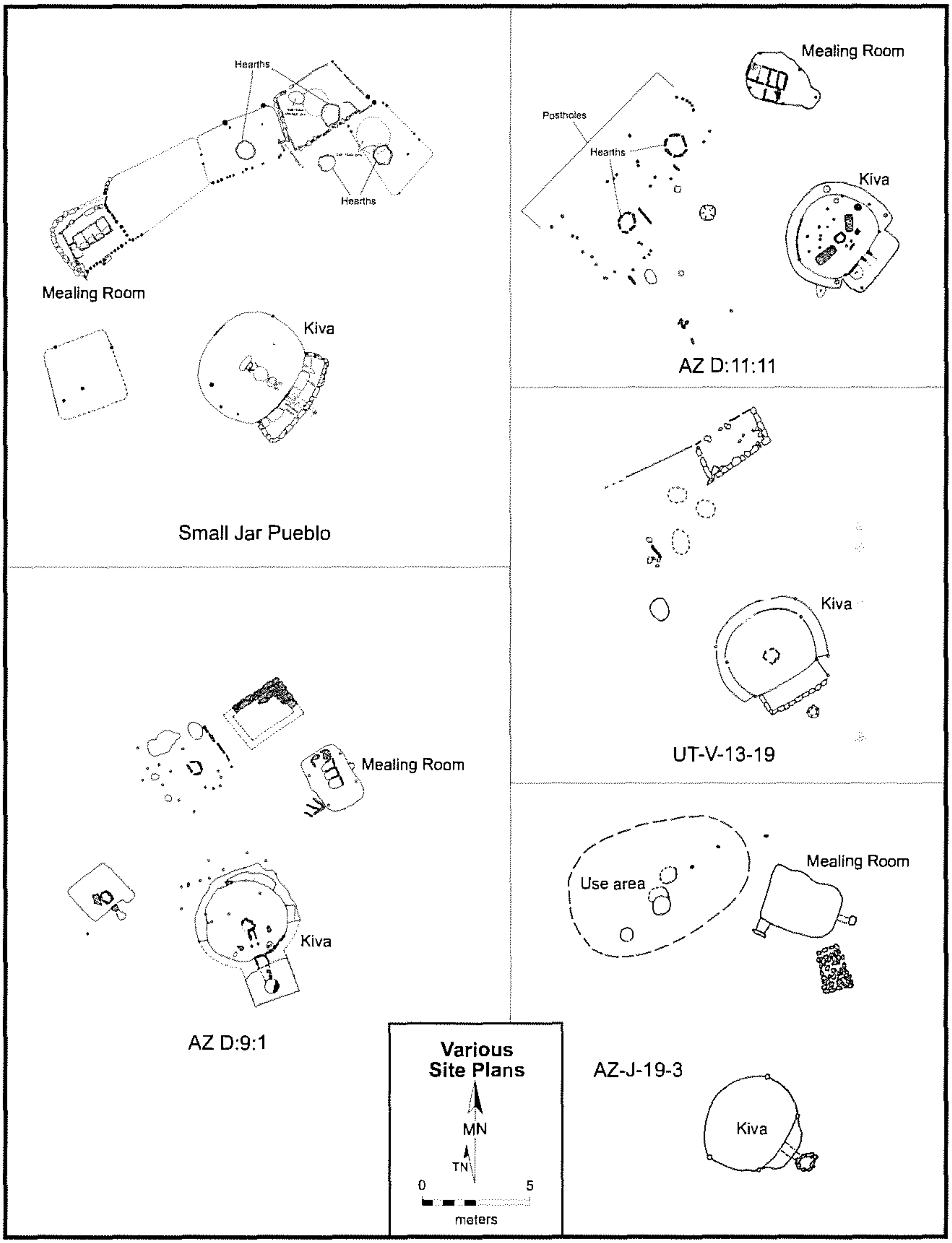


Figure 8.1. Examples of late Pueblo II (ca. A.D. 1100-1150) residential sites in the Kayenta Anasazi region (from Geib et al. 1985; Gumerman 1970; Gumerman and Euler 1976; Lindsay et al. 1968; Schroedl 1989).

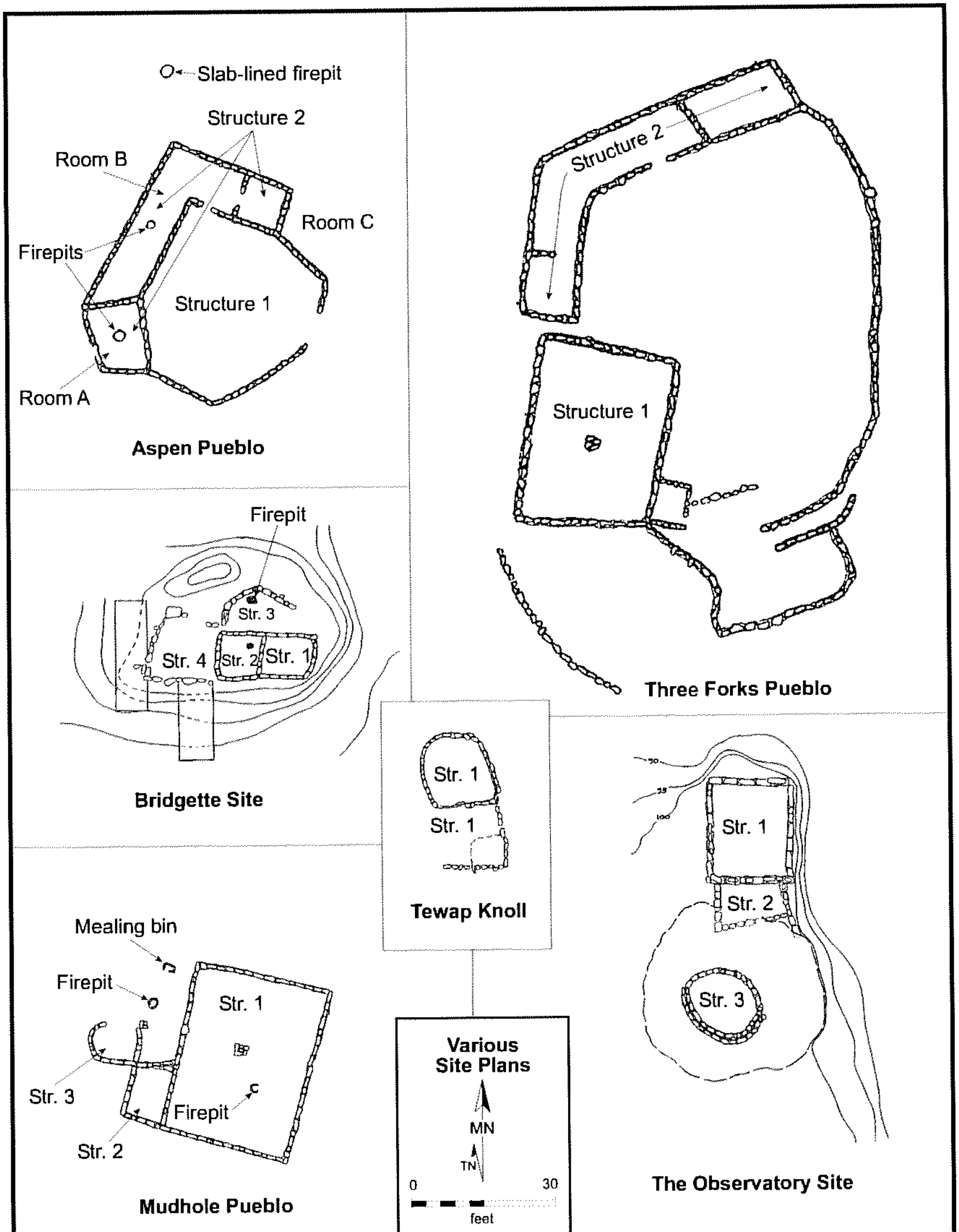


Figure 8.2. Excavated late Pueblo II sites on Fiftymile Mountain, Kaiparowits Plateau (from Fowler and Aikens 1963).

denote real differences in the way people construct their world. If Fiftymile Mountain was settled by the Kayenta Anasazi, then the likeliest source for this incursion would have been the immediately adjacent Rainbow Plateau, Cummings Mesa, and Paiute Mesa. If it occurred, then why did they abandon their late Pueblo II tradition of making corrugated pots and expedient tools from bipolar flakes and simple core flakes as soon as they crossed the Colorado River and climbed out of the Glen Canyon lowlands? Why do we see high proportions of plain gray jars and (on Collet Top) lithic assemblages dominated by bifacial reduction debris? Why are kivas and mealing rooms absent from the Kaiparowits Plateau when they are essential elements of late Pueblo II Kayenta residential sites? Why would the Kayenta, who rarely constructed a living room larger than about 2 by 4 m, instead build ones of far greater dimensions?

If Fiftymile Mountain is simply Collet Top writ large, then it is perhaps time to dust off Gunnerson's notion of a Virgin Anasazi occupation on the Kaiparowits Plateau. There might well be Kayenta Anasazi influence in decorated ceramics on the plateau, just as there is across all of the Arizona Strip and the adjoining part of southern Utah. There might even have been some Kayenta migrants, but the bulk of the Anasazi population must have had roots elsewhere, likely to the west and southwest from the Anasazi tradition of the Grand Staircase. Kitchen Corral is the closest known area to the Kaiparowits Plateau that has an Anasazi developmental sequence into Pueblo II from at least the Basketmaker III period (McFadden 1996:7). This area lies roughly 60 km from Collet Top and 75–85 km from Fiftymile Mountain. Problematic, with regard to a western source for the Kaiparowits Plateau Anasazi population, is that Douglas McFadden (personal communication 2001) sees few resemblances between the Anasazi remains of the Grand Staircase and those of the Kaiparowits Plateau.

Naming for the sake of naming is not our point; rather we seek to understand how Anasazi communities became established on the Kaiparowits Plateau in a region that lacked a local developmental trajectory for such communities. The direction of movement for such a population is important for understanding what technologies and social organization they might have brought with them and how these might have changed to fit the new setting. The "push and pull" mechanisms (see Anthony 1990) for migration doubtless varied depending upon which source region the Anasazi population came from. If the terms *Kayenta* and *Virgin* carry too much baggage and interfere with productive archaeological debate, then our entire discussion could be rephrased by substituting neutral terms such as "Anasazi from the southeast" (Kayenta) and "Anasazi from the southwest" (Virgin).

Formative Settlement and Subsistence

In the following attempt to create a preliminary model of Formative settlement-subsistence on the Kaiparowits Plateau, we use McFadden's (1998) recent "tale of two adaptations" and site chronology (2000) as our primary points of departure. McFadden proposed two models to account for differences that he had observed in the archaeological record produced by the Escalante Fremont and the Virgin Anasazi of the Grand Staircase:

> *Escalante Fremont*: Seasonal mobility was the basis for Fremont adaptation in the Escalante; during the summer, camps were occupied in the perennially watered canyons below 7000 feet (2134 m) primarily to farm; during winter, the uplands were occupied to hunt migratory mule deer and exploit an abundant source of firewood. Concealed storage granaries facilitated this mobile lifestyle by securing seed corn for the following year, as well as providing short-term storage during their absence. (McFadden 1998:97)

> *Grand Staircase Virgin Anasazi*: The Virgin Anasazi pattern of settlement in the Grand Staircase reflects an adaptive strategy aimed at reducing risk by alternating occupation between multiple residential sites that were located in a variety of different agricultural niches. These shifts in residence ... would have occurred in response to a variety of circumstances. (McFadden 1998:95)

No specific settlement-subsistence model has been proposed for the Kaiparowits Plateau, and McFadden contends that the Fiftymile Mountain "settlement pattern ... remains to be understood" (2000:164). He has suggested that aspects of upland residential sites can be used to argue for either full-time residency (McFadden 2000:162) or "limited" site use (2000:168), perhaps moving from uplands to lowlands depending on the season (see Geib 1996:181). Gregory and Moore (1931:27) were generally unimpressed with the plateau ruins, commenting that they were "poorly built and suggest temporary dwellings, pioneer's outposts, or refuges for scattered bands driven out from better places." Gunnerson (1959a:361) reached a different conclusion: "There is nothing to suggest that the Kaiparowits sites were occupied only seasonally. Some of the people

might have left the plateau seasonally, but there do not seem to be enough sites in lower areas [such as the Escalante drainage and Lower Glen Canyon] to have accommodated all of the Kaiparowits people." He concluded that Fiftymile Mountain was one of the most densely populated areas of the general region. Curiously, Fowler and Aikens (1963) took no obvious stance on the issue, even with the benefit of having excavated 11 Fiftymile Mountain sites, but Lister may have been speaking for them when she stated that "the presence of several hundred habitation sites ... certainly suggest[s] a dense aboriginal population that was more likely permanent than transient" (1964:47).

It is interesting that both Gunnerson and Lister's conclusions are based on site density rather than site and artifact composition, architecture, or settlement patterning, and on this basis we concur: the Collet Top settlement is at least as dense as Fiftymile Mountain, and compares with the density of permanent Virgin residences that McFadden has identified in the Grand Staircase area. Yet site density is no measure of permanence; the sites themselves must be examined individually and as a set. As far as we can determine, based on surface observations, the Anasazi sites on Collet Top mirror the following description by Fowler and Aikens for Fiftymile Mountain:

> In sum, the pattern of prehistoric settlement of the Kaiparowits Plateau is one of small sites approximately 1/4 to 1/2 mi. apart, often consisting of a single structure partitioned into 2–4 rooms, or clustering of separate single-room structures; equally frequent are single room sites. Sites with over four or five rooms are rare, although one settlement with a total of 13 rooms was recorded by survey. (1963:7)

Sites on Collet Top are concentrated much more densely than "1/4 to 1/2 mi. apart"—they are often spaced only a hundred meters or so from each other—but in other respects sites from the two areas appear similar.[8] The University of Utah teams observed both full-height masonry rooms and structures with low masonry walls and proposed "jacal walls or superstructures" (Fowler and Aikens 1963:6). The latter appear to be more common on Collet Top, but this could be partially a factor of visibility. No systematic information is available on presence/absence and content of middens on Fiftymile Mountain, but several Collet Top middens are extensive and rich enough (e.g., 42KA5458) to have been the result of extended or repeated site use. Conversely, although few obvious hearths were observed in association with structures on Collet Top, several excavated Fiftymile Mountain sites had fire pits. These features were generally interior hearths, and similar features might occur at the Collet Top sites buried by structure fill. The point here is that the presence of hearths may indicate cool-season occupation and more substantial site permanence. McFadden interpreted some of the more substantial masonry structures on Fiftymile Mountain as possible winter residences (2000:162), with food stores cached not on site but in the "abundant isolated granaries found on the mesa that may have been used by full-time residents."

At this point, there is enough accumulated evidence to suggest that members of the Anasazi population on the Kaiparowits Plateau spent a major part of the year on the plateau uplands. The dynamics of the occupation are still unknown, but intra-site patterning on Collet Top may fit McFadden's model of systematic use and re-use of multiple residential homesteads and farmstead within a circumscribed environment. It is also highly likely that some of the Anasazi logistical sites on other Kaiparowits benches were created by Fiftymile Mountain and Collet Top peoples on hunting and foraging trips; this would be expected.

But what was the relationship of the plateau population with the lowlands surrounding the plateau, such as the upper and lower Escalante River basin and lower Glen Canyon? It may be no coincidence that the Fiftymile Mountain settlement is contemporaneous with the Coombs Site, and it seems highly unrealistic to expect that the two "communities" did not relate in some substantive manner. If Collet Top, Fiftymile Mountain, and the Coombs Site are part of the same interaction sphere, perhaps we should be reviewing the conventional notion of Coombs as an outpost of Kayenta immigrants or culture bearers—a kind of "in for a penny, in for a pound" approach to reassessing the identity of the Anasazi in south-central Utah. In his recent survey of the Escalante River drainage, Keller (2000) observed the same complex of western Anasazi ceramics as we observed on Collet Top, albeit in smaller numbers. It takes no stretch of the imagination to visualize Collet Top residents traveling to the Escalante lowlands via the Collet Canyon break in the Straight Cliffs, hunting, foraging, and perhaps even resid-

[8]The site spacing quoted for Fiftymile Mountain may be meant as an overall average; in fact, sites are much more densely packed in some portions of this upland. Aikens, for example, recorded "eleven sites ... in one rolling sage flat, approximately 1 mi. sq." (1963:71) during a limited reconnaissance in 1961; see also Figure 46 in Gunnerson (1959a).

ing for parts of the year. If Fiftymile Mountain and Boulder Valley residents were truly "Kayentan" then they resided in rather remarkable islands of cultural exclusivity.

Based on our observations and assessments of Anasazi sites on the Kaiparowits Plateau, we propose the following model of settlement-subsistence. The model includes the Fiftymile Mountain population by extrapolation. This interpretive reach may exceed our grasp, but we now believe that there is enough evidence to support a re-evaluation of the role that Fiftymile Mountain played in the region during the Pueblo II.

The Anasazi of the Kaiparowits Plateau occupied a productive dry-farming zone in the uplands of Fiftymile Mountain and Collet Top during a roughly 100-year period between A.D. 1100–1200. These settlements were semi-permanent residences that included at least some winter habitations, with storage in the form of numerous isolated granaries and also in storerooms within settlements. Intra-site patterning suggests systematic use and reuse of multiple residential homesteads and fieldcamps within a circumscribed environment and for a relatively brief interval (likely less than 50 years). Settlement dynamics likely involved seasonal rotation through the well-watered lowlands of the Escalante River basin and lower Glen Canyon, as well as the drier mid-elevation benches of the Kaiparowits Plateau and Escalante Desert, with inhabitants regularly returning to upland settlements. Based on material traits, modes of production, architecture, and site configuration, the direction of the initial Anasazi occupation of the Kaiparowits Plateau appears to have been from the west, likely out of the closest densely settled population centers on the Grand Staircase, and not by the Kayenta Anasazi from the south. Contact to the south is evidenced by trace amounts of Kayenta pottery manufactured south of the Colorado River, but most pottery appears to be of local manufacture.

Based on the limited number of Fremont sites observed, we are not advocating a settlement or subsistence model limited to the plateau, but we refer to McFadden's (1998, 2000) model that includes an upland hunting-foraging component that would include the Kaiparowits. We reiterate that we saw no conclusive evidence of Fremont-Anasazi interaction, but allow that there is a possibility for coextensive occupation of slightly different ecological niches involving different adaptive strategies, as McFadden (1998, 2000) has suggested. The southern portion of the Kaiparowits Plateau appears to demarcate the southern extent of the Fremont logistical range.

THE POST-FORMATIVE PERIOD

We have adopted the term Post-Formative here to designate Native American archaeological remains from the interval between Anasazi (and Fremont?) abandonment of the region and the end of what can be considered traditional use of the area. This period begins about A.D. 1300[9] and extends until about 1900, when traditional Native American use of the area effectively came to a close and Euro-Americans controlled the region (see Chapter 9). The period can be subdivided into three intervals that have broad applicability throughout North America, though the specific dates for inception vary greatly depending on geography. The first portion of the Post-Formative period extends from ca. A.D. 1300 to 1500, a time when Native cultures adapted to and exploited the area without the influence of Euro-Americans. A.D. 1500 seems a conservative dividing line for this remote portion of the Southwest between the pre-Spanish and post-Spanish influence. This Late Prehistoric interval might have lasted longer in far-removed areas like the Kaiparowits Plateau, but change ultimately arrived. The Protohistoric (Wilcox and Masse 1981) portion of the Post-Formative period ranges between A.D. 1500 and about A.D. 1850. It began with the first indirect influences of early Spanish settlers and entradas in Mexico and later the American Southwest, and ended with the onset of Mormon colonization in southern Utah. During much of this interval, Native American occupants of the Kaiparowits Plateau likely were little affected by outside influences. A third brief interval can be defined as the historic; this is the time of major disruption in the lifeways for the indigenous inhabitants of the region. Slave raiding was prevalent early on, followed by Mormon colonization and the spread of cattle. By 1900 it was essentially impossible for Native Americans to survive by traditional means, and they incorporated themselves to varying extents into adjacent Euro-American communities.

[9]Based on the current set of dates and ceramic evidence it appears that the Anasazi had abandoned the Kaiparowits Plateau by A.D. 1200, if not before. The earliest reliable dates for the start of the Post-Formative period in the general region of the Kaiparowits Plateau come from two brush structures (wickiups) within a cave in Bowns Canyon that have an averaged two-sigma date range of ca. cal. A.D. 1280–1420 (Geib and Fairley 1992: 166).

The Kaiparowits Plateau was traditional territory of the Southern Paiute during the time of historic contact, beginning in 1776 with the Franciscan Fathers Domenguez and Escalante (Bolton 1950). There seems little doubt that the Paiute were relatively new inhabitants of this region, being part of the so-called Numic expansion or spread throughout the Great Basin and onto the Colorado Plateau and intermountain West. Research issues concerning the origin, timing, and form of the Numic spread are discussed most recently in Madsen and Rhode (1994; also see Altschul and Fairley 1989:147–186 and Kelly and Fowler 1986, among others), and are not repeated here. Ethnographic data and syntheses on the Southern Paiute are available in Fowler and Fowler (1971), Heizer (1954), Sapir (1930), Lowie (1924), Kelly (1934, 1964), Stewart (1942), and Euler (1966). Aspects of Numic ethnography and issues are integrated into the following section, which focuses on the Post-Formative cultural resources recorded during the Kaiparowits Plateau Survey.

Ethnographic Background

Southern Paiute is the only culture in the project area that we can place in ethnohistorical context. But we are now 200 years removed from an indigenous Southern Paiute lifestyle unaffected by Euro-American contact. Whether or not the ethnographic accounts are useful for interpreting the Post-Formative archaeological record on the Kaiparowits Plateau is not yet known, but at least we are dealing with entities of shared ancestry and not a cross-cultural analogue. This section provides an ethnographic background to the following analysis of Post-Formative survey results.

Our primary published reference for the historic Southern Paiute is Kelly (1964), based on interviews she conducted with Kaibab, Kaiparowits, San Juan, and Panguitch informants in the early 1930s. Kelly and Fowler (1986) follow Kelly (1934) and Stewart (1942) in defining 16 Paiute "sub-groups, bands, or tribes if you like ... dialectic units with political concomitants" (Kelly 1934: 550). These include the Kaiparowits subgroup or band,[10] an arbitrary designation of three population clusters upon or adjoining the Kaiparowits Plateau. Kelly (1964:149) provided the following definitions of the three Kaiparowits population clusters (also known as economic units):

> XI. Avua (pocket-between-hills); located in the "upper Paria Valley [near what are now the communities of Cannonville and Henrieville], extending south along the east bank, to [the confluence with] Cottonwood Wash."
>
> XII. Kwaguiuavi (seed valley); "described as lying between the Kaiparowits Plateau and the Paria River, 'below' Cottonwood Wash." Kelly suggests that this means "the comparatively open area between the wash and the plateau," but in Map 1 (1964: Facing page 1) she shows an area centered on what might be termed the middle portion of Wah–weap Creek around Fourmile Bench and Long Flat and including Jack Riggs Bench and Horse Flat.
>
> XIII. Sanwawitimpaya (sagebrush-canyon mouth); "Potato Valley [mostly west of the town of Esca–lante] and a strip along the Escalante Valley, appar–ently to the bend of the river at Circle Cliffs."

Kelly (1964:1) characterized her Kaiparowits material as "extremely sketchy." She listed just four Kaiparowits informants, but relied primarily on one, an individual named Lucy. This person was born around 1870, shortly before the arrival of Mormon settlers in the area of Escalante. Until she was 12, she lived with the Kwaguiuavi population cluster; both her father and grandfather lived on and around the plateau. Her grandfather was probably born at a time when the Kaiparowits area was little affected by outside Anglo, Spanish, or Mexican influence, but how much of his ancestral know-how was channeled through Lucy we do not know; Kelly (1964:3) considered her to be a "mediocre informant."

Both the Kaibab and Kaiparowits Plateaus were called Kaivavic (Mountain-lying-down) and "anyone who camped habitually on the Kaiparowits Plateau ... might be referred to as ... Kaivavic ˇici" (Kelly 1964:143). Informally, these individuals were called "the people on the other side of the Paria" or "the Escalante people," and were sometimes considered to be "almost Ute" or "half Ute" (Kelly 1964:143).

As far as can be determined, at least part of the Kaiprowits Plateau Survey project area is congruent with the Kwaguiuavi population cluster, but the other two clusters utilized the plateau as well, especially during the summer and fall. The Kwaguiuavi winter camp was at a place called Kankari (Boulder knoll), a juniper-covered hill listed as being "near the Paria" [River] (Kelly 1964:150); it was the only source of large trees for fuelwood ("rest of the country described as treeless ... with rabbitbrush and greasewood," Kelly 1964:150). We

[10]Kelly and Fowler (1986) used "sub-group" or "group" whereas Kelly (1964:24) stated that she "cannot quite abandon the notion of the Kaibab as a band" and used "groups" and "bands" interchangeably. In this section we use "group" and "band" as synonyms in the manner of Kelly (1934:550).

wonder if the Paria reference is a mistake and that the term 'near' should not be taken too literally. Her map of the geographic territory of the Kwaguiuavi economic unit does not include the Paria, but is centered along Wahweap Creek. Having the valley of this creek as the location of the winter camp better fits with her claim that the chief fuel was single-leaf ash (*Fraxinus anomala*), a shrub or small tree that we observed primarily on the upper benches and that is uncommon along the Paria River near our survey area.

Spring was usually spent at Kwaguiuavi, but occasionally on the Kaiparowits Plateau to gather roots (perhaps Thompson peteria [*Peteria thompsonae*], a legume gathered this time of year by several Kaibab groups) and "seeds stored from the preceding fall harvest" (Kelly 1964:150). "Valley seeds"—or seeds that could be harvested early from the lower benches—were collected during the summer at Kwaguiuavi. As seeds became available on the plateau, summer and fall trips were made to the Ankaigavi, the "red rough" between Canaan Peak and the Kaiparowits Plateau. Berries and roots were also gathered, and pinenuts in the fall. Kelly (1964:150) claimed that "part of the harvest [was] left there, stored in the caves [or rockshelters]"; no caves and few shelters were evident during the Kaiparowits Plateau Survey but we explicitly avoided canyons. Fall was also the time for hunting excursions onto the plateau. Water was available from potholes and a large wash called Oauipi, "apparently Wahweap Creek" (Kelly 1964:150). The latter was "owned" by a man named Uinpuci, who was Lucy's brother, and it was a place of residence for Lucy's mother and other family members. However, Kelly did not describe the location of the Oauipi camp, so it is not known if she was referring to a winter camp on lower Wahweap or a summer camp on the plateau.

It is important to point out that Kelly used the term Kaiparowits Plateau quite specifically to refer to the high terrain that borders the Straight Cliffs. This includes the areas that we identify as Fiftymile Mountain and Collet Top. We use the term Kaiparowits Plateau quite broadly in reference to all of the benches and plateaus in the block of terrain between the Cockscomb, the Straight Cliffs, and Glen Canyon. Thus to us, the Kwaguiuavi economic unit was resident upon the Kaiparowits Plateau, with their core use area centered along Wahweap Creek at Long Flat and Fourmile Bench. They made forays from this core area to the higher elevations of Collet Top and Fiftymile Mountain (Kelly's Kaiparowits Plateau) as well as Canaan Peak and the high ridges that extend from this prominence such as Horse Mountain.

On the thin evidence provided by Kelly it is difficult to specify the exact settlement patterns and subsistence strategies of the historic Kaiparowits Plateau Paiute, but a reasonable counterpart might be the Kawich Mountain Shoshone in Nevada, as described by Thomas (1983:27–30). This group inhabited an environmental setting not unlike the Kaiparowits band, with winter quarters at lower elevations and access to pinyon-juniper uplands during the warmer "harvest-and-hunt" months. The main difference is that pinyon nuts appear to have been more of a staple food item for the Kawich—one that directed social organization (e.g., "pinyon chiefs") and settlement behavior to a greater extent than was documented for the Kaiparowits Paiute. Thomas (1983:30) classified the Kawich as "foragers, whose settlement pattern consisted of individual families who worked throughout an extended core area, generally independent of other family units," but coming together for "socioeconomic functions such as fandangos [festivals], piñon nut trips, and possibly rabbit drives."

The "economic cluster" of the Kwaguiuavi may have been small, even compared to units of the Kaibab, where it was not uncommon for as many as 10—or possibly up to 20—families or households to aggregate during certain portions of their annual cycle. Although Kelly provided no information to this effect, winter base camps probably harbored only a few families. John Wesley Powell's brief account of the Kaiparowits Paiute states that "There was nominally but one tribe [band], but as the members of this tribe were in very small parties and separated by wide distances the tribal bonds were very weak and often unrecognized" (cited in Fowler and Matley 1979:9). For the Kaibab, several units might have joined for the fall hunt on the high plateaus, but Kelly (1964: 154) suggested that game on the Kaiparowits was "strictly limited in quantity," with deer and antelope hunting parties of just five or six individuals. Based on Kelly's map of band boundaries (1964: Facing page 1), the logistical range of the Kwaguiuavi was 20 to 25 km (primarily northward across the Kaiparowits benches), about that of the Kawich (Thomas 1983:89). The latter, however, had a greater extended range of up to 120 km, but this, again, was connected to pinyon nut gathering, with longer trips necessitated by local crop "failures."

Identification of Post-Formative Sites

Before presenting an analysis of the Post-Formative sites, it will be useful to describe the various methods used to assign sites to this period. More than a third of the Post-Formative sites were temporally assigned based on evidence other than diagnostic artifacts. In this regard, it is worth mentioning that the testing results detailed in Chapter 5 totally corroborated the Post-Formative temporal assignments based on alternative dating methods. We must also mention that a Paiute cultural affiliation is suspected for all sites that we could assign to the Post-Formative period. It is possible that some other cultural groups (such as Pai or Navajo) used the area during the Post-Formative interval, but this remains to be demonstrated.

Lyneis (1994:144) summarized the difficulty in identifying Numic sites during archaeological survey, stressing that Southern Paiute Brown Ware and Desert Side-notched points do not "necessarily mark the initial spread of Southern Paiutes into the area" and that "neither artifact can always be expected to be present among the remains of ... Paiute occupations." Even when present, the artifacts may not be useful as "fully satisfactory cultural marker[s]" (Lyneis 1994:142). Geib and Warburton (1991:32), for example, noted that points similar to Desert Side-notched were also used by the ancestral Hopi, Pai, and early Navajo. Lyneis (1994:143) also cautioned against assuming a single point of origin for Southern Paiute Brown Ware pottery, a standard production technique (e.g., paddle-and-anvil), or even that all Southern Paiute peoples made pottery (Kelly and Fowler 1986:375).

Lyneis, nevertheless, still considers Southern Paiute Brown Ware "our best marker for Southern Paiute occupation" (1994:143), but no such pottery was observed during the Kaiparowits Plateau Survey. This may be due to several factors. It is possible that the Kaiparowits band was one of a handful of Paiute groups who did not make pottery. This behavior was never documented ethnographically, but the Antarianunts, Gunlock, and San Juan bands had no pottery-making tradition (Stewart 1942:273; Kelly 1964:77–78), and the Beaver, Panaca, Panguitch, and Kaibab groups made a type of unfired, sun-dried pottery that "did not last long, not more than a few weeks" (Kelly 1964:78). The open nature of nearly all Kaiparowits Plateau sites does not lend itself to the preservation of Southern Paiute Brown Ware, whose weak, crudely constructed walls disintegrate easily when exposed to the elements. It is worth mentioning, however, that Gunnerson (1959a:349, 429) recovered portions of a fingernail-impressed Paiute vessel from an open site on Fiftymile Mountain (at the head of East Steer Canyon). Douglas McFadden (personal communication 2001) also reports Paiute Brown Ware from a site at Mudholes Spires on Fiftymile Mountain. The most common vessel form—a conical or round-bottomed cooking pot—was designed to fit in a conical burden basket for ease of transport (Fowler 1994:109). Ceramic vessels likely were seldom part of the traveling tool kit of Southern Paiutes on the Kaiparowits Plateau.

Twined and coiled Paiute basketry would have been a more portable type of container, and one that is perhaps even more ethnically diagnostic (see Adovasio and Pedler 1994; Fowler and Dawson 1986). Unfortunately basketry is perishable, and even in sheltered contexts Paiute baskets are rare finds. We found part of a Paiute winnowing tray on this survey (see Chapter 6) and there are other examples from the general region, including a winnowing tray fragment from the Alvey site of Coyote Wash (Gunnerson 1959b:106) and a pitched water container from one of the Desha Caves near Navajo Mountain (Schilz 1979: 58–62). Basketry will always be an exceptional survey find, but one of significance. For example, none of the other ethnic groups who might have used the Kaiparowits Plateau are known to have made fan-shaped winnowing trays by twill twining such as the example that we found at a site on Smoky Mountain.

Besides pottery or perishable materials, the other common Post-Formative diagnostic is the Desert Side-notched projectile point. Cottonwood Triangular points may not be useful diagnostics of Numic occupations if they are unfinished items broken in production; such tools might have been intended Desert Side-notched points or Bull Creek points or some other arrow point type (see Chapter 6 discussion). Of the 48 Post-Formative sites, 19 (40%) have Desert Side-notched points. Although Desert Side-notched points should be considered horizon markers rather than ethnic markers, Southern Paiute use for the project area is well documented (Palmer 1933; Kelly 1964), and probably constituted the primary post-A.D. 1300 indigenous occupation. This is not to say that other cultures were not occasionally present. Slave raiding for Southern Paiutes may have begun as early as the late 1700s (Brugge 1968), and continued into the mid 1850s, when the practice was

largely halted by Brigham Young and his territorial legislature. During this 50+ year interval, Utes from the north and Navajos from the southeast conducted numerous raids and many slaves were moved along the Old Spanish Trail, which passed to the north and west of the project area. Other groups, such as the Pai and ancestral Hopi, may have traveled into this country as well, on trading forays, hunting expeditions, or other ventures.

These kinds of intrusions could have left behind archaeological sites with attributes similar to those of the resident Paiute, including Desert Side-notched projectile points. Fifteen of the 18 Desert Side-notched points collected during the survey were of Paradise chert/chalcedony (see Chapter 6), strongly suggesting local production. Thus, the ethnographic and archaeological data support the notion that the majority of the sites with Desert Side-notched points are affiliated with the Southern Paiute.[11] During the 1800s, this was most likely the band called the Kaiparowits by Kelly (1934), the Toyebeits/Toyweapits by Palmer (1933), or the Escalante band by Sapir (1930). Visitations from members of nearby bands likely occurred, such as the Kaibab (on the Kaibab Plateau to the southwest), San Juan (south of the San Juan River to the southeast), Antarianunts (a possible Ute group near the Henry Mountains to the northeast), and Panguitch (near Panguitch Lake to the northwest). Historically, "those of the Kaiparowits area were 'friendly' with the Kaibab [and] there also was a certain amount of contact with the San Juan Paiute" (Kelly 1964:144).

In addition to Desert Side-notched points, the other indisputable Post-Formative temporal diagnostic is Jeddito Yellow Ware, sherds of which are easily identified and virtually indestructible. NNAD surveyors found sherds of this ware on two sites, both near springs on Long Flat: a bowl rim at 42KA4572 and portions of a dipper (or small bowl) from 42KA4827. The dipper is identified as Awatovi Black-on-yellow, a type that dates between A.D. 1300 and 1350 in the place of manufacture. The bowl sherd is identified as either Awatovi or Jeddito Black-on-yellow. Gunnerson (1959a:349) reported finding two sherds of Jeddito Black-on-yellow from an architectural site on Fiftymile Mountain and attributed them to Hopi use. In contrast, we have concluded that the Hopi pottery provides evidence for Southern Paiute occupancy of the Kaiparowits Plateau because of the associated material remains and documented Paiute use of the area. Jeddito Yellow Ware was widely distributed among forager populations throughout the Southwest (Baldwin 1944; Schaefer 1969; Wells 1991; Fairley et al. 1994). Twenty-nine Jeddito Black-on-yellow sherds from the same vessel were found at a Paiute campsite (NA11,617) excavated during MNA's Navajo-McCullough project. The site was located in the Cedar Mountain portion of the transmission line corridor, southeast of East Clark Bench. Other examples of Jeddito Yellow Ware are known from Fiftymile Mountain and elsewhere in Glen Canyon.

As discussed in Chapter 7, we used alternative methods of dating to tentatively designate some sites lacking diagnostic artifacts as either Post-Formative, or Formative/Post-Formative. These methods concern the presence or absence of various site attributes to gauge relative age. For Post-Formative sites, the attributes can include the presence of undiagnostic arrow point fragments, a lack of artifact patina and weathering, the presence of fingernail size charcoal pieces on the surface of hearths (or large pieces of surface bone, especially if unburned), reworking of old patinated tools and flakes, the presence of "fresh-looking" obsidian tools and flakes, and the presence of mostly intact and unweathered grinding slabs. The presence of one of these attributes does not mean that a site is unambiguously Post-Formative. Some sites may well be Formative, or in unique cases, Archaic—but when two or more attributes are observed, there is a greater likelihood that the site is Post-Formative.

The utility of several of the attributes hinges on two corollary assumptions: (1) the older a site is, the more likely it is to have patinated and weathered artifacts and degraded remains and features, and (2) the younger a site is, the more likely it is to have intact or less eroded artifacts and organic remains. Preservation of thermal features can also vary, due to exposure, feature type, and the composition of fuel wood, to name a few factors. But observations in the field and laboratory appear to bear out these common-sense assumptions, as do the testing results reported in Chapter 5. For example, surveyors assigned site 42KA4662 to the Post-Formative period during Phase 1 of the survey based on the combined presence of surface charcoal pieces in hearths, unpatinated and "fresh-looking" flaking debris, an arrow

[11] The single caveat is that during the first few centuries following the Formative abandonment there may have been little internal distinction between peoples now designated as Ute and Paiute.

point tip, and unburned surface bone. Radiocarbon dating of a bone fragment from the site confirmed the temporal assignment (80 ± 40 B.P.) and testing also recovered a basal portion of a Desert Side-notched point snapped off during basal notching.

In the absence of other attributes, fresh-looking flake waste came to be the most common marker of possible Formative/Post-Formative occupations (for examples, see sites 42GA4784 and 42KA5465). This evidence is not sufficient to argue for a Formative or later occupation, but it provides a good clue that the site might be more recent and that surveyors should look for supporting evidence. Another related attribute is the reworking of older, patinated tools and flakes. This generally results in fresh, unpatinated scars that stand out against the weathered surface remnant of the original artifact. The Southern Paiute were known to scavenge prehistoric tools and materials, such as pottery vessels (Fowler and Matley 1979:84) and grinding tools (Kelly 1964:59, 152). Archaic and Formative flaked stone artifacts would have been plentiful and easily recycled into useful tools. Site 42KA4828 is an example with both an assemblage of unpatinated lithics and an older, reworked item, a weathered flake of Utah obsidian retouched to create a small, drill-like projection.

The lack of Anasazi habitations across most of the Kaiparowits Plateau would have severely limited the number of Formative metates that the Paiute could have scavenged. Instead, they made do with local sandstone slabs, creating expedient grinding tools. Local sandstones are generally weakly cemented and easily fragmented, and thus quick to erode. Therefore, the presence of whole or nearly whole grinding slabs is another potential attribute of more recent occupations. In nearly all cases when surveyors found large intact grinding slabs with well-preserved use surfaces they occurred at sites with other evidence suggesting Post-Formative uses, such as surface charcoal pieces and fresh-looking flaking debris; at one site (42KA4563) two slabs were associated with a Desert Side-notched projectile point. Perhaps one of the most striking instances of a whole intact grinding slab of probable recent origin was one found cached within the branches of a large juniper tree (IO854, see Chapter 6). An actual test of the utility of grinding slab preservation as a relative indicator of age comes from the tested site 42KA4575 (see Chapter 5). Surveyors assigned this site to the Post-Formative period during Phase 1 of the survey based on the combined presence of a whole well-preserved metate, charcoal pieces in a hearth, and a tool of "fresh-looking" obsidian. Radiocarbon dating of bark from the bottom of the hearth confirmed the temporal assignment (400 ± 40 B.P.).

The presence of "fresh," unweathered obsidian appears to be an important age marker for distinguishing Post-Formative sites. Obsidian debitage occurred at 19 sites regarded as Post-Formative. Occasional tools of weathered obsidian—nearly all dart point fragments—occurred at earlier sites, but early sites usually did not have flakes of obsidian, only finished tools. This may reflect a preservation bias in the archaeological record, but could also denote a behavior difference between Archaic and Paiute hunter-gatherers in the procurement of exotic lithic raw material.

It appears that the Paiutes obtained obsidian principally as cores (or occasional nodules, such as the Apache tear flakes found at site 42KA4585) and reduced them to produce simple flakes for expedient cutting and scraping tools (see Chapter 6). At two excavated Southern Paiute sites near Kanab, Utah, Firor (1994:56–57) hypothesized that "obsidian will be more thoroughly reduced, and will be more frequently used for formal tools than other lithic materials." He concluded that the 12 obsidian flakes recovered from the Kanab sites were "insufficient to adequately address this hypothesis." To us, the lack of "formal" tools found by Firor and our survey suggests that the value of obsidian lay elsewhere, for example in the extremely sharp cutting edge to be had with volcanic glass. As such, there would be no necessary relationship between the distance to the source and tool formality.

Survey Results

Of the 689 prehistoric sites recorded during the Kaiparowits Plateau Survey, 86 (13%) are assigned Formative/Post-Formative or Post-Formative temporal affiliations. There are 38 sites with Formative/Post-Formative remains; these appear to postdate the Archaic, but cannot confidently be assigned to one of the periods specifically. There are 48 sites/components assigned a Post-Formative temporal affiliation based on various criteria; these can reasonably be considered Southern Paiute. Of the 48 Post-Formative sites, 29 are single component and the other 19 are multiple component with clearly distinguishable Post-Formative components.

Table 8.12 is a breakdown of Formative/Post-Formative and Post-Formative components by

survey stratum. The density of Post-Formative sites is somewhat bimodal, in terms of elevation, with highest use on Horse Mountain, and next highest use on Long Flat and Horse Flat. Use of East Clark Bench and Nipple Bench is minimal, at least regarding activity that leaves a site signature. When Formative/Post-Formative and Post-Formative components are considered (under "Total") the emphasis on Horse Mountain is even more pronounced.

The lack of Paiute evidence on the lowest benches runs counter to the historical record (Kelly 1964) of an annual winter base camp situated somewhere around lower Wahweap Creek. Clearly, our survey did not locate this camp, assuming that some surface indication remains. No sample units were located adjacent to the Paria or where Wahweap Creek flows across East Clark Bench below Jack Riggs Bench—the most likely locales for the Kwaguiuavi winter residence. What Binford (1982) and Thomas (1983) deemed the foraging range of the winter camp encompasses East Clark Bench, but the archaeological record of such activities—if any—is absent (perhaps for reasons considered in the discussion of sample variance).

On the other end of the scale is Horse Mountain, with the highest site density for both Formative/Post-Formative and Post-Formative sites. This area was popular because it (along with Long Flat) was comparatively resource rich (particularly on Horse Mountain, for big game hunting)—but there may be a second reason for the spike in site density: the region could have been the upland focal point for all three of Kelly's economic units. Irrespective of Kelly's band boundaries, foraging (and extended) ranges probably overlapped for the Kwaguiuavi and Avua units, and perhaps the

Table 8.12. Summary data on Formative/Post-Formative and Post-Formative components by sampling stratum.

Sampling Stratum	Formative/Post-Formative			Post-Formative			Total		
	n	C%	DPU*	n	C%	DPU	n	C%	DPU
Collet Top	3	7.9	0.2	7	14.6	0.4	10	11.6	0.6
Horse Mtn.	8	21.0	1.0	8	16.7	1.0	16	18.6	2.0
Long Flat	6	15.8	0.3	15	31.3	0.8	21	24.4	1.2
Horse Flat	0	0.0	0.0	4	8.3	0.6	4	4.7	0.6
Fourmile Bench	9	23.7	0.6	6	12.5	0.4	15	17.4	1.0
Smoky Mtn.	3	7.9	0.3	3	6.2	0.3	6	7.0	0.8
Brigham Plains	6	15.8	0.5	5	10.4	0.4	11	12.8	1.0
Nipple Bench	2	5.3	0.2	0	0.0	0.0	2	2.3	0.2
East Clark Bench	1	2.6	0.1	0	0.0	0.0	1	1.2	0.1
All Strata	38	100.0	0.3	48	100.0	0.4	86	100.0	0.8

*DPU = Density per unit.

Table 8.13. Summary data on Post-Formative component sites by site type and sampling stratum.

Sampling Stratum	Residential			Processing			Hunting			Reduction			Unknown		
	n	C%	DPU[a]	n	C%	DPU	n	C%	DPU	n	C%	DPU	n	C%	DPU
Collet Top	1	14.3	0.1	3	14.3	0.2	3	23.1	0.2	0	0.0	0.0	0	0.0	0.0
Horse Mtn.	1	14.3	0.1	2	9.5	0.2	2	15.4	0.2	3	50.0	0.4	0	0.0	0.0
Long Flat	2	28.6	0.1	8	38.1	0.4	4	30.8	0.2	1	16.7	0.1	0	0.0	0.0
Horse Flat	0	0.0	0.0	1	4.8	0.1	2	15.4	0.3	1	16.7	0.1	0	0.0	0.0
Fourmile	2	28.6	0.1	2	9.5	0.1	1	7.7	0.1	0	0.0	0.0	1	100.0	0.1
Smoky Mtn.	0	0.0	0.0	2	9.5	0.2	1	7.7	0.1	0	0.0	0.0	0	0.0	0.0
Brigham Plains	1	14.3	0.1	3	14.3	0.3	0	0.0	0.0	1	16.7	0.1	0	0.0	0.0
Nipple Bench	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
East Clark	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
All Strata	7	100.0	0.1	21	100.0	0.2	13	100.0	0.1	6	100.0	0.1	1	100.0	0.1

[a]DPU = Density per unit.

Sanwawitimpaya as well. All three groups used the Kaiparowits Plateau during the summer-fall months, and members may have united for specific tasks, such as deer hunts, that benefited from multiple-family involvement; this behavior is well documented by Kelly (1964) for the Kaibab Paiute.

Site Types

The remainder of this section is devoted to an analysis of the 48 Post-Formative sites recorded during the Kaiparowits Plateau Survey (Table 8.13). Although this reduces the sample of sites that we can extrapolate from, it also eliminates the more temporally problematic sites that might actually be Formative. The sites fall within five types: temporary residential camps, processing camps, hunting camps, lithic reduction loci, and sites of unknown function; no Post-Formative storage sites are known. In reality, there is probably more functional overlap than is indicated by these discrete categories, but that is the nature of archaeological inventory.

About 44 percent of all Post-Formative single-component sites are processing camps, the highest percentage of this type for any time period. This is followed by hunting camps (27%), residential camps (15%), reduction loci (13%), and just one site of unknown function (2%).

Seven Post-Formative single-component residential camps were recorded, more or less randomly distributed across the project area. These are hypothesized to be temporary base camps—occupied between spring and fall—where various processing, manufacturing, and maintenance activities occurred. On a relative scale, they had a greater number and variety of features and artifacts than processing and hunting camps, but it is possible that some of the processing camps played a more residential role than we assume. Site 42KA4797 is a Post-Formative residential camp that was tested and is reported in Chapter 5.

Processing camps figure most prominently in the Long Flat stratum (0.4 sites per unit, or 1.6 per section), but this type of camp is present across all but the lowest Kaiparowits Plateau Survey strata. This may be due to the greater availability of food and lithic resources on these interior landforms, and domestic water in the form of springs and washes with intermittent, but occasionally large flows. Site 42KA4819 on the Horse Mountain stratum is typical of what we are calling Paiute processing camps, and recalls the problem discussed in Chapter 7 of differentiating between residential camps and processing camps. The site is little more than 4 m across, and consists of a single hearth with a few burned cobbles, two cores, flake tools, a sandstone mano fragment, possible grinding slab fragments, and cobbles with worn facets. A Desert Side-notched point, found next to the hearth, identified the site as Post-Formative. The inclusion of grinding and hunting tools suggests that the site was probably occupied by a family and as such it is perhaps not a logistical processing camp (the presence of grinding tools is probably the one critical indicator) but one used as a residential camp. This situation is common for Post-Formative sites; they simply contain few remains compared to the record left by the Archaic foragers of the region (see previous Archaic discussion). This greatly subdued record is evidently typical for the Post-Formative period and requires field workers to rethink the idea that artifact abundance is an important measure of residential camps; to whit: if Post-Formative processing camps are the functional equivalent of Archaic residential camps, and we believe that this is the case, then why are their archaeological records so different?

Above Smoky Mountain the evidence for hunting camps is about the same for the upper five strata (one to two sites recorded per stratum and identical site densities). This is to be expected, as deer would inhabit the higher elevations of the project area during the summer and fall. An excellent example of a Paiute hunting camp is site 42KA4662 on Horse Flat. Two hearths at the site contain and are surrounded by burned and unburned animal bone, mostly deer and unidentifiable large mammal fragments, but also rabbit (see Chapter 5). Around each of the hearths is a scatter of chert flaking debris that is characterized by a mixture of simple core reduction and pressure flaking of flake blanks to produce arrow points. All large flakes are from simple core reduction, removed from prepared cores—that is, lacking most or all cortex. The core flakes are of raw material but virtually all of the pressure flakes have been removed from heat-treated flake blanks. Arrow point fragments broken during production were made on flakes that were heated treated, then pressure flaked to fashion the points.

As for reduction loci, the higher density for this site type on Horse Mountain (0.4 sites per unit) may be due to the presence of Paradise chert/chalcedony nodules that occur as a lag deposit on this gravel-capped ridge. This was the favored lithic raw material type of the local

Paiutes, who exploited this source as part of their hunting and foraging rounds on the plateau. It is also possible that what we call reduction loci may sometimes be versions of hunting camps, or stopovers during a hunt, in which case we would expect to see more such sites in the higher elevations.

Site 42KA4714 on Horse Mountain is a good study of a Paiute lithic reduction loci. It is another small site—with the majority of the remains in a 5 m diameter area—consisting of primary and secondary flakes struck off of the same cortical nodule of Paradise chert. A nearby core is of a different, poorer-quality chert. Among the flakes is a broken, patinated biface of heat-treated gray chert, apparently scavenged and retouched. Surveyors found a partial Desert Side-notched point just a meter or so from the lithic concentration.

The debitage assemblages of single-component Post-Formative sites are generally distinct from preceding cultures and easy to characterize. There is bound to be some variance, as different needs required different strategies, and mixed assemblages from multiple components are common. We are also looking at a time span of some 500 years, during which land use, social structure, economic activities, and concomitant tool production may have changed. That said, there appear to be two different patterns in the lithic assemblages of Paiute sites. The first is a general emphasis on unstaged core reduction of chert/chalcedony to produce flakes for use as tools. There seems to have been little emphasis on producing percussion thinned bifaces. Pressure flakes, however, routinely occur on Post-Formative sites—the result of edge resharpening, reworking of scavenged tools, and the production of arrow points crafted from flakes. This was the second pattern observed at some Paiute sites, and flaked lithic assemblages with the dichotomous pairing of core reduction and small pressure flakes seem common at Post-Formative sites. Yet, not all sites with this technology are necessarily Paiute. The lack of lithic raw material on Brigham Plains–Jack Riggs Bench means that both Formative and Post-Formative peoples were bringing ready-made tools to these benches, and resharpening them as needed. The resulting lithic scatters are dominated by small pressure flakes and look remarkably alike.

Congruent with the debitage evidence, percussion thinned bifaces were evidently a minor component of Southern Paiute lithic technology on the Kaiparowits Plateau. The numbers bear this out; 86 percent of the 29 single-component Post-Formative sites have either no bifaces or just a single biface. Of the 195 Archaic sites in this category, by comparison, about three-quarters have between 1 and 15 bifaces. It is also highly likely that many of the bifaces on Post-Formative sites were scavenged from earlier sites and refurbished for use in some expedient task, a pattern noted by NNAD crews. Our results can be verified during future research in the area by paying close attention to evidence for reworking of older tools.

Southern Paiutes also seem to have placed comparatively less emphasis on the manufacture and use of flaked cobble tools such as choppers. Of the single-component Post-Formative sites, 22 (76%) have no flaked cobble tools and the remainder have three or less. Archaic sites have more flaked cobble tools in general, and a much wider range of frequency.

Grinding slabs occur on almost half of the single-component Post-Formative sites, and are found in greater numbers than at sites of any other temporal affiliation. Much of this is due to age, the Southern Paiute being the most recent culture to occupy the Kaiparowits Plateau. But the presence of grinding slabs and manos indicates that the plateau was valued as more than just a good place to hunt, and suggests participation by family units in upland foraging activities as defined by Kelly (1964:25–26).

The above examples illustrate the relative differences in Paiute site types: residential camps have several thermal features and a greater quantity and variety of flaked stone tools and grinding tools and reduction debris; processing camps have just one or two thermal features and grinding tools, and flaking debris that emphasizes core reduction to produce simple flake tools; hunting camps have usually just a single hearth or no thermal features, with debitage that reflects pressure flaking of flake blanks to create arrow points; and reduction loci consist almost entirely of flake waste from single lithic reduction episodes—either core reduction of cortical Paradise chert nodules or pressure flakes from arrow point production or tool refurbishing. Regardless of type, Post-Formative sites tend to be small. In fact, Post-Formative sites are the smallest of any temporal affiliation, followed by Formative/Post-Formative sites. In many cases, the main concentration of artifacts and features is in an area much smaller than the site boundary itself. Many of the Post-Formative sites of larger than normal size consisted of discrete artifact concentrations, often around small

thermal features, separated by open space (i.e., not a continuous scatter of debris like at Archaic sites). It is clear that the single-component Post-Formative sites are the result of short-term occupations of limited scale by small social groups, perhaps no more than a family or two.

Post-Formative Settlement and Subsistence

Combining the results of NNAD's inventory with ethnographic data, we can propose a preliminary model of Southern Paiute land use for the Kaiparowits Plateau. The plateau was probably used as a highland food gathering area for family or economic units, with winter quarters off of the plateau in well-watered (usually in the form of springs), lower elevation valleys. These economic units may have been small—perhaps just a few families—but fluid, with individuals and family units splitting and uniting as needed (e.g., deer hunts, communal animal drives, plant-specific foraging tasks). The Kaiparowits Paiute would have been "foragers," as partly defined by Thomas (1983:10–12), but with a more differentiated habitat, some reliance on stored foods, and generalized winter and summer residential bases.

During the winter and spring there was a dependence on stored foods; food was cached not only at the winter quarters, but on the plateau, after the fall harvest. During certain years, spring was a time of near-starvation; as food stores ran out, attention switched to cacti, juniper berries, agave (near the Paria and far lower Glen Canyon), valley seeds, and roots. In the summer, families were heavily dependent on plateau seeds, such as ricegrass. Fall was the time when family units came together to harvest and hunt; pinyon pine nuts, fall grass seeds, deer, mountain sheep, yucca fruit—the fall bounty usually provided a season of plenty, and propitiously timed prior to the lean months of winter.

Within this seasonal round, the Kaiparowits Plateau figured prominently in the summer-fall foraging regime. Encampments focused on water sources are an integral part of the "economic clusters" defined by Kelly (1964), during both the summer and winter. Nonetheless, there is no evidence for large, intensively used summer residential camps. Even at locations likely to have been reoccupied on a seasonal basis—such as those near springs—NNAD crews did not observe large accumulations of debris solely attributable to Post-Formative use. At this point our sample of Southern Paiute sites on the plateau consists primarily of processing and hunting camps and lithic reduction loci, with site density weighted toward the middle portion of the project area around Fourmile Bench and Long Flat. Two regional mobility strategies might account for this pattern in the archaeological record.

Exploitation of the Plateau from a Lowland Residential Base. In this model, Paiute hunter-gatherers operating from lowland base camps such as along the Paria River or Escalante River would visit the Kaiparowits Plateau only as part of logistic, task-specific groups. The groups would then return to their residential base camps when the tasks were completed.

Exploitation of the Plateau from Many Highland Residential Bases. In this model, Paiute hunter-gatherers would operate primarily from the plateau itself during the entire year, using many briefly occupied residential bases. This does not preclude occasional visits to locations off the plateau. Part of this strategy might have involved more intensively occupied winter camps rotating around known and dependable springs along Wahweap Creek, but this area was not included in our survey so such sites have yet to be documented.

The Post-Formative Southern Paiute are the least-documented culture in the monument (Madsen 1997). As Tipps (1998:140) commented, "known sites are relatively rare, but ... this may be the result of a weak database rather than sparse occupation." Data from survey and excavation of Paiute sites in the Circle Cliffs area (Tipps 1988), along the Burr Trail (Tipps 1992), on the Arizona Strip (Moffitt, Rayl and Metcalf 1978; Huffman et al. 1990; Wells 1991), near Kanab (Firor 1994), in the St. George Basin (Westfall, Davis and Blinman 1987), and elsewhere are accumulating at a steady pace. To this record we can now add the Kaiparowits Plateau Survey data, a first step toward the initial goal of "locating, identifying, and documenting" this most recent of indigenous lifeways (Tipps 1998:140).

CHAPTER 9

SUMMARY OF EURO-AMERICAN SITES AND ISOLATED OCCURRENCES

Euro-American sites in the Kaiparowits Plateau Survey area provide a glimpse of activity in a remote region during the first half of the twentieth century. The project documented 39 sites with historic components, as well as one recent site that is relevant to interpreting historic use of the project area. Nineteen of the sites also have prehistoric components, and at least seven sites exhibit evidence of more than one episode of use during the historic period. In addition, the survey recorded 62 historic or recent isolated occurrences (IOs). This chapter presents descriptions of the Euro-American resources and a discussion of the historic themes and site types that are represented. A brief summary of the historic development in the Kaiparowits region provides a context for the resources discussed in this chapter.

HISTORIC USE OF THE KAIPAROWITS PLATEAU

Recorded history in the region of the Kaiparowits Plateau began with the passage of the Dominguez-Escalante Expedition in 1776. This small party, led by Fray Atanasio Dominguez and documented by Fray Silvestre Velez de Escalante, intended to establish a route between the New Mexican capital of Santa Fe and Monterey, the capitol of Alta California (Bolton 1950). The expedition traversed a circuitous route through the Four Corners region, progressing as far northwest as Utah Lake and the Sevier Desert, then turned southwest and followed the edge of the mountain ranges nearly to Mount Trumbull. Forced by the onset of winter and a lack of supplies to return toward Santa Fe, the Dominguez-Escalante party traveled through Antelope Valley and along the base of the Vermilion Cliffs to the mouth of the Paria River, the future site of Lee's Ferry. After several unsuccessful attempts to cross the Colorado River at this location, they scaled the steep eastern wall of Paria Canyon, crossed the benches and canyons below Cedar Mountain, including East Clark Bench, perhaps traversed along the southern edge of Nipple Bench, and eventually forded the river at Ute Crossing, just upstream from Warm Creek. From there they traveled to the Hopi Mesas and onward to Santa Fe (Bolton 1950; Topping 1997:55–58). Although the friars failed to achieve their primary goal, the geographic knowledge gained by their travels aided many later explorers, and their detailed documentation of the country and native inhabitants provided a wealth of important early observations.

No documented Spanish expeditions passed through the area after the Dominguez-Escalante party failed to blaze a trail to California. In 1821, soon after Mexico gained independence from Spain, an expedition led by Antonio Armijo traversed the route pioneered by Dominguez and Escalante. When Mexican trading caravans to California became a regular event, the Spanish Trail followed a longer but less hazardous route, crossing the Colorado River near Moab and avoiding much of the labyrinthine canyon country to the south (Crampton 1994; Heath 1998: 438). Trappers pursuing beaver undoubtedly visited the Glen Canyon country in the first half of the nineteenth century, but left little evidence. An inscription by Denis Julien, dated 1836, demonstrates such incursions (Crampton 1994:11). The next well-documented exploration of the Kaiparowits Plateau region was by religious refugees seeking a place to live and worship apart from American society.

In 1847, before the United States had acquired the land that would become Utah, Brigham Young led members of the Church of Jesus Christ of the Latter Day Saints to settle in the valley of the Great Salt Lake. By 1854, missions were established in the mountain valleys and desert basins south of Salt Lake City, and from these bases Mormon explorers and settlers moved south and east. By the time the U.S. government sent explorers and survey parties through the area, scattered small communities had been established on the Arizona Strip and in the well-watered valleys throughout southern Utah (Geary 1992). Conflicts with the Ute, Paiute, and Navajo Indians in the late 1860s

resulted in temporary abandonment of numerous towns in central and southern Utah, but many were permanently resettled within a decade. In 1866, an expedition headed by Captain James Andrus traversed much of the country between Cedar City and the Escalante Desert, searching for places where Navajo raiding parties could cross the Colorado River and assessing the area for natural resources and potential town sites (Chesher 2000; Geary 1992: 140; Woolsey 1964). The route of this party followed along what would become the Skutumpah Road, crossing below the Pink Cliffs, moving east along the future Highway 12 corridor into Potato Valley, to the top of Canaan Peak, and then along Alvey Wash and into the Escalante drainage. The group left the area by traveling north across Boulder Mountain (Chesher 2000; Heath 1998:438).

Exploration of the region continued with two expeditions organized by John Wesley Powell under the auspices of the U. S. Government beginning in 1869. Although focused on the Colorado River and its canyon system, the 1871–72 expedition laid a foundation for much of the subsequent geologic, cartographic, and ethnographic research in the surrounding area, and brought the region to the attention of the American public. Almon H. Thompson, the geographer with Powell's second expedition, undertook reconnaissance work north of the Colorado River in 1872, traveling up Johnson Canyon to the Paria River, across the Table Cliff Plateau and into Potato Valley, the future site of the town of Escalante. His route to this point generally followed that of previous explorers such as Andrus. Thompson's party continued along the base of the Aquarius Plateau to the Henry Mountains and down the Dirty Devil River to its confluence with the Colorado (Gregory 1939; Woolsey 1964). Thompson was the first to apply the Paiute word "Kaiparowits" to the plateau that the locals later called Fiftymile Mountain, and he produced the first general maps of the Kaiparowits and Aquarius Plateaus (Crampton 1983:71). During an expedition in 1873, Thompson explored and mapped the Paria River and Cottonwood Wash along the Cockscomb (Heath 1998). In 1875, he returned to the area and explored along the southeastern edge of the Kaiparowits Plateau, traversing the canyons of Wahweap Creek and Warm Creek, then moving north to Harris Wash, which he called False Creek, and Last Chance Creek. During this trip Thompson traversed the Collet Canyon drainages and spent some time on the Kaiparowits Plateau east of Last Chance Creek, the first documented exploration of the plateau itself (Chesher 2000; Topping 1997: 220).

The areas north and west of the Kaiparowits Plateau were settled by expansion from Cedar City, Parowan, and then Panguitch. The towns of Escalante and Cannonville were founded in 1876, the centennial of the Spanish friars' excursion through the region (Woolsey 1964). At the suggestion of Almon Thompson, the new town in Potato Valley was named after the chronicler of the earlier expedition. At least eight villages were established along the Paria River in the 1870s, most abandoned within a decade due to the unreliable flow of the stream. Alternating cycles of flood and drought through the 1870s and 1880s doomed these small towns, which relied on irrigation systems to maintain their agricultural economy (Chesher 2000). Near the confluence of the Paria River and Cottonwood Creek, the town of Paria (or Pahreah) moved as the channel moved, but ultimately the settlement was abandoned after a series of major floods. Settlements farther south on the river, Rockhouse, Adairville, and White House, could support only a few families with the unpredictable water supply, and none lasted more than a few years. A period of flooding and arroyo cutting in the 1880s made irrigation difficult, and shortly after the turn of the century most of the settlements were completely abandoned. Residents from the failed villages coalesced to establish Henrieville and Tropic in 1878 and 1891, respectively (Kearns 1982:95), in the better-watered valleys at the north end of the Paria drainage. The town of Johnson, established on a tributary of Kanab Creek in 1871, lasted more than a decade and became a way station on the road between Salt Lake City and southern Utah (Chesher 2000: 82). Boulder, the last town established in the region, was settled by ranchers in 1889. Isolated by rugged terrain, Boulder received mail and all other goods by mule until the first automobile road reached the town in 1939 (Chesher 2000).

Settlements that were situated in areas with surface water and adequate growing seasons grew quickly and the inhabitants soon assessed their newly claimed lands for potential natural resources. The early settlers of the small communities north and west of the Kaiparowits Plateau focused on agrarian occupations, and stock raising was an important component of the economy (Gregory and Moore 1931:34–35; Hauck 1979:90). Both cattle and sheep were brought to the area in 1875 and 1876, as towns were being settled (Woolsey 1964). The previously wild range land,

covered with abundant grass and forage, was quickly filled as herds increased rapidly. Dry years beginning in 1893 and continuing through the 1890s damaged the land because herds were not reduced to compensate for the lack of forage. Large reductions in range stock were necessary after the turn of the century in response to the decreased vegetation. Numerous accounts indicate that the first few decades of heavy livestock presence depleted vegetation and reduced the productivity of the range, a condition from which it has not recovered (Chesher 2000:85; Gregory and Moore 1931). Herds were increased again during the second decade of the 1900s to meet market demand during World War I (Topping 1997:317; Woolsey 1964). Although the typical image of Western ranching involves cattle, the number of sheep documented after the turn of the century actually exceeded that of cattle (Woolsey 1964), but large-scale sheep ranching has now nearly disappeared in the area (Geary 1992). Livestock are still grazed on the Kaiparowits Plateau, although the number of ranchers using the area, and the total number of livestock, is lower than in the past. Efforts during the 1960s to improve the range included construction of water tanks, fences, and roads for access, as well as chaining and reseeding to remove trees and increase grass cover (Woolsey 1964:140). Ultimately the latter activity proved more harmful than useful, both to the natural floral and faunal communities and to archaeological sites.

Scientific exploration of the area continued after the turn of the century, beginning with Herbert Gregory's geological surveys between 1915 and 1924 (Gregory and Moore 1931), which produced detailed maps of much of the Kaiparowits Plateau, including areas briefly visited by Thompson. Gregory was an astute observer, and in addition to geological and geographic data, he presented a concise summary of the settlement and use of the area in the period between 1875 and 1930. A mapping expedition from the U.S. Geological Survey explored Glen Canyon in 1921, producing detailed topographic maps to the 3,900-foot level of the gorge and tributary canyons, including those draining off the Kaiparowits Plateau. Partially funded by the Southern California Edison Company, this work was undertaken to locate and assess potential dam sites between Cataract Canyon and Parker, Arizona (La Rue 1925; Topping 1997:334–338; Westwood 1992). Survey crews from the USGS continued mapping the Kaiparowits Plateau and surrounding benches, and established brass cap markers at corners of all school sections between 1917 and 1966. In addition to early geologic and geographic mapping, archaeological research was also carried out to the southwest of the project area, on the Arizona Strip and in Paria, Cottonwood, and Johnson Canyons in the late 1910s and early 1930s (Judd 1926; Steward 1941). According to Fowler and Aikens (1963:1) the earliest archaeological reconnaissance of the Kaiparowits Plateau itself was undertaken in 1928. This work was not published (Scott 1928) but was incorporated by Morss (1931) in his summary of the Fremont culture. Nearly a hundred sites were recorded on the Kaiparowits Plateau in 1937, when a crew from the Rainbow Bridge–Monument Valley Expedition traversed Fiftymile Mountain to assess its archaeological potential and collect sherds for comparative typology studies (Beals, Brainerd and Smith 1945:6).

The modern era of archaeological research began with surveys and excavations in advance of the construction of Glen Canyon Dam and creation of Lake Powell (see summary in Jennings 1966). Known as the Glen Canyon Project, documentation and excavation of prehistoric resources on the west side of the river fell to the University of Utah (Fowler and Aikens 1963; Fowler et al. 1959; Gunnerson 1959a), and the east side of the Colorado River and the canyon of the San Juan River were explored by the Museum of Northern Arizona (Adams, Lindsay and Turner 1961; Ambler, Lindsay and Stein 1964; Lindsay et al. 1968). Part of the University of Utah's efforts involved an intensive sample survey on Fiftymile Mountain in 1958 (Gunnerson 1959a), followed by excavations and additional survey in several areas (Fowler and Aikens 1963; Aikens 1963). Most relevant to this chapter, the University of Utah also had the responsibility of documenting all of the historic remains throughout the entire region. During 13 river trips, Crampton (1959, 1983, 1994) documented abundant evidence of historic activity in the canyon. The extensive debris related to gold mining efforts in the 1880s was the most conspicuous resource, but there was also evidence of Navajo families, Mormon ranchers, and early river runners. Inscriptions on rock faces, stairs pecked or cut into slickrock slopes, and cabins built of stone or driftwood were all part of the record of human presence (Crampton 1983, 1994; Pattison and Potter 1977). Although most of the historic sites were within the canyon itself, Crampton (1959:96) reported a trail that descended from the bench below the Kaiparowits Plateau to Klondike Bar, one of the more prosperous mining areas during the "gold rush" of the 1890s. This route,

perhaps the most elaborate trail into Glen Canyon, was also noted by members of the 1921 USGS crew (Westwood 1992:66).

Cadastral mapping and geologic studies continued on the Kaiparowits Plateau during the late 1960s and early 1970s in conjunction with exploration for coal and oil reserves. Commercial development of mineral deposits in the region was initially considered around the turn of the twentieth century. The first exploratory well was drilled for oil in 1921, but no producing oil wells were developed until 1964 (Heath 1998; Sargent 1984). Although a few exploratory wells drilled in the Kaiparowits Plateau and Burning Hills area showed traces of oil or gas, by the early 1990s no producing wells had been developed. During the 1960s, intensive exploration for coal deposits (first identified by Almon Thompson in 1875) brought welcome infusions of cash and jobs to residents in the towns north of the Kaiparowits Plateau. Towns like Escalante and Cannonville were used as bases of operation for exploration crews, and the numerous roads built to reach the drilling areas opened the country to vehicular travel. Preliminary plans for one or more mines on Smoky Mountain and coal-burning power plants on Fourmile and Nipple Benches prompted a number of archaeological surveys (see Chapter 3). The Class II survey reported by Hauck (1979) did not include the central portion of the Kaiparowits Plateau, but recorded 199 sites on Fiftymile Mountain and in the Escalante Desert. An area at the north end of the Kaiparowits Plateau was included in a sample survey reported by Kearns (1982).

The spectacular scenery of the region that surrounds the Kaiparowits Plateau has been extolled by explorers and adventurers for more than a century. The natural environment provided both the prehistoric native groups and the early settlers with a variety of resources, but the rugged terrain inhibited intensive use of much of the region. Lack of water and transportation routes prevented widespread settlement, and during the historic period the area was used only intermittently for ranching, mineral extraction, and recreation. Early attempts to preserve the undeveloped land began in 1936, when a national monument covering 7 million acres of southern Utah was proposed by Secretary of the Interior Harold Ickes. The plan was opposed by individuals and groups interested in developing mineral resources, and the numerous smaller national parks and monuments subsequently established in the region include only a portion of the original proposed area. In 1947, the National Geographic Society sponsored an expedition that brought national attention to the natural wonders of the Kaiparowits region and Escalante canyons, and again sparked interest in preserving the land in the public domain. A second, less inclusive preservation proposal came in 1956, in the form of the Escalante National Monument, but it too was defeated. The confrontation between preservationists and development erupted again during construction of the Glen Canyon dam, which both closed and opened access to the canyon country, depending on one's point of view. Threats of development related to coal mining in the 1960s and 1970s renewed efforts by environmental groups to preserve the land. The creation of the Grand Staircase–Escalante National Monument in 1997 is the latest chapter in the battle between preservation and development of land in this vast wild region.

NATIVE AMERICANS IN THE HISTORIC PERIOD

The scanty evidence for historic Native American use of the Kaiparowits Plateau suggests that indigenous occupants were not living traditional lifestyles by the early 1900s, the period of greatest historic use of the Kaiparowits Plateau region. Kearns (1982:253) also noted that all historic resources documented for the Escalante Project dated between 1904 and 1931, and that all appeared to relate to Euro-American, rather than Native American, use of the area. Although most native groups in the West were settled on reservations by the turn of the century, and so were generally living apart from Euro-American communities, the Southern Paiutes followed a somewhat different path. A series of inadequately small and semi-supplied reservations could not support the Paiute, who instead lived peripherally to Euro-American communities and were largely dependent on the local Mormon economic and social system by the early portion of the twentieth century (Fowler and Matley 1979:86). A survey of archival data on the Southern Paiute suggests that the lack of archaeological evidence for historic native occupation of the area is due to two main factors: (1) traditional economic uses of the land (i.e., gathering) were practiced only intermittently after the arrival of Euro-Americans and the severe ecological impacts of livestock; and (2) the material culture of the Paiutes had changed, incorporating many of the same items used by the Euro-Americans who passed through the area. For more archaeological insight into the second situation, see Chapter 5 in this volume, which

describes test excavations at a historic Paiute site (42KA4662).

In the Kaiparowits region, the Dominguez-Escalante expedition documented Southern Paiute groups that were nearly unaffected by the Spanish presence in New Mexico and California. The few material items that the Paiutes obtained through trade with the Utes and Navajos, both of whom were in more direct contact with the Spanish, had little influence on traditional lifeways. The Southern Paiute continued to be minimally impacted by the Spanish and Mexican settlers, with one important exception. Through the 1700s and early 1800s, both Ute and Navajo raids were mainly aimed at procuring slaves that could be sold in New Mexico and California. By the 1830s, Mexican and Euro-American trappers and traders were also involved in the trade. The extent of the slave trade on the Paiute population is difficult to assess, but Euler (1966) suggested that a fear of raiders might explain the absence of Southern Paiutes in ecologically favorable but heavily traveled areas within their territory. Soon after their arrival in Deseret, the Mormon settlers effectively ended slave trading except for the occasional raid by neighboring tribes. Cessation of the slave raids was a positive effect of Mormon colonization, but it was soon offset by the establishment of permanent settlements that displaced the Southern Paiute from their most productive economic environments.

Mormon settlements expanded into the area that would become southern Utah in the 1850s, and by the 1870s most Southern Paiutes had experienced direct and sustained contact with the newcomers. Traditional food supplies were depleted by Mormon agricultural systems and livestock or became inaccessible due to establishment of communities (Kelly and Fowler 1986). The LDS doctrine that Indians were the descendants of the Lost Tribes of Israel generally fostered favorable attitudes toward the native peoples, and a common view held that the "savages" could and should be taught "civilized" ways (Euler 1966:61). Southern Paiute groups began to settle in proximity to Mormon towns, although they were not entirely accepted and generally lived on the fringes, in both a physical and social sense. Some of the Paiutes were baptized into the LDS Church, although the ideological impact may have been negligible. The converted Paiutes were only slightly more accepted into the Mormon communities than their brethren, but could rely more on the church for economic support. Often the Paiutes attempted to combine aspects of traditional subsistence with menial wage labor (Euler 1966: 83–86, quoting J. W. Powell). Non-traditional implements were relatively common by the 1870s, including metal-tipped arrows, metal buckets and pans, and European-style clothing, often obtained as charity from the Mormon settlers (Fowler and Matley 1979; Euler 1966). Reports by Powell and others in the early 1870s attest to the mixture of native and introduced material items that the Paiutes were using at that time (Fowler and Matley 1979).

Conflicts between the Indians (mainly Navajo and Ute) and Mormons in the mid 1860s prompted plans for establishment of reservations. In 1865, the Treaty of Spanish Fork was signed by six Southern Paiute headmen, promising that the Paiute would relinquish their land and move to the Uintah Reservation in northeastern Utah (Kelly and Fowler 1986:387). None of the Paiute groups moved, as many feared living on the same reservation with their former enemies, the Utes, and the treaty was never ratified by Congress. The first Southern Paiute reservation was established in 1872 by executive order, providing an area of roughly 3900 acres on the Muddy River in Nevada. Although the reservation was intended for all Paiutes in Southern Utah, Arizona, Nevada, and California, only the Moapa band actually relocated (Clemmer and Stewart 1986; Kelly and Fowler 1986).

A government commission report assessing the status of the Paiutes and the feasibility of moving them away from settlements resulted in an expansion of the Moapa reservation in 1874 and an agreement by the Utah Southern Paiute to move there. The government failed to deliver supplies promised in the agreement, and again few Paiutes moved to the reservation. Lack of funding and conflicting land claims resulted in a reduction of the reservation to 1000 acres in 1875, and by 1900 only a few families remained. After the failure of the Moapa reservation, the government largely ceased to provide aid to the Southern Paiute, who either migrated to unoccupied areas and tried to take up traditional economic endeavors, or moved nearer to Mormon settlements for wage work. The LDS Church and local landowners provided for a few small settlements, but the government insisted that removal to the Moapa or Uintah reservations was the only option for federal aid (Kelly and Fowler 1986:388).

The first Southern Paiute reservation in Utah was for the Shivwits band, established just west of St. George, in 1903 (Kelly and Fowler 1986). Al-

though the reservation boundaries were expanded twice, the amount of land suitable for living and farming was insufficient to support the occupants, and eventually most moved to surrounding Mormon settlements for wage labor. The Kaibab band, most of whom had moved near Kanab because they could no longer make a living on the livestock-damaged range, were established on a reservation at Moccasin Spring in 1907. Enlarged in 1913 and 1917, this is one of the few Paiute reservations that proved viable, due to the availability of water, timber, grasses for livestock, and suitable areas for agriculture.

Other reservations were established for the Southern Paiute near Las Vegas in 1911, northwest of Cedar City in 1915, and near Kanosh in 1929. Officially, the Kaiparowits band of the Southern Paiutes was assigned to the Koosharem Reservation, east of Richfield, which was established in 1928. Kelly (1964:3) interviewed members of the Kaiparowits band on the Kaibab Reservation at Moccasin, but did not clarify whether they lived on that reservation. It is also possible that some of the Kaiparowits Paiutes crossed the Colorado River to live with the San Juan Paiutes on land set aside for the latter group along the Utah-Arizona border east of the river.[1] None of the reservations in Utah were large enough to support their assigned populations, particularly through agriculture, which was the subsistence economy preferred by the government. After the reservations were established, Southern Paiutes living elsewhere were without federal aid, and most were involved in wage work. Ultimately, the Southern Paiute groups received little more than token assistance from the government over the years, as they were too few in number and too isolated to be of much concern (Kelly and Fowler 1986:390).

In 1954 most Southern Paiute reservations, including Koosharem, were terminated from federal control. Lands were quickly lost to non-Indian investors or sold for back taxes. In 1957 the Southern Paiutes filed a suit for compensation for their aboriginal lands, and were awarded a settlement of 27 cents per acre in 1971. By 1984 land was acquired near Cedar City for the groups that lost their reservations, including the Koosharem. The experiences of the Southern Paiute in their relationships with the U.S. government followed a rather different course than that of adjacent native groups, who were often placed on reservations that, while insufficient to support the population, were based on historic use areas. The consequent dispersal of Paiute groups prompted a disintegration of traditional Paiute social and economic systems, which were not particularly cohesive to begin with (Euler 1966). These impacts were already widespread by the early twentieth century, effectively obscuring the Paiute in the archaeological record.

PREVIOUSLY RECORDED HISTORIC SITES

As discussed in Chapter 3, a few portions of the Kaiparowits Plateau Survey area were previously included in archaeological inventories, but no historic sites had been formally recorded in any of the Kaiparowits Plateau Survey sample units. A review of historic sites recorded during survey projects in adjacent areas, however, suggested the types of resources that might be encountered in the current project area. The number of historic resources is typically small compared with the abundant prehistoric remains, a trend demonstrated during our survey as well. For example, only a single historic site, an inscription left by Sam Lacy in 1920, was documented in the preliminary report for the Kaiparowits Power Project (Fish n.d.:117). In contrast to earlier projects, which sometimes dismissed small historic sites as insignificant, the Kaiparowits Plateau Survey thoroughly documented all cultural resources greater than 50 years old. In several cases, resources that did not meet the 50-year guideline were recorded os IOs to illustrate variety of historic and recent human activity in the area.

The Southern Coal Project (SCP) included a Class I record search and a Class II field survey of 10 planning units in southern Utah, two of which are directly adjacent to the Kaiparowits Plateau Survey area. The Class I survey documented seven historic sites in the Escalante Planning Unit, comprising one wagon road, three habitations, and three miscellaneous sites (Hauck 1979:124). The Class II survey for that

[1]The Paiute Strip along the Arizona-Utah border, comprising nearly 500,000 acres, was set aside as a reservation in 1884. In 1907 the portion in Utah was designated for exclusive use by the San Juan and Kaibab Paiutes, but in 1922 the land was returned to the public domain. The Paiute Strip was appended to the Navajo Reservation in 1933, at the request of the Navajo Nation, by which time many of the Paiutes had moved to the Allen Canyon–White Mesa area of Utah (Bunte and Franklin 1987; Clemmer and Stewart 1986:544). Although a large segment of the population in the area acknowledges Paiute ancestry, some within the Navajo Nation do not officially recognize any Paiutes living within the reservation boundary (Alan Downer, personal communication 1992).

planning unit reported only one historic site, a trail dating to the nineteenth century (Hauck 1979:191). No Class II survey was completed in the Paria Planning Unit but Class I records for that unit reveled seven previously recorded historic sites, consisting of two habitations, two inscriptions, two mines, and one brush fence (Hauck 1979:124). The SCP report does not provide dates of use for the Class I historic sites, and the report offers no interpretations of historic activity in the planning units, but the brief descriptions suggest exploitative activities related to establishment of Euro-American communities and dispersed settlements.

Kearns (1982:253–255) reported for the Escalante Project that Tract I contained one historic site and four sites exhibiting both historic and prehistoric components. The single-component site was a corral of undetermined age, possibly pre-dating 1930, but the multi-component sites were not described. Several recent trash dumps were also noted in Tract I, but were not fully recorded. Two single-component historic sites and two other sites with historic components were recorded in the Tract II sample area, which comprises the northwest portion of the Kaiparowits Plateau. One site comprised an inscription on a rock face, initials associated with the dates 1904 and 1925. Two of the other sites, a trash scatter associated with a corral and a temporary camp, probably pre-date the 1930s. The historic component at the final site was undated, but was probably later than 1931. Tract III contained three single-component historic sites, which date between 1915 and 1935, and five historic components associated with prehistoric remains. One site in Tract III was dated to 1920 based on an inscription on rock. Kearns (1982:255) also noted that several unrecorded homesteads and an unrecorded sawmill occur in Tract III. These sites appear to date to the interval between 1910 and 1940. With the exception of an abandoned sawmill, all of the historic sites reported by Kearns (1982) are probably directly associated with ranching activities, and most represent use of the area during the first four decades of the twentieth century.

DATING METHODS

Most of the historic sites in the survey area can be assigned to a period of 20 years or less. Historic use of the region was apparently most intensive during the first four decades of the twentieth century and during the 1960s and 1970s, or at least use during these periods left the most visible remains. Activity in the earlier interval was primarily associated with ranching activities, and later remains are most commonly the result of exploration for mineral resources.

Establishing a date for activity at historic sites is a satisfying task for many archaeologists because the period of use can often be narrowed to a few years. By contrast, prehistoric sites recorded during survey often must be placed in temporal brackets of hundreds or even thousands of years. As with prehistoric sites, dating of historic resources must be directed toward the episode of activity rather than the individual artifacts. Disregarding possible reuse of artifacts, such as glass bottles, can result in a temporal assignment that is earlier than the actual use of the site (Busch 2000). Accurate dating of activity at a site generally requires multiple independent dates garnered from the artifact assemblage, and must account for possible spatially discrete or overlapping activity areas. When estimating site age, NNAD crew members considered more than a single criterion whenever possible, such as milk can size or bottle manufacturing technology. In nearly all cases where more than one dating criterion was available, the evidence was complementary and indicated a tight range for the age of the site, or demonstrated two distinct episodes of use. At two sites, dates indicated by the artifact assemblage were verified by inscriptions.

We dated the majority of the historic sites and isolated occurrences using artifact types. Milk can measurements, following Simonis (1997), formed the core dating method. NNAD crews found only one milk can size that could not be dated using this guide. Two sites on Smoky Mountain have crimped-seam milk cans that measure 4-5/16" tall by 2-15/16" in diameter. The height dimension of these cans falls between Type 9 (height = 4-6/16") and Type 10 (height = 4-4/16"); the diameter of all these cans is identical (Simonis 1997). The undated cans were probably produced between about 1915 and 1930, the same interval covered by the Type 9 and 10 cans. Numerically, the most common milk cans are Types 18 and 19, which date after 1935 and 1930, respectively. The next most common are Types 9 and 12, which date between 1915 and 1930. The latter two types occur at more sites (n = 12 and 8 vs. 6 and 5), but in smaller numbers than the more recent types, a trend that probably reflects increased integration of canned food into the daily lives of rural residents in more recent periods of time. Type 6 (1903–1914), Type 7 (1908–1914), and Type 14 (1920–1930) milk cans

are also fairly common, and occasional other cans include Type 10 (1917–1929), Type 11 (1917–1929), and Type 13 (1917–1930). Milk cans were present at 21 of the historic sites and nearly half of those sites produced more than one type of milk can.

Food cans proved too general in size to be useful for dating, but several patent or manufacturer's markings on cans were checked to verify dates obtained from other artifacts. Nearly all food cans from the project area are sanitary style, which became widely used shortly after the turn of the century (Busch 1981; Rock 1981: 17). A few hole-and-cap, crimped-seam cans that probably contained fruit or vegetables were encountered at earlier sites. Meat cans, rectangular with tapered sides, were noted on several sites. Canned meat became widely available in the mid 1870s, and score-strip meat cans were introduced in 1895 (Rock 1981:14). Lard buckets were occasionally found, as were baking powder canisters. Ward, Abbink and Stein (1977:240) presented an excellent discussion of the dating potential of baking powder cans, which were useful in verifying dates for a few sites in the project area. Square or round cans with pry-out lids, which probably contained cocoa, tea, or other dry or powdered foods, were found at several sites. The can assemblages noted at most of the camps are quite uniform, and reflect the standard, probably mundane, menu of the range hands and others who traversed this area.

Glass manufacturing technology and maker's marks on bottle bases proved useful for confirming the ages of glass artifacts at several sites (Toulouse 1971). General discussions of glass manufacturing technology, including significant changes through time, are presented by Firebaugh (1983) and Miller and Sullivan (2000). Glass color is not considered diagnostic enough for dating purposes, with the exception of "purple" glass. Manganese was used as a decolorizer to produce clear glass during the late nineteenth and early twentieth centuries. When exposed to ultraviolet light, glass containing manganese changes color, turning gray to purple depending on the manganese content and the duration of exposure. From this alteration comes the term sun-colored amethyst (SCA) glass. After 1917, when World War I prevented importation of inexpensive manganese from Germany, selenium and then arsenic were substituted to produce clear glass. The presence of purple glass is therefore an indicator of sites that may date to the early part of the twentieth century. Bottles that turn purple through sun exposure were only manufactured prior to 1917, but such bottles certainly continued to be reused for years, and this behavior must be considered in applying dates to historic sites. With two exceptions, all of the bottles noted during the survey are fully machine-made, indicating manufacture after 1903. Fragments of bottles produced with a semi-automatic machine were recovered from Long Flat and Fourmile Bench. The first is an SCA bottle and so was produced prior to 1917. The other semi-automatic bottle was also the only bottle with an embossed panel, typical of patent medicine containers prior to 1915. One small SCA medicine bottle from a site on Long Flat exhibits markings on the base typical of the Owens machine, and so must date after 1909, when Owens machines were capable of producing small bottles, but prior to 1917 (Firebaugh 1983; Miller and Sullivan 2000).

The general condition of sites and artifacts was taken only as supplemental evidence of site age. Actually, given the use of many sites in the first four decades of the twentieth century, the condition of the artifacts is surprisingly good. Most cans in the survey area are heavily rusted, but intact enough to identify manufacturing technology and can function. Those portions of painted labels on cans that were buried in stable sediment are often legible. Wood is also well preserved by the dry climate, and even milled lumber is generally intact enough to measure. A wooden pack saddle at one site is especially well preserved, considering its 50+ years of exposure. The most destructive process at historic sites is livestock activity, which crushes cans and glass containers so they cannot be measured.

The most straightforward method of dating historic sites is by the presence of dated inscriptions. Historic petroglyphs provide evidence of activity at a single point in time, and several of the panels contain more than one inscription, indicating use of a canyon, trail, or camp through time. The inscriptions also provide valuable references to individuals who were in the area, allowing correlation between known individuals or families who shaped the history of the region.

HISTORIC SITES BY SAMPLE FRAME

This section presents brief descriptions of all Euro-American sites recorded during the Kaiparowits Plateau Survey. Basic descriptive information for the historic sites is presented in Table 9.1. Maps and photos of selected sites are included to illustrate typical site layouts and the types of features encountered. A synthetic discussion of historic site types and themes follows the site descriptions.

Table 9.1. General attributes of Euro-American sites from the Kaiparowits Plateau Survey.

Site Number	Site Type[1]	Site Age[1]	Structure	Cans	Glass	Milled Wood	Metal	Hearth	Other
Collet Top									
42GA4780	Camp	1990s	wickiup	—	—	—	—	—	
42KA5232	Camp	1930-1975	—	X	—	—	—	—	
Horse Mountain									
42KA4715	Camp	1935–1945	tent area?	X	X	X	—	—	cut wood
42KA4718	Camp	1935–1975	corral	X	—	—	X	—	cut wood
42KA4757	Camp	1915–1930	corral	X	—	—	X	—	
	Camp	1935–1975	—	X	X	X	—	X	cut wood
42KA4820	Camp	1915–1930	—	X	—	—	—	—	cut wood
42KA4848	Camp	1915–1930	—	X	—	X	—	X	cut wood
Long Flat									
42KA4546	Camp	1917–1929	tent area, corral	X	X	X	X	—	cut wood
42KA4560	Camp	1909–1917	tent area	X	X	—	X	—	
42KA4572	Artifact scatter	1881–1917	—	X	X	—	—	?	
42KA4577	Camp	1903–1917	—	X	X	X	X	X	bench
42KA4582	Camp	1935–1945	windbreak, corral	X	—	—	X	X	cut wood
42KA4593	Camp	1935–1945	—	X	X	—	—	X	inscriptions
42KA4623	Camp	1920–1930	—	X	—	—	—	—	cut wood
42KA4667	Camp	1908–1914	tent area	X	—	—	—	—	
42KA4679	Camp	1908–1914	tent area	X	—	X	X	—	
42KA4680	Camp	1908–1914	tent area	X	X	X	X	X	cut wood
	Camp	1917–1929	—	X	—	—	X	—	
42KA4682	Camp	1933	tent area	X	—	X	bucket	—	inscription
42KA4775	Fence line and camp	1915–1930	—	X	X	—	—	X	fence posts
42KA4776	Camp	1914–1940s	tent area	X	X	—	horseshoe	—	rock pile
Horse Flat									
42KA4589	Camp	1915–1930	—	X	—	—	—	—	
Fourmile Bench									
42KA5480	Camps	1903-1930	tent area?	X	X	—	X	—	
42KA5482	Camp	1903-1914	tent area?	X	X	—	—	—	
42KA5488	Camp	1917-1930	—	X	—	—	—	—	
42KA5489	Camp	1917-1929	—	X	—	—	—	X	
Smoky Mountain									
42KA5306	Camp	1935-1945	tent area?	X	X	—	—	—	
42KA5310	Camp	1945-1970	—	X	X	X	X	X	
42KA5313	Camp	1917-1930	—	X	—	—	—	—	
42KA5318	Camp	1917-1930	windbreak	X	X	X	X	X	
42KA5353	Camp	1915-1930?	—	X	—	—	—	—	
42KA5359	Camp	1935-1945	tent area	X	—	X	X	X	wood pile
42KA5360	Camp	1915-1930?	—	X	—	—	—	X	
42KA5361	Corral	?	corral	—	—	—	—	—	
42KA5397	Camp	1915-1930	tent area?	X	X	—	—	—	rock line
42KA5398	Camps	1920-1970s	tent area?	X	—	—	—	—	rock line
Brigham Plains									
42KA4637	Inscriptions	1919–1931	—	X	—	—	—	—	inscriptions
42KA4695	Camp	1915–1930	—	X	—	—	—	X	cut wood
42KA4704	Camp	1915–1930	tent area?	X	—	—	stove pipe	—	
42KA4707	Camp	1915–1945	tent area?	X	—	—	—	—	
Nipple Bench									
42KA5492	Camp	1917-1929	—	X	—	—	—	—	

[1]Refers only to historic component.

Historic sites were recorded in all sample frames except East Clark Bench, but the majority of the sites are on Long Flat (13) and Smoky Mountain (10). The survey included a random sample of units in each stratum, so we can calculate the expected number of historic sites and compare that to the observed frequency to determine whether the sites are randomly distributed or clustered in specific areas (Table 9.2). The number of historic sites recorded in the Horse Mountain, Horse Flat, and Fourmile Bench sample strata deviates by one or two from the expected number, and Brigham Plains contained the exact number expected. Collet Top and Nipple Bench, however, each contain only a fraction of the expected historic sites (2 vs. 7 and 1 vs. 5, respectively). Long Flat and Smoky Mountain each contain more than twice as many historic sites as expected. In contrast, three historic sites would be expected on East Clark Bench, based on a proportional distribution, but none were discovered. These patterns demonstrate that historic sites are not evenly distributed throughout the project area, but are concentrated in select areas to take advantage of desirable resources. A chi-square test of the distribution demonstrates that the differences are significant at the $p = 0.005$ level (Table 9.2). The large number of sites on Long Flat and Smoky Mountain is not simply a reflection of a greater number of survey units, but represents more intensive use of those areas by ranchers. Appealing characteristics might include relatively gentle topography, access to water, abundant vegetation for livestock, and ease of access. Horse Flat, Long Flat, Fourmile Bench, and Smoky Mountain exhibit the first three characteristics. The historic route across the Kaiparowits Plateau illustrated by Gregory and Moore (1931:Plate 1) approximates the modern road as it crosses Long Flat and passes adjacent to Horse Flat and Fourmile Bench, demonstrating access routes. Most of the areas containing historic sites are still used as livestock range. Smoky Mountain and portions of East Clark Bench are, in fact, two of the few year-round grazing allotments in the area (USDI 1999: Appendix 6).

Collet Top

The only historic site within the Collet Top sample frame is a small camp at the base of a prominent ridge south of the Big Sage area. The location has an excellent view of the Carcass Canyon drainage system and Fiftymile Mountain. Site 42KA5232 comprises a diffuse scatter of rusted food, milk, and tobacco cans. The milk cans are a size produced continually between 1930 and 1975, but the condition of the cans indicates that the site is of substantial age and probably dates to the first half of the 1900s. The presence of 14 cans suggests use for a few nights by a small group or perhaps for a week by a single person. There is no evidence of a hearth or other features. The site is most likely related to ranching activity. The surrounding area is currently used as cattle range, and a large stock tank has been constructed to the southeast.

One site recorded on the main part of Collet Top is a recent activity area that is of interest because it represents modern behavior that can directly affect archaeological interpretation. The site (42GA4780) comprises a standing wickiup without associated artifacts. The wickiup is a sub

Table 9.2. Chi-square analysis of Euro-American site distribution among sampling strata.

Sampling Stratum	Observed (f_o)	Expected (f_e)	Difference ($f_o - f_e$)	$\frac{(f_o - f_e)^2}{f_e}$
Collet Top	2	7	−5	3.6
Horse Mountain	5	3	+2	1.3
Long Flat	13	6	+7	8.2
Horse Flat	1	2	−1	0.5
Fourmile Bench	4	6	−2	0.7
Smoky Mountain	10	4	+6	9.0
Brigham Plains	4	4	0	0.0
Nipple Bench	1	5	−4	3.2
East Clark Bench	0	3	−3	3.0
			$X^2 = \Sigma \frac{(f_o - f_e)^2}{f_e}$	= 29.5

Note: df = (n − 1) = 8 so p(0.005) = 22.0; therefore X^2 is significant at the 0.005 level.

rectangular, semi-conical structure built of pinyon and juniper branches and logs, leaned against the large, primary branches of a stout juniper (Figure 9.1). The branches and logs were scavenged from the ground and visible ends show neither axe nor saw cut marks and the wood elements are of variable age and condition. The wickiup entry faces east, one side defined by the juniper tree trunk and the other by a forked support post. The forked post supports a cross-beam that extends to the back of the wickiup and upon which some of the upright slanting wall elements are leaned. The entire exterior is covered with copious strips of juniper bark as finishing material, to the extent that little light filters into the interior. This bark appears quite recently peeled from the adjacent tree, as neither the tree nor the bark is weathered. Several centimeters of pinyon and juniper duff and twigs (representing a rodent midden) have accumulated on the interior floor. Interior dimensions of the wickiup are 3 x 2.5 m and maximum interior height is just over 1 m; exterior dimensions are nearly a meter larger in all directions. The condition of the wickiup indicates recent construction, and the complete lack of artifacts fits with this interpretation, as both prehistoric and historic campers tended to leave unwanted items behind. The type of structure is uncharacteristic of a cowboy camp, but is quite similar to shelters built by Paiute groups who occupied the region.

The intact and unweathered condition of the wickiup indicates that its last use was probably between a few months and a year or two ago. This wickiup may be related to excursions by outdoor survival or adventure groups that operate in this area, in which participants camp without modern equipment and emphasize primitive technology. Interest in prehistoric technology and past lifeways as an alternative perspective on the modern world has spawned organizations such as the Boulder Outdoor Survival School, based in Boulder, Utah, which offers wilderness survival courses using no modern tools. The professed standard of conduct for participants is to leave as little trace as possible, and specifically to avoid creating archaeological sites (David Wescott, personal communication 2000), but it is possible that not all participants adhere to these proscriptions. Another potential source for the structure is programs aimed at helping troubled youths. Some of these programs, such as the Turn-About Ranch in Escalante, culminate with a solo or supervised excursion away from civilization. Although primitive technology is not the emphasis in these programs, a structure like the one at 42GA4780 could result. Finally, the wickiup may be the result of recreational campers.

The significance of this site lies not in the structural remains at the site, but in the fact that there are no artifacts associated with the structure. Because most archaeological sites are placed into a temporal (and cultural) context based on artifact assemblages or diagnostic tools, the lack of artifacts presents a dilemma. In many situations, a site lacking evidence of recent or historic trash would be considered prehistoric. Modern people seldom leave no trace of their passage, whereas the lack of prehistoric artifacts could be explained away by postdepositional processes or other natural or cultural influences. On Collet Top, small rock shelters containing arrangements of sandstone slabs but lacking artifacts were recorded as isolated occurrences (see below), and posited to result from modern behavior. A hearth and stacked or upright rocks within a rock shelter are certain indicators of human activity, but if no artifacts, either prehistoric or modern, are present, the archaeologist has no reliable way to assign the site to a cultural group or temporal period. Charcoal condition may be appropriate as a proxy tool for dating (see Chapter 7), but does not provide the certainty of diagnostic projectile point types or metal or plastic artifacts. This is particularly true in sheltered settings. In the case of the Collet Top survey stratum, the presence in nearby communities of groups that are interested in imitating prehistoric ways of living, or groups that might inadvertently produce "archaeological" sites, made us cautious in recording cultural manifestations that lacked evidence of temporal affiliation. Survey crews not familiar with this phenomenon could easily defend recording such sites as prehistoric, thereby erroneously inflating the site count in a project area. This site offers a cautionary tale for field archaeologists and land managers alike. In 20 years the wickiup at 42GA 4780 might appear sufficiently weathered (aged) that it could be mistaken for an authentic Paiute structure.

Horse Mountain

Five historic sites were recorded in this sample stratum, three on Horse Mountain and two on Paradise Bench. All of the sites appear related to ranching, as is typical of the historic sites throughout the project area. One of the best-preserved historic camps, 42KA4715, is located on Horse Mountain (Figure 9.2). This site contains a scatter of more than 35 milk, food, tobacco, cocoa, and

Figure 9.1. The modern wickiup at 42GA4780 on Collet Top that could be mistaken for an authentic Paiute structure: a) overview of site area and intact wickiup, b) wickiup doorway and details of construction.

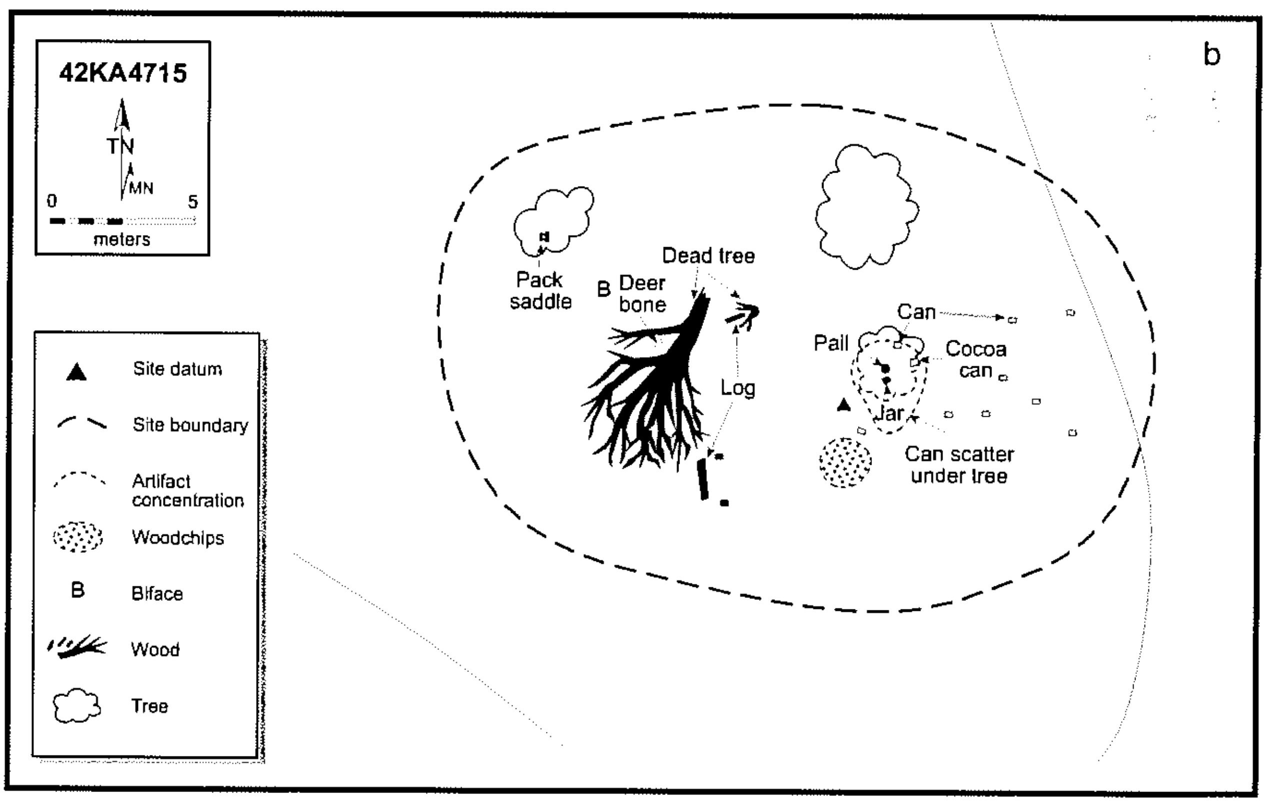


Figure 9.2. Site 42KA4715 on Horse Mountain: a) pack saddle hanging in tree; b) plan map of site.

lard cans, as well as an intact glass jar and a deer or elk leg bone. A wooden pack saddle, still in good condition, hangs in a juniper tree, waiting to be picked up on a return to the site (Figure 9.2a). The well-used saddle has been repaired with metal strips and carriage bolts, but is still quite serviceable. A pole leaned into a dead juniper tree marks the location of a tent or tarp shelter and several axe-cut logs may have provided seats as well as firewood. No hearth area was identified, but the presence of a woodchip scatter indicates that one probably existed and has been scattered by erosion. The relatively large number of artifacts suggests that the camp was used for an extended period of time or was used more than once over a short period of time. Milk can types indicate that the site occupation occurred between 1935 and 1945.

A more brief historic camp, site 42KA4820 on Horse Mountain, also has a prehistoric component. The historic locus of the site consists of seven milk and food cans and a small woodchip scatter. Although no defined hearth area was noted, the woodchips suggest that a fire was built for cooking or warmth. The milk cans place site occupancy between 1915 and 1930.

The only corral noted on Horse Mountain is at 42KA4718 (Figure 9.3a). The corral, which measures roughly 12 x 9 m, is constructed of axe-cut trees and branches stacked to create walls that lean against or are wedged between living trees (Figure 9.3b). The corral would not have held many cows but could have been used for sheep or horses. A woodchip scatter is present, although no hearth was visible. Artifacts at the site include 25–30 milk, food, fish, and meat cans and a screw-top jar lid. The milk can types indicate manufacture between 1935 and 1975, but the camp probably dates to the earlier end of this period based on the condition of the remains. It is likely that the site was used between the 1930s and 1950s, which corresponds to the age of most other historic sites in the area.

One corral was located on Paradise Bench at 42KA4757, a huge multicomponent site with two historic camp loci as well as seven prehistoric lithic scatters, all connected by a sparse background scatter of lithic debitage. The historic camps appear to represent separate episodes of use, based on the diagnostic artifacts. The older artifacts are directly associated with the corral, although that feature may have been used during the second historic occupation as well. The corral measures approximately 17 x 10 m and is in excellent condition considering its age. The walls consist of juniper logs and branches, both axe-cut and scavenged, piled between live and dead juniper trees (Figure 9.4a). The corral walls are generally 1.5 m high and mostly intact. The south-facing entrance is partially blocked by two logs. Associated artifacts include milk, baking powder, large and small food cans, and one possible coffee can. The relatively large number of cans in this area suggests a stay of several days for a small group, and the milk can types indicate use between 1915 and 1930. Also adjacent to the corral are 12 sherds from a single Shinarump Corrugated jar and a single sherd from a Virgin Black-on-white bowl. These sherds must have been collected elsewhere and then discarded by cowboys using the corral, because survey indicated no other evidence of Virgin Anasazi presence in the immediate vicinity. A Virgin Anasazi habitation that has been recorded northwest of 42KA4757 (Douglas McFadden, personal communication 1998) could be the origin of the sherds. The second historic camp at 42KA4757 consists of a large shallow charcoal stain, a small woodchip scatter, several milk cans and a spice can, a piece of aqua glass from a jar body, and a piece of milled lumber with nails, probably the remains of a wooden crate. Milk can types date this locus between 1935 and 1975, but the condition of the cans suggests occupation toward the beginning of this interval. The sparse remains probably result from a brief camp, possibly associated with activity at the corral. No evidence of tents or other shelters was found at either camp area.

Additional evidence of short-term camping on Paradise Bench was found at 42KA4848. The historic component of this site consists of a hearth, a woodchip scatter, two milk cans, one tea can, and four pieces of milled lumber. There is no evidence of a structure, although a tent could have been erected between the hearth and several juniper trees to the west. Can types indicate use between 1915 and 1930, commensurate with other sites in the area. One interesting artifact at this site is an intact score-strip can that held "Blue Pine Tea" according to the stamped lid (Figure 9.5). The can was opened by two knife punches forming a V, through which tea could be poured. By opening the can in this manner, rather than with the intended score-strip and key, the remaining can contents could be transported with minimal spillage.

It is worth mentioning that Paradise Bench contains various features from coal exploration of the 1960s and 1970s. Most prominent among these

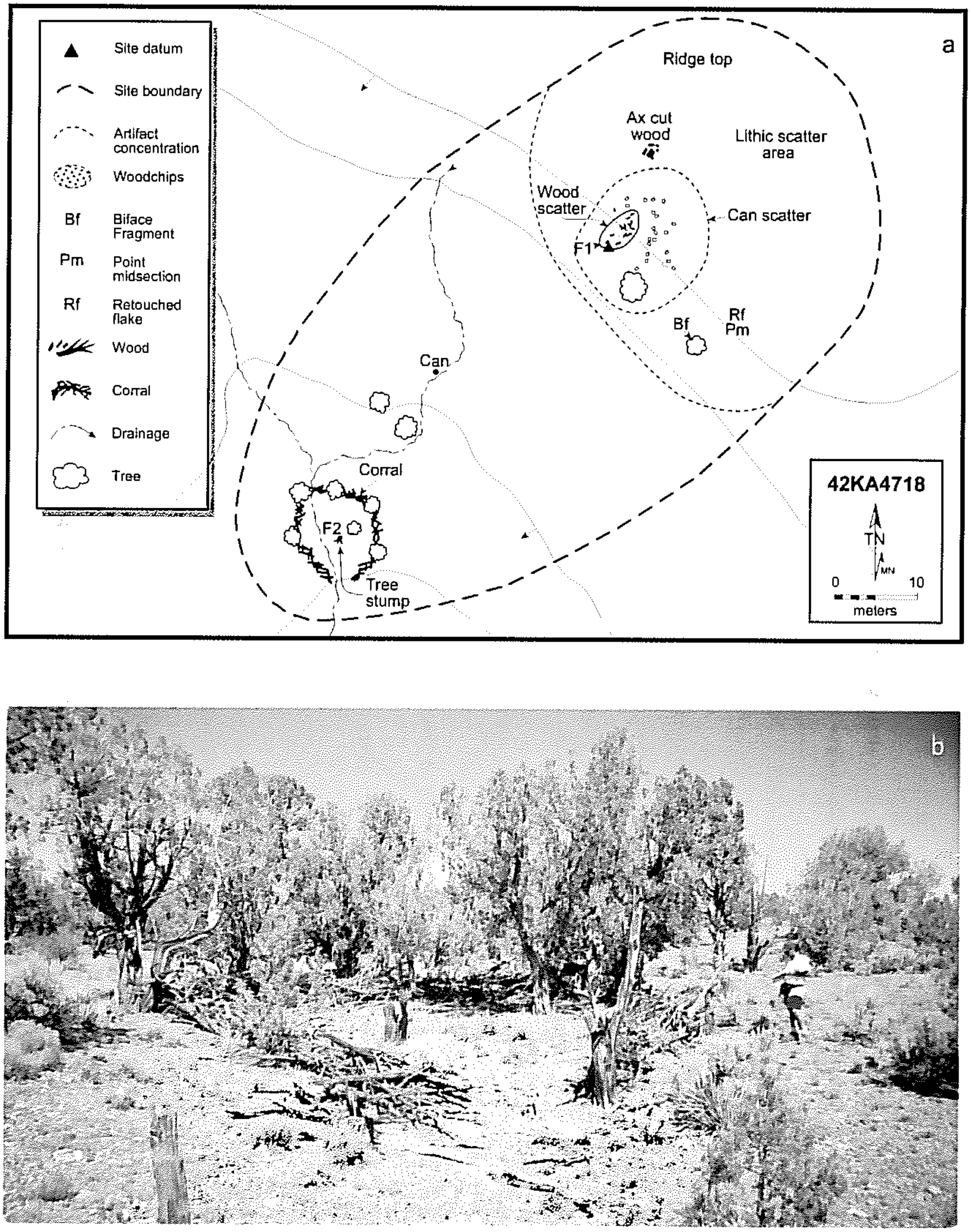


Figure 9.3. Site 42KA4718 on Horse Mountain: a) plan map of site; b) entrance to corral.

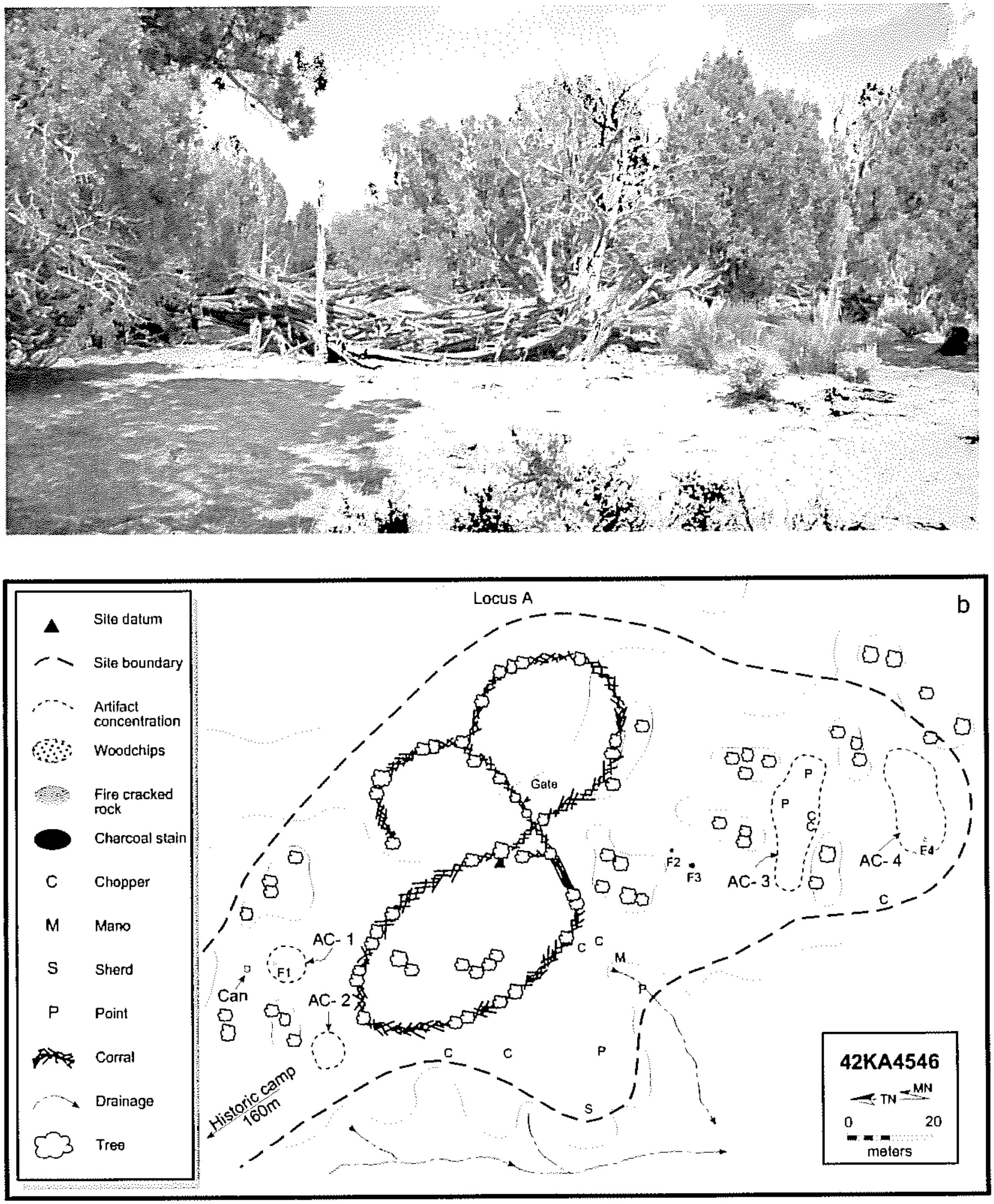


Figure 9.4. Examples of historic corrals: a) site 42KA4757 on Paradise Bench, showing construction of walls; b) plan map of 42KA4546 on Long Flat, with largest corral in project area.

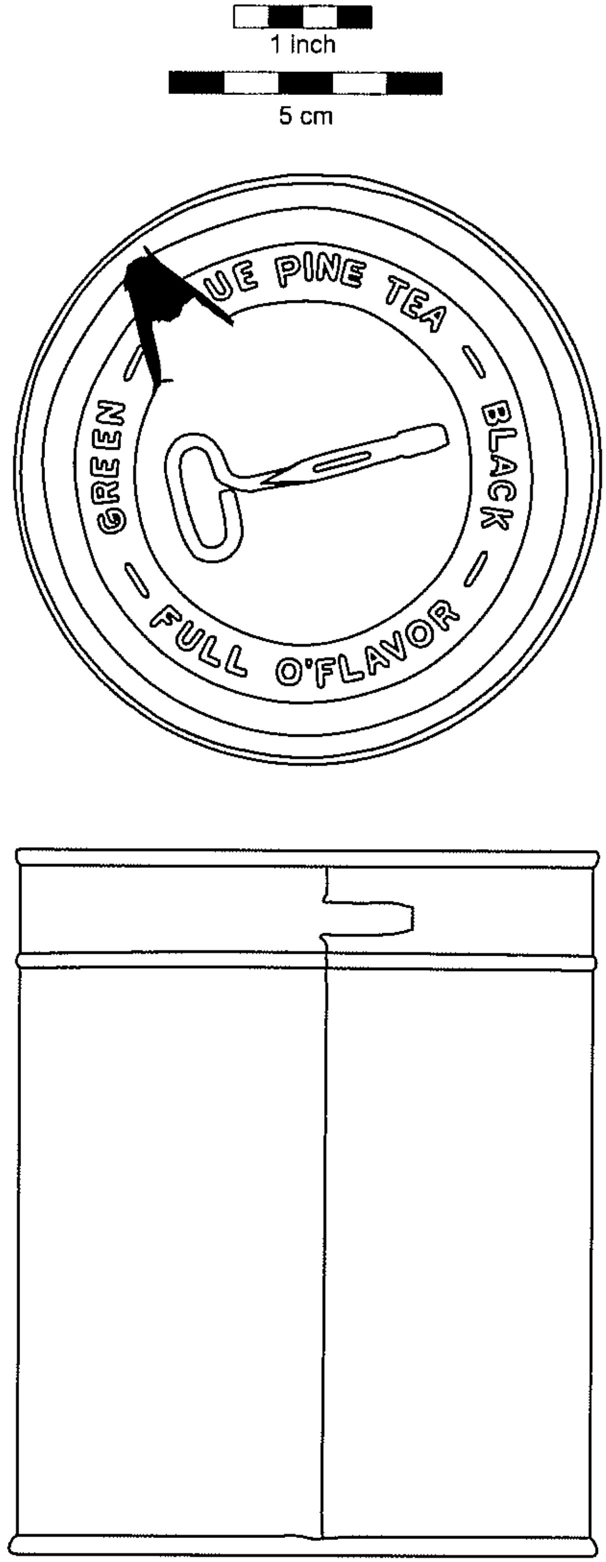


Figure 9.5. Intact tea can with key and score-strip lid, from site 42KA4848, a temporary historic camp on Paradise Bench.

is an airstrip that includes drainage culverts, a windsock, and a temporary airplane parking area. Reputedly there was a bar and pool hall on this bench (Douglas McFadden, personal communication 1999).

Long Flat

The largest number of historic sites recorded in any sample stratum occurred on Long Flat, and most are probably related to ranching activities. These 13 sites are representative of the types of historic manifestations found in most of the other strata, and include short- and longer-term camps and corrals. The largest corral in the project area was recorded at 42KA4546, which also contains a historic camp area with trash scatters and several loci of prehistoric artifacts. The corral consists of three lobes, two of which are completely enclosed and one that encloses roughly three-quarters of a circle (Figure 9.4b). The two closed lobes measure 58 x 33 m and 34 x 36 m; the partial lobe is 30 m in diameter. The corral is constructed of axe-cut pinyon and juniper branches and scavenged dead tree trunks and branches, which are stacked between standing trees (Figure 9.6a). One portion of the wall at the junction of the three lobes consists of large dead tree trunks stacked horizontally, held in place by upright posts and lashed with barbed wire (Figure 9.6b). At the eastern end of this wall segment is a small gate made of milled boards nailed to two tool handles, probably from axes. Only three cans were found adjacent to the corral, but approximately 160 m to the northwest are two can scatters and a woodchip concentration that mark the location of the associated camp. A slightly leveled and cleared area, situated in the shelter of a large sand dune and two juniper trees, was probably the location of a large tent. The 40–50 cans in the scatters include mostly milk and solid food types, as well as coffee and fish cans, meat cans from Brazil, and lard buckets. A few shards of clear glass are present. Milk cans date the site occupation between 1917 and 1929. This site is a good example of a substantial corral that is located away from any obvious water sources, a pattern noted throughout the project area. Surveyors did note that the area to the southeast of the site contained small drainages infested with tamarisk, evidence that these areas hold water intermittently and concentrate subsurface moisture. Perhaps in the winter or early spring, when cooler temperatures lessen evaporation, livestock could use these small depressions as water sources. The relative abundance of trash suggests that this site

Figure 9.6. Corral at 42KA4546 on Long Flat; a) detail of wall construction; b) wall construction at junction of three lobes.

was used for an extended period of time or by a large number of people, and the size and multiple lobes of the corral point toward an activity such as branding or inventorying livestock.

Another site with a well-preserved corral is 42KA4582. This camp contains a corral, a windbreak, a charcoal stain, a woodchip scatter, and a scatter of milk, food, tobacco, and coffee cans (Figure 9.7a). Both the corral and the windbreak are built of axe-cut juniper logs and branches piled between living trees. The corral has two lobes, one measuring 3 x 4 m and the other 5 x 8 m. Several axe-cut logs, probably used as seats, are arranged south of the hearth area, and two other axe-cut logs are adjacent to the woodchip scatter, which measures 8 m in diameter. Rusted milk cans indicate occupation between 1935 and 1945, and the number of cans suggests use for several days. The investment of time in construction of the corral and windbreak may indicate an intention to use the site during more than one season, perhaps while transferring livestock between grazing areas; this is equally true of the corral at 42KA 4546. There is currently little forage in the immediate vicinity of this site (although it was recorded during a wet year), but the riparian ecotone along Tommy Smith Creek lies less than a half-mile to the east.

Several historic camps on Long Flat retain evidence of tent construction, and 42KA4560 is a good example. It is situated on the east side of a gravel terrace, in a sheltered place with an eastern exposure, probably a pleasant spot on a windy day. A circle of stones lies between two small juniper trees, one of which had a limb removed with an axe. Within the circle of stones is a juniper log, about 2 m long, that probably served as a center pole for a tarp or tent, and the stones were evidently used as weights to hold down the edges. Artifacts associated with the site include a crushed metal wash basin, two fragmentary cans, two can lids (one embossed with CALUMET BAKING POWDER 6 oz. FULL WEIGHT ABSOLUTELY PURE), the neck and base of a small SCA patent medicine bottle, and several pieces of heavy-gauge wire, including one formed into a short handle. The bottle exhibits marks on the base consistent with manufacture by an Owens machine; the size and color indicate a manufacture date between 1909 and 1917. Actual site occupancy may date slightly later, considering the potential for reuse of the bottle. Two stone tools were noted on the site but they do not appear related to the historic camp.

Site 42KA4682 is a short-term camp that consists of a tent area and small trash scatter. The tent area, which measures 3.3 x 4 m, is delimited by clusters of 2–3 rocks at three corners and a scatter of juniper branch fragments at the southwest corner. An associated artifact scatter includes 10–15 milk and food cans and a bucket hanging from a nearby juniper tree. Milk cans were types manufactured between 1915 and 1930, but lying in the lower branches of the juniper tree is a piece of milled lumber inscribed with "Gates 1933." In addition to demonstrating the brief time lag that is likely between artifact manufacture and deposit in the archaeological record, the inscribed board provides good evidence for use of the area by residents of Escalante. The Gates family members were early settlers in that town, beginning with William Henry Gates in 1875 (Woolsey 1964:31), and it is likely that his descendants were using the benches around the Kaiparowits Plateau as livestock range.

Another brief camp is represented by site 42 KA4667, where three juniper branches supported a tarp or tent. The three branches remain within a small grove of living juniper trees on a flat alluvial terrace. Three milk cans and one food can scattered nearby place the occupation between 1908 and 1914. There is no evidence of a hearth or wood-chopping area. Yet another small camp dating between 1908 and 1914 (42 KA4679) was recorded on a sandy rise on the west side of Long Flat. A single milled board, nearly 8 feet long, is attached with wire to a juniper tree, and probably once supported a tarp or tent. Five food and milk cans indicate that the site was in use long enough for only a meal or two, and a coffee can suggests that the occupant was perhaps not a devout Mormon.

Another short-term camp on Long Flat is 42KA4577, where a "sittin' log" was constructed by lashing a juniper log to two living juniper trees. The axe-cut log, nearly 2.5 m long, is lying on the eastern side of the juniper trees to which it was originally attached (Figure 9.7b). A possible hearth area is situated just east of the bench. Sparse artifacts scattered toward the east along a small wash include several pieces of SCA glass from a single screw-top jar, a zinc jar lid with fragments of the milk glass interior, one flattened can, a piece of milled lumber attached to a wire loop, a belt buckle, one trouser rivet, and several fragments of bailing wire, barbed wire, and metal. The fully machine-made SCA glass jar was manufactured between 1903 and 1917, although reuse of the

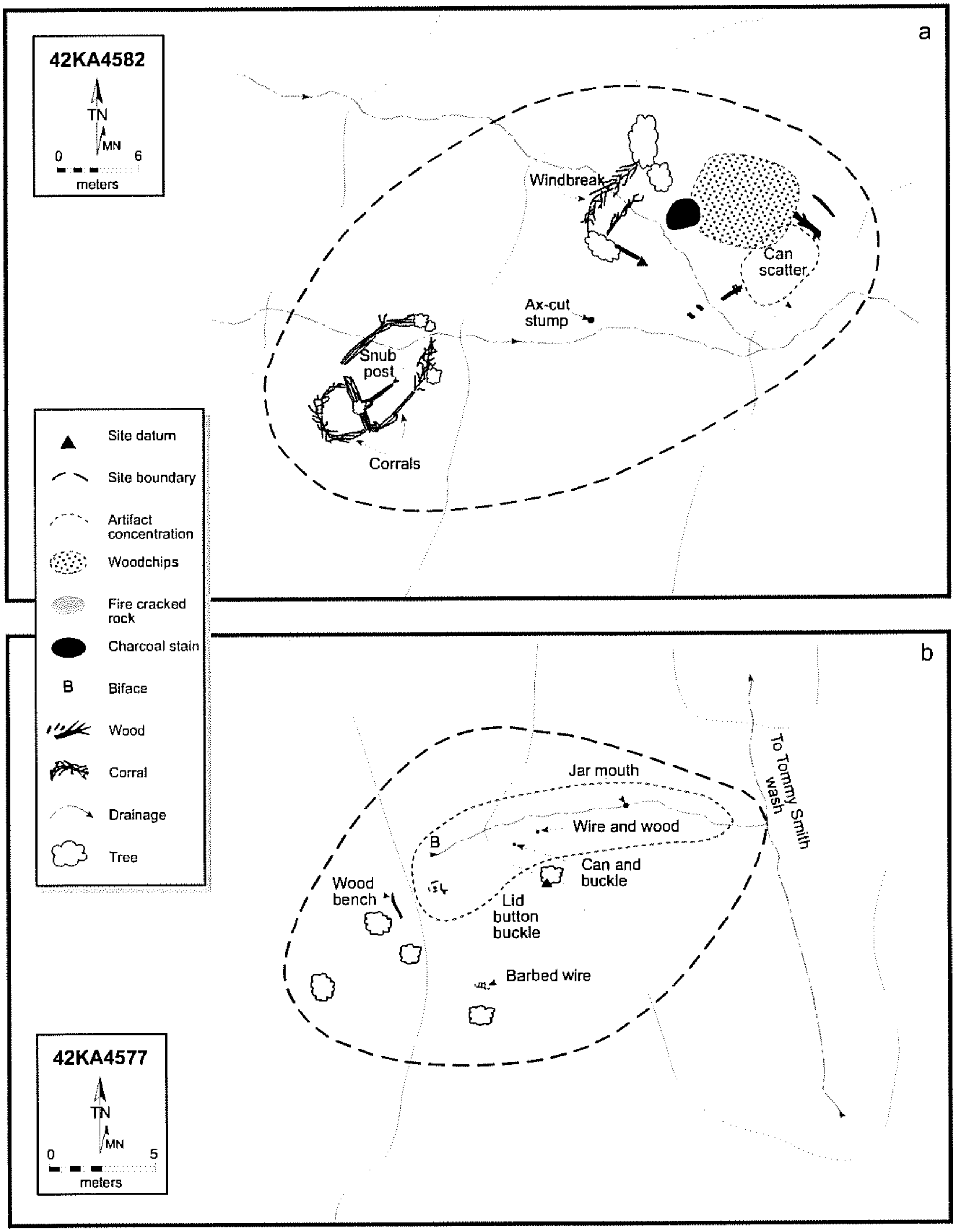


Figure 9.7. Plan maps of historic sites on Long Flat: a) corral and associated camp at 42KA4582;b) temporary camp at 42KA4577.

bottle could place site occupation slightly later. A temporary camp consisting of just a small woodchip scatter and a few milk and food cans was designated 42KA 4623. There is no evidence of a tent area, although it is possible that some type of expedient shelter was erected. There is also no evidence of a hearth, but the presence of the woodchips suggests that a fire was built for cooking or warmth. This site was occupied between 1920 and 1930.

Two concentrations of historic artifacts at 42KA4572 are dwarfed by the surrounding prehistoric site, which covers the entire ridge overlooking Tommy Water Spring. One activity locus has a surface concentration of charcoal chunks and fire-cracked rock associated with quartzite flakes and several SCA glass fragments from a single bottle. The bottle was manufactured with a semiautomatic machine between 1881 and 1917 but its deposit at this location could have occurred after this interval. Surveyors were uncertain whether the thermal feature and flakes are related to the prehistoric occupation of the site or whether this locus represents a rare historic Paiute camp. The other historic locus at 42KA4572 is a small concentration of milk and food cans that lies 110 m northeast of the hearth and glass scatter. None of the artifacts could be measured to provide an accurate temporal assignment. The cans are adjacent to a two-track road, but the age of the road is unknown; it is possible that the cans were dumped from a passing vehicle. The ridge is a good camp location, as demonstrated by the presence of several recent campfires, including one built by the surveyors. A cinder-block line shack lies at the base of the ridge, just across the wash from Tommy Water Spring.

Two separate historic occupations are also evident at 42KA4680. The earlier component, produced between 1908 and 1914, consists of 10–15 milk, food, cocoa, and baking powder cans and 7 (carbon?) battery cores. The latter implies an overnight stay that required an electric lamp, but the use was probably restricted to a single night or possibly two. There is no evidence of a hearth or tent area associated with the earlier trash scatter. The second occupation of the site was of much greater duration and represents one of the largest historic sites, in terms of artifact density, in the entire project area. More than 100 cans form a scatter that extends downslope from the main camp area, which contains a tent site, a hearth, and a woodchip scatter. A large central juniper tree provided shelter and support for a tarp or tent, and three branches were removed from the east side of the tree to enlarge the sheltered area. A few axe-cut logs are present but none are long enough to be tent poles, so perhaps they were used as seats or for firewood. Cans in the main scatter contained milk, food, fruit, meat, fish, coffee, lard, spices, and tobacco. Other artifacts include two loops of wire, the remains of a wooden crate that may have held perishable food or canned goods, and a complete bottle that contains lumps of dried organic substance, probably the residue of the original liquid contents. The second occupation took place between 1917 and 1929, and may represent a base camp for ranching activity in the area, perhaps through multiple seasons. It is somewhat surprising that no corral exists near the site, as the trash is comparable in type and greater in quantity than at the camp at 42KA4546, on the opposite side of Long Flat.

Another example of a camp that was probably used repeatedly is 42KA4776. Artifacts at the site include 15 to 20 milk, food, tobacco, baking powder, and coffee cans, a Mason jar lid, fragments of green, clear, white (milk), and SCA glass, one complete and one broken horseshoe, and most of a leather lace-up boot and sole. A number of cans also occur at the base of the small ridge that contains the site. Based on milk can type and maker's marks on glass shards, the site was occupied at least two times, the first in the late 1910s or early 1920s and again in the early 1940s. The site also exhibits a tent area, marked by small clusters of quartzite cobbles arranged in a rectangular configuration adjacent to a juniper tree. The tent site measures approximately 4 x 6 m and the tree has axe-trimmed branches on one side to clear the lower portion. Nearly 35 m southwest of the tent site is a cluster of four large quartzite cobbles of unknown function, but that were clearly placed at that location intentionally. A few flakes and a sandstone cobble mano noted on the site are related to ephemeral prehistoric use of the ridge.

Site 42KA4593 is a camp area within a small southeast-facing rock shelter (Figure 9.8a). The only associated feature is a charcoal stain at the mouth of the overhang, probably the remains of a campfire. Several axe-cut logs are beneath the overhang, behind the charcoal stain, evidently used for seating around the hearth. Two inscriptions on the cliff wall within the shelter demonstrate use of the site at least twice during 1938, and it is possible that the site frequently provided an overnight camp for cowboys in the area. Its protected location and proximity to Wahweap Creek,

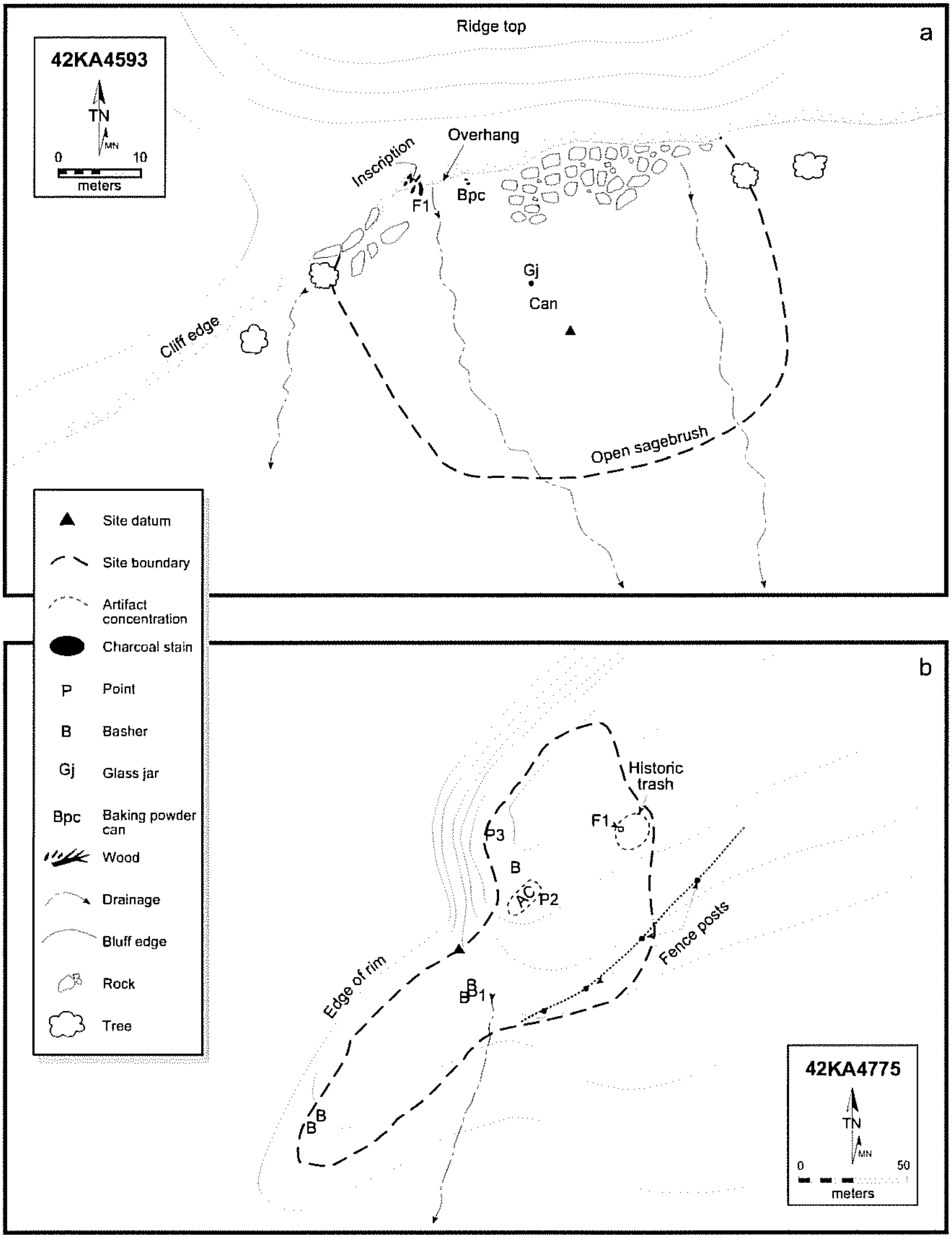


Figure 9.8. Plan maps of historic sites 42KA4593 and 42KA4775, on Long Flat: a) camp and inscriptions within small rockshelter, b) possible range fence and associated camp.

just 300 m to the south, would make it an appealing camp. The large number of artifacts, including more than 40 milk, food, meat, lard, baking powder, and tobacco cans, and a screw-top glass jar, suggests substantial, and probably repeated, use of this location. Surveyors noted that this site confirmed the accuracy of the milk and baking powder can dating systems, because the milk can date is 1935–1945, the baking powder can date is 1938–1939, and two inscriptions verify use in November and December of 1938.

The only historic range fence recorded in the project area is at 42KA4775, where three standing juniper fence posts form a roughly straight line along a narrow ridge (Figure 9.8b). The axe-trimmed posts are widely spaced over a distance of more than 130 m. The posts do not form an enclosure such as a corral, but apparently are part of a drift fence or grazing area boundary fence. The fence line begins near the point of a ridge overlooking Wahweap Creek and runs northeast along the ridge. Additional posts were probably present when the fence was in use, because the remaining posts are so far apart that they would form a rather flimsy fence. Several trees along the fence line have been axe trimmed on the side where the fence wires would have passed. Associated with the fence posts are an area of charcoal-stained soil mixed with charcoal chunks and a scatter of historic artifacts, including milk, food, spice, tobacco, and baking powder cans, a jar lid, and green glass jar fragments. The trash may signify that the fence builders spent a night at this location, and milk cans date the camp to between 1915 and 1930.

Horse Flat

The only historic site recorded on Horse Flat is 42KA4589, a short-term camp. The site consists of two milk cans, five tobacco cans, and a lard pail with a handle. The milk cans indicate that the camp was occupied between 1915 and 1930, contemporaneous with sites in other survey strata. The cans are situated around a large juniper tree, which would have provided pleasant shade. There is no evidence of a tent site or hearth, but the number of cans suggests an overnight stay, rather than just a lunch stop. An extensive prehistoric lithic scatter surrounds the small historic trash scatter.

Fourmile Bench

We recorded several historic camps on the northwestern edge of Fourmile Bench, all related to ranching activities in the first four decades of the last century. These sites are all located on the slopes of sandy ridges on the bench above Fourmile Canyon, and all exhibit the same suite of artifacts. They represent the debris from single-night camps for lone cowboys, as well as the more abundant trash associated with a longer stay, probably by a small group. Site 42KA5480, located along the crest and upper slope of a sandy ridge, contains debris associated with three episodes of use. A prehistoric artifact and burned rock scatter represents a processing area for plant resources. There are two historic artifact concentrations, representing two separate camps, at opposite ends of the site. At the west end of the site is Artifact Concentration 1, which contains a milk can, two small sanitary cans, and three Mason jar fragments. Based on the milk can, these items were deposited between 1903 and 1914. AC1 is separated by 90 m from the larger historic artifact concentration (AC2) that contains milk cans dating to 1917–1929 and 1930–1975, so probably represents activity right around 1930. AC2 includes 25–30 cans that held milk, vegetables or fruit, meat, Velvet tobacco, cocoa, coffee, and baking powder, a few pieces of wire, and a metal buckle. Fragments of a small patent medicine bottle with an embossed panel were also found. This artifact was probably produced prior to 1915, but could have been reused after the original contents were gone. Several branches were removed from a large juniper tree with an axe, perhaps to clear an area for a tent or tarp shelter. Small axe-cut branches lie on the ground in this area, but there is no evidence of a hearth.

A small camp designated 42KA5482 lies on the southwest slope of a small sandy ridge, just a half-mile from Fourmile Water spring. The location offers a great view to the west, and the site would have been pleasant in the late afternoon sun on a cool day. The artifact assemblage consists of a glass canning jar (broken into 20–30 pieces), a few small pieces of wire, a gas or kerosene can, and 10–15 milk, food, cocoa, and tobacco cans. All of the cans are rusty and most are crushed, but one intact milk can gave a date of 1903 to 1914. A main branch was removed from a large juniper to the south of the artifact scatter, possibly for erecting a tent or tarp shelter. Based on the number of cans at the site, the camp probably represents a stay of a few nights for one person, or a single night's camp for several people.

Situated on an east-facing ridge slope, 42KA 5488 represents two temporary camps, one prehis-

toric and one from the early twentieth century. Artifact Concentration 2 contains a coffee pot lid and seven food and milk cans scattered along the sandy slope. All items are rusted and most of the cans are crushed. There is no evidence of a tent area, so the historic use was probably during the warm season; milk cans indicate an occupation between 1917 and 1930.

At 42KA5489, there is a small hearth near a ridgetop but most of the artifacts are dispersed down the ridge slope. The artifact assemblage consists of 10–15 cans that held milk and solid food, a tobacco can, the pry-out lid of a square cocoa can, and a bullet casing that was manufactured between 1911 and 1960. Two milk can types are present, both manufactured between 1917 and 1929. Food cans comprise both sanitary and hole-and-cap types; the latter were not manufactured much past 1920, so the site probably dates to the late 1910s or early 1920s. The hearth is a concentration of axe-cut juniper branches, most of which are partially burned as though being fed into a fire, but there is no intact charcoal on the surface. A nearby juniper tree has several branches removed with an axe, resulting in an area that could have sheltered a tarp or tent. A few white chert flakes present at the site are related to the prehistoric artifact scatter at 42KA5490, which is just 40 m to the south.

Smoky Mountain

The sample units on Smoky Mountain contain numerous small historic camps, the second highest concentration on the Kaiparowits Plateau Survey. Most of the sites are related to ranching activity, and probably reflect temporary camps used by cowboys on the range. The most extensive historic camp is at 42KA5318, situated at the west edge of an extensive prehistoric habitation. The historic component consists of a scatter of cans and bottles associated with a hearth and a probable windbreak wall in a sheltered overhang on the southeast side of the sandstone outcrop (Figure 9.9a). Artifacts include a wash basin, two bottles, 25–30 cans that held food, milk, coffee, and Velvet tobacco, and a piece of drywall lying within the alcove. The artifact assemblage indicates occupation between 1917 and 1930. Three pieces of wire made into double-pronged hooks hang from a juniper branch wedged into the rock within the alcove, forming a convenient place to hang clothes or bags (Figure 9.10a). Feature 2, just in front of the small shelter, is a probable hearth with charcoal and fire-cracked rock exposed on the surface. Feature 3 is a windbreak wall built with axe-cut juniper branches and dirt piled against the base of the wall to a height of about 5 cm. The windbreak is nearly 6 m long, beginning at the back wall of the shelter and extending out to the small drainage in front of the outcrop (Figure 9.10b). A juniper tree south of the alcove has branches removed with an axe, and may have been the source of most of the branches used in the windbreak. The size of the hearth, number of cans, and modifications to the shelter suggest that the camp was occupied for more than just a few nights, and perhaps served as a base camp.

The camp at 42KA5310 is on the crest and southeast slope of a ridge, with a spectacular view toward Fiftymile Mountain and Navajo Mountain and relatively easy access into both Warm Creek and Last Chance Creek. The large number of artifacts suggests occupation by several individuals, perhaps for several days. The artifact assemblage includes approximately 75 rusted cans, 2 bottles, milled wood that was probably part of a crate, a galvanized metal bracket, a double-edged razor blade, 4 horseshoe nails, 3 wire nails, a .22 rim-fire bullet case, a washer, and a rivet. Feature 1 is a burned area that measures 1.5 m in diameter. There is no intact charcoal on the surface, but the sand is quite black and has a slightly ashy texture. Most of the small hardware is within the Feature 1 area, probably tossed into the fire for disposal. The majority of the milk cans date between 1935 and 1945, and the others have a broader but overlapping span (1930–1975); the result is a probable date between the middle 1930s and late 1940s. A maker's mark on the base of a small medicine bottle indicates manufacture between 1916 and 1929, but this container could have been reused after the original contents were gone. There are also three aluminum beer cans that are faded but readable and probably relate to more recent activity.

Smaller camps, probably occupied for just a few nights, are more common on Smoky Mountain. Site 42KA5306 (Figure 9.9b) consists of 25 scattered cans that held food, milk, coffee, and tobacco, a mustard jar, and a medicine bottle. All cans are rusted but most are intact except for being flattened by livestock. The assemblage documents use of the area between 1935 and 1945. A juniper tree at the northwest edge of the site has six small branches removed with an axe to form a sheltered area within the tree canopy, which may have served as a tent or lean-to area. A tree east of the main can scatter has two large and four smaller branches removed with an axe, perhaps also for

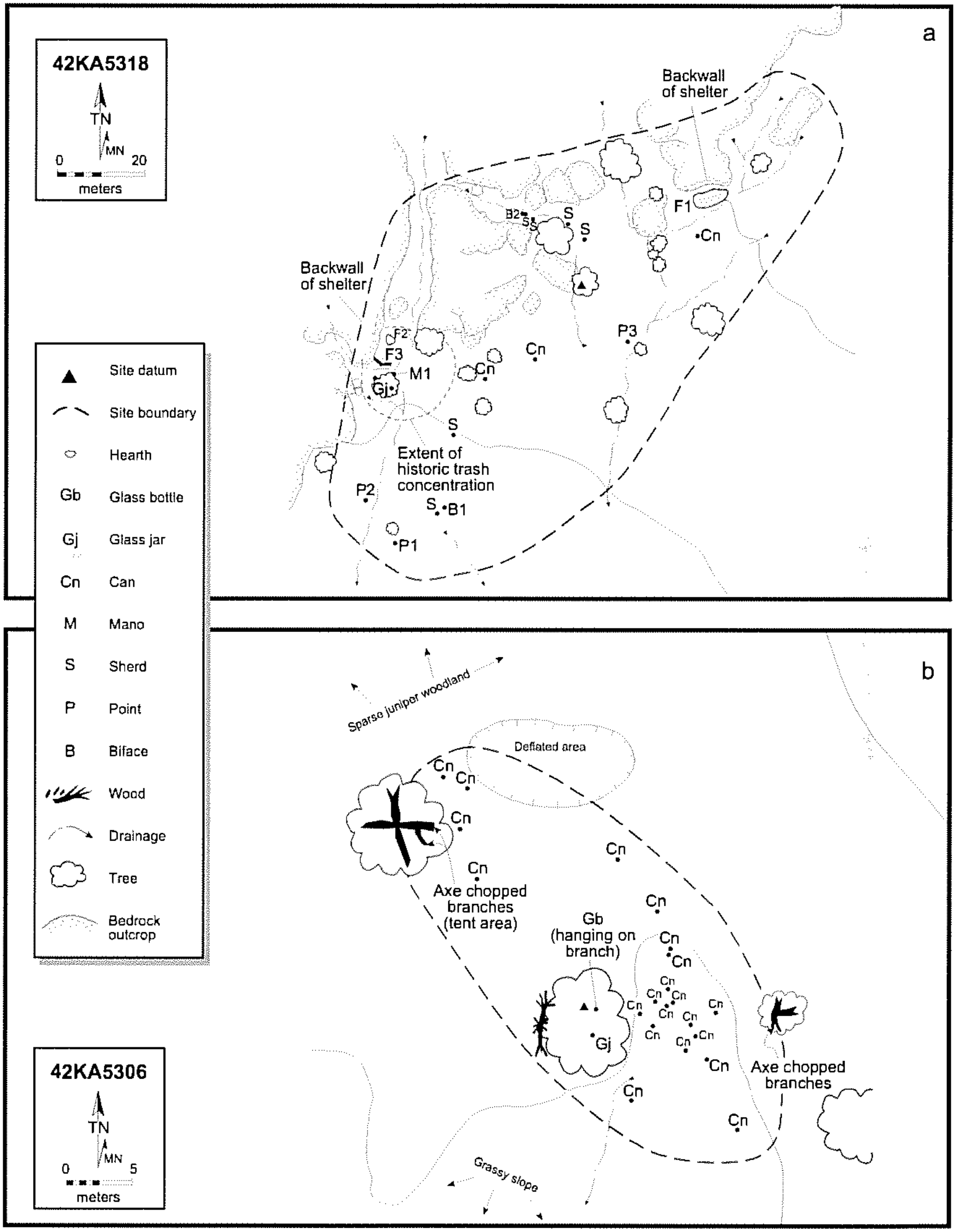


Figure 9.9. Plan maps of historic camps on Smoky Mountain; a) sheltered long-term camp at 42KA5318 with features and artifact scatter, b) short-term camp at 42KA5306, an artifact scatter with possible tent area.

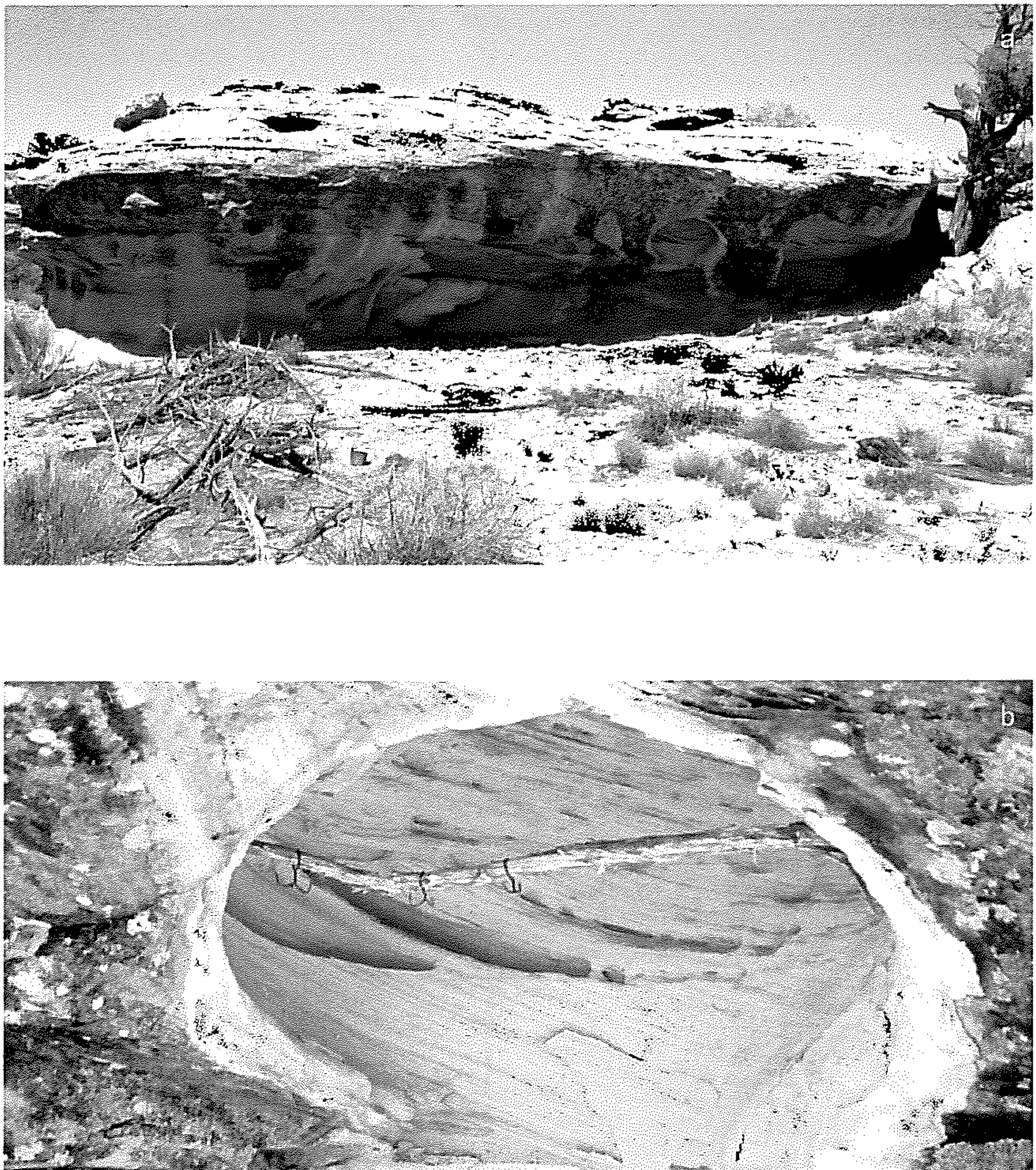


Figure 9.10. Historic component at 42KA5318, on Smoky Mountain: a) low shelter containing historic camp, with wind break wall along south end, b) juniper branch with wire hooks, wedged into ceiling alcove of shelter (note alcove in overview photo, above) .

tent construction. Several axe-cut branches are lying within the artifact concentration, but there is no evidence of a hearth.

Site 42KA5313 is situated on the main ridge along Smoky Mountain, with an excellent view to the east and southeast of the Burning Hills, Fifty-mile Mountain, and Navajo Mountain. The site consists of a small dense concentration of nine rusted milk and food cans, with an additional few cans and lids beyond the concentration. There is one lid from a Blue Pine Tea can, opened with a score strip (compare with 42KA4848 on Paradise Bench, Figure 9.5). Although there are axe-cut juniper branches on the site, there is no evidence of a hearth. Three sizes of milk cans offer complementary dates for use of the site, between 1917 and 1930. The open camp designated 42KA5353 consists of several cans and a few axe-cut branches, located on a slight rise near the canyon rim above Last Chance Creek. The five cans contained fish, vegetables or fruit, milk, and tobacco. The milk cans suggest use of this site between 1915 and 1930, and the sparse cans point to just an overnight stay. Indeed, more tobacco was consumed than food. The camp location, out in the open without tree cover, suggests use during a cool time of year when shade was not important. Given the exposed setting, though, it must have been a calm night.

Site 42KA5359 is a camp situated just south of a small drainage that leads into Smoky Hollow. There is a sparse scatter of cans, some axe-cut wood, a few cow bones, and four rock piles that doubtless served to hold down tent corners (Figure 9.11a). There is a small wood pile near the center of the tent area, so the tent was probably floorless, and the wood put there to be kept dry. Artifacts include 15 milk and sanitary food cans, a coffee can, and a Planter's Peanuts can. Also at the site are one mule shoe and a few flat thin milled boards, probably the remains of a crate. A hearth is indicated by a small area of charcoal and charcoal-stained soil, situated directly east of the rock piles, probably just out the front of the tent door. Judging by the number of cans and the presence of a hearth, this appears to be a short-term, cool-season campsite. Milk cans indicate occupation between 1935 and 1945.

Site 42KA5360 is a small scatter of cans around a hearth, which was built against a small bedrock ledge along a drainage that leads into Smoky Hollow. A flat sandstone outcrop north of the hearth may have been used for sleeping (tent or simply bed rolls). A nearby juniper exhibits a few axe-cut branches that probably provided fuel for the hearth. The 12 cans found on the site consist of hole-and-cap types used for solid food (in two different sizes), milk cans, and one cocoa (?) tin with a pry-out lid embossed with "Caro." There is also a .22 long rim fire Winchester cartridge. The sparse cans and the presence of a hearth denote this as another short-term camp. Its location suggests use in cooler months when tree shade was not important. The cans date the camp occupancy between 1915 and 1930. In addition to the historic remains, the site contains a sparse scatter of fewer than five flakes along the wash, the typical "background noise" of prehistoric artifacts. A Pinto point might be part of the background scatter or an item that the cowboys collected and left behind.

A scatter of historic artifacts marks the camp at 42KA5398, with a smaller concentration of recent trash near the northwest edge of the site. Locus B, the historic camp area, contains about 10 milk and sanitary food cans; the milk cans suggest occupation in the 1920s. Feature 1 is a collection of sandstone fragments, in one instance two slabs piled on top of each other, that may delimit a tent or tarp shelter area. The more recent Locus A contains an aerosol can, 25 milk and sanitary food cans, a Hershey's cocoa can, aluminum fish cans, and a plastic button, remains of a camp that dates to the 1960s or 1970s. Another small camp was documented at 42KA5397, where an artifact scatter contains three rusted food and milk cans and a few shards of milk glass, probably from the interior liner of a zinc canning jar lid. One of these shards appears to have been flaked on one edge, but does not appear to have been used as a tool. Sandstone slabs delimit a camping area against a juniper tree, within which may have been a tent or tarp shelter. An axe-cut log leans against the adjacent juniper tree. Based on the milk cans, activity at the site occurred between 1915 and 1930.

The only historic corral on Smoky Mountain was documented at 42KA5361, within a small U-shaped embayment defined by sandstone outcrops. Sandstone walls of the embayment provide three sides for the corral. The open north side is blocked by a fence built of juniper branches, which extends for 28 m between sandstone outcrops (Figure 9.11b). The wood is weathered and degraded but most of the fence is still visible, though not standing in a functional sense. An outlet at the back end (south side) of the bedrock embayment is blocked with a juniper branch wall measuring 3.5 m long, and a few other small openings are also plugged with branches. The corral measures about 30 m in maximum length by 26 m in maximum

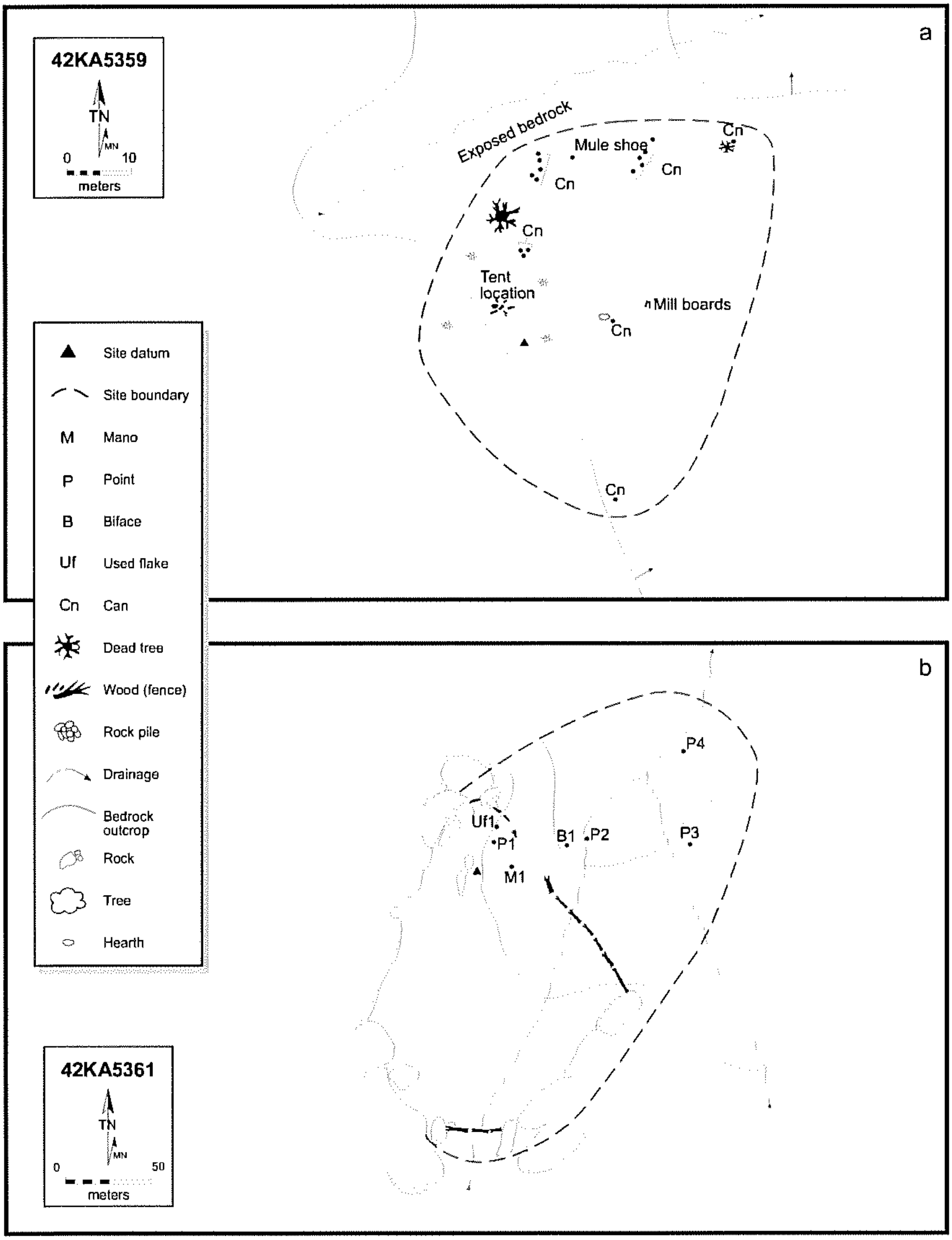


Figure 9.11. Plan maps of historic sites on Smoky Mountain: a) a short-term camp at 42KA5359, with rock piles to stabilize a tent; b) corral in rock embayment at 42KA5361.

width, providing a sizable space to contain animals. There are no historic artifacts within or around the corral, just debitage, flaked stone tools, and a mano from Archaic use of the setting. An unrecorded historic camp lies on the ridgetop south of the corral, outside of the survey area, and the corral is probably associated with this camp. Based on the degree of wood degradation and the remains seen at the nearby historic camp, it seems likely that the corral was used sometime between the 1910s and 1930s.

Brigham Plains

Sample units on Brigham Plains contained three historic sites, including one with several inscriptions but few artifacts. Site 42KA4637 contains three inscriptions forming two panels on a rock face, which were created over a period of 12 years. Panel 1 has inscriptions by Art Chynoweth in 1919 and S. T. Graff in 1931, with an additional section of unreadable script to the right (Figure 9.12a). Panel 2 contains a single inscription by Elmer Smith in 1927 (Figure 9.12b). The panels are etched into the base of a sandstone outcrop and are separated by 70 m. In front of the cliff face is a sparse lithic scatter, but two small can fragments are the only historic artifacts at the site.

A brief camp is represented at 42KA4695, where a few cans are concentrated around a scatter of burned wood and small charcoal chunks, the remains of a surface hearth. Charcoal pieces are also present within a small woodchip scatter and several axe-cut stumps are near the site. Artifacts include a galvanized metal washtub, the lid to a large can, and milk and tobacco cans. Milk cans offer evidence that the site was used between 1915 and 1930, probably as a single night's camp. Another small camp, designated 42KA4707, consists of a few cans and a possible tent site beneath a juniper tree. There is a slightly leveled area next to the tree, which has several small branches removed with an axe. One associated axe-cut juniper branch may have served as a support post for a tarp or tent, or to stabilize the tent base. Two copper fasteners were found beneath the juniper tree. Associated milk cans suggest two uses of the site, one between 1915 and 1930 and another between 1935 and 1945. Both uses must have been quite brief, as the total artifact assemblage at the site consists of only 25–30 milk, food, and sardine cans.

Insight into historic activity besides ranching may be offered by a small camp at 42KA4704, the only historic site on Jack Riggs Bench. The site is situated directly west of a brass cap at a benchmark. Because the milk can dates for the site are 1915 to 1930, it is quite possible that the camp was used by members of the U.S. Geological Survey party that placed the benchmark in 1917. The site consists of about 10 milk and food cans, a piece of boot rubber, and a possible tent area. The tent site lies just east of two juniper trees and contains a 1.5-foot length of stove pipe and a few pieces of axe-cut wood, including one 6-foot-long post, perhaps used to support a tarp or tent.

Nipple Bench

A single historic activity area was recorded on Tibbet Bench between Tibbet Canyon and Clints Canyon. The scattered artifacts consist of six rusted food and milk cans that have been dispersed along an eroded slope. The cans are surrounded by a large, sparse scatter of flaked stone debitage and tools; both components are part of the site designated 42KA5492. All of the cans are heavily rusted and most are crushed. The small assemblage probably represents a brief camp or perhaps just a rest stop for a meal; milk cans indicate use between 1917 and 1929. A permanent line camp at Tibbet Spring, just over a mile to the south, provides additional evidence of historic use of this area by ranchers.

HISTORIC ISOLATED OCCURRENCES

In addition to the Euro-American sites located during the survey, 62 historic or recent isolated occurrences (IOs) were also recorded. The IOs are described in Table 9.3, grouped by survey sample stratum. In many cases these resources are similar in content to the historic sites, but represent a more limited activity locus. For example, historic inscriptions were recorded as IOs when there were no associated artifacts or features; these comprise four of the isolated resources and are discussed in detail in the following section. Many of the IOs are small scatters of historic trash, especially cans, which are probably the remains of "lunch camps" used during a single brief episode. These scatters are typically situated on ridgetops or other high points with a view of the surrounding terrain. Perhaps the occupant was assessing topography in search of a camp for the night, or keeping watch over livestock in the area. None of the can scatters is associated with a definite hearth, although a few contain axe-cut tree branches. Other isolated artifacts documented during survey include occasional horseshoes, attributable to sporadic use of the area by cowboys or other travelers, a cow or sheep bell, and two 55-gallon barrels cached next to a

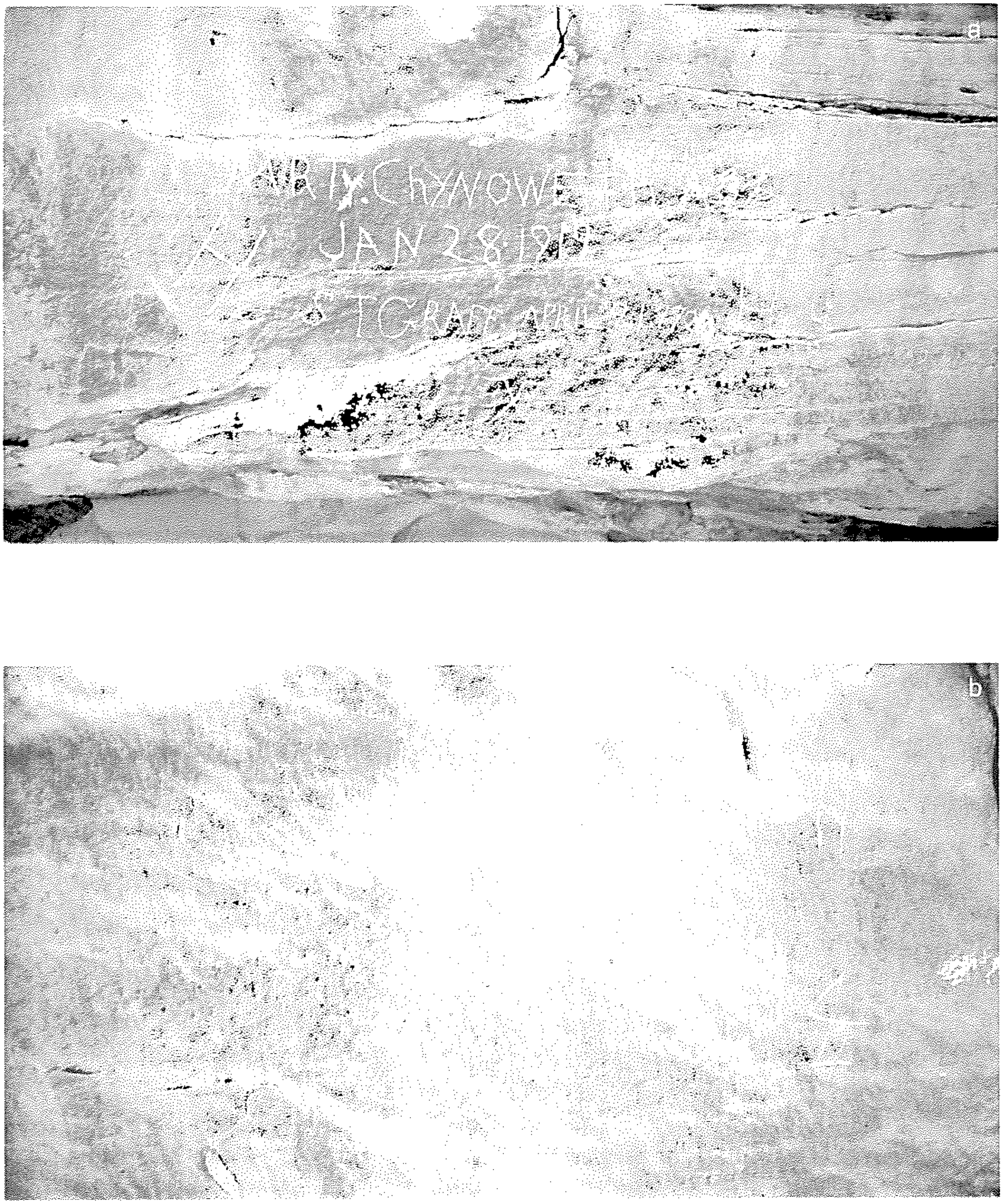


Figure 9.12. Historic inscriptions at 42KA4637 on Brigham Plains: a) panel 1, the stylized "X" is the brand used by Samuel Traugott Graff; the "H" may also be a brand; b) panel 2, created by Elmer Smith in 1927 with marks at right and left that may be brands.

Table 9.3. Description of Euro-American isolated occurrences (IOs) from the Kaiparowits Plateau Survey.

IO number	IO Description
Collet Top	
568	Surveyor's blaze on pinyon tree, probably from 1922, since it occurs next to a quarter-section marker with that date. Blaze reads "132 (next line) B ?"; it is partially grown over by bark.
575	Collector's pile of 4 artifacts: a stage 5 reworked biface of heat-treated Boulder jasper, 2 heat-treated petrified wood flakes, and 1 chert flake.
803	4 flakes and a modern camp fire with cans in it; debitage is 1 metasediment cobble chopper refurbishing flake, 2 chert core flakes, and 1 biface thinning flake.
829	2 axe-cut juniper logs in a small rock shelter; no artifacts are present, but logs must have been brought to the shelter.
847	4 hole-and-cap milk cans (Type 6; 1903-1914), 2 sanitary food cans, 2 pieces of wire, 1 piece of axe-cut wood.
878	A small shelter in a drainage with recent one-person camp comprising a hearth and deflector slab and a wood pile; adjacent shelter has two large upright slabs covering the opening.
883	Small shelter with recent hearth and firewood.
888	Modern collector's pile: 6 flakes of various materials plus a biface fragment laid out on a stump.
Horse Mountain	
163	Complete sheep or cow bell on steep rocky talus slope.
241	1 can: "Calumet Baking Powder Absolutely Pure" and "6 oz full weight" embossed on lid.
Long Flat	
19	2 cans and 1 horse (?) shoe wired together to make a noise maker.
23	Scatter of 6 milk cans on cobble-covered slope.
29	5 milk cans (Type 7?; 1908–1914), 3 hole-and-cap food cans, 1 square half-gallon can; all cans opened with a knife.
30	2 milk cans, 3 sanitary food cans, 1 baking powder can (16 oz), 1 hole-and-cap food can, 1 spice can, 1 zinc insert from a jar lid, 1 fragmentary milk glass jar.
34	Solder-dot milk can next to drainage.
53	Upright sandstone slab with inscription: HOMER S DIED OF LOCO WEED 11 97; slab situated at end of soil mound ca. 1.2 m x 50 cm; possible animal burial?
54	Broken portable latrine, fragments of lumber and various pieces of galvanized metal; appears to have been dumped at this location; ca. 1950–1970.
69	Rebar marker, wooden stake, 1 food can and 1 tobacco can; survey station?
71	1 can (opened with can opener) and stack of logs (chainsaw cut); perhaps remains of a corral or fence?
72	Inscription on rock face: W CLARK JAN 26, 1930 ALL IS NOT GOLD THAT GLITTERS
73	Modern cobble-lined hearth; built 1970s–1980s?
127	Inscription on sandstone face, north bank of Blue Wash: SEARS WILLIS NOV 24, 1914; EDSON ALVEY JAN 20.
246	Gasoline can and several wood posts with attached wire, probably formed enclosure against a low cliff.
247	Recent surface hearth being eroded by pour-off, some wood but no associated artifacts; temporary camp under overhang?
248	Temporary camp with recent trash and charcoal pile, plus some historic cans and milk glass; just outside unit.
Fourmile Bench	
512	Remains of a campfire associated with 3 potted meat cans, 3 juice cans, 1 sanitary food can (1950s-60s).
519	Bladed area around a coal exploration drill hole, marked with a metal pipe inscribed "EPNG NW / 18 40 & 3E"; possible campfire burn to south of pipe.
616	Rock cairn on edge of canyon; 9 rocks piled to 1 m high by 1.5 m diameter, no associated artifacts. Could be surveyor's marker, because it's along the quarter-section line.
853	1 extra-large horse shoe with nails.
912	An "Apollo Mark II" winding alarm clock of yellow plastic (now faded) with metal hands and a separate small sweep hand (time is 1:20).
936	9 tall cylindrical cans with friction lids that held linagraph film (1 has paper liner inside); 14 Kodak Linagraph Fixer cans with pry-out lids; 21 Kodak Linagraph Developer cans with pry-out lids; remains of developing film from seismic line studies of subsurface coal deposits.

Table 9.3 (cont)

IO number	IO Description
Smoky Mountain	
636	1 milk can (Type 19; 1930-1975); 1 sanitary food can, 1 15" bow saw blade; 1 key-strip lid for "BLUE-GREEN-BLACK PINE TEA", and a juniper tree with axe cut limbs; 80 m north of 42KA5310.
638	4 white chert flakes; 1 squashed milk can within 70 m area.
651	U.S. Government vehicle license plate (#A155047), in small canyon west of Wesses Canyon.
664	3 milk cans (2 are Type 9; 1915-1930; 1 is Type 19; 1930-1975).
667	Complete H.J. Heinz ketchup bottle, style dates to 1893-1947, probably from later part of range.
712	1 sanitary can with both lids cut off to make an open cylinder.
713	2 hole-and-cap milk cans (Type 6; 1903-1914) and an axe-cut juniper log.
714	1960s camp with glass jars, food cans, woodchip pile, wooden crate, donkey dung (perhaps dates to 1958, which is the date on the nearby quarter-section marker).
719	Can and glass scatter outside of survey unit: 1 spice can, 2 crushed milk cans, 2 bottle bases and associated glass; this is probably a pre-1930 cowboy camp, possibly goes with corral at 42KA5361.
759	An enigmatic stack of rocks and perhaps a low wall, which looks quite recent (kids play?).
761	A hearth and late 1960s-early 1970s sanitary food can.
766	A modern collectors pile: 7 flakes of different material and technology in a small pile (10 cm area).
768	A rusted, squashed, enamel-covered metal bowl.
775	A crushed solder-dot milk can (1920s to 1940s based on comparison with others in vicinity).
779	Solder-dot milk can (Type 9; 1915-1930) with a pile of axe-chopped juniper branches.
Brigham Plains	
217	2 broken logs under overhang (one has bailing wire attached), another piece of bailing wire, humerus of small ungulate.
219	2 rusted sanitary food cans.
220	1 milk can (Type 19; 1930–1975) and 1 unidentified can.
229	3 milk cans (Type 9; 1915–1930) and some wood chips; possible temporary camp?
328	Inscription on rock face: LEE SAVAGE May 1, 1920 and ART CHYNOWETH May 1, 1920 (latter in two places on the panel).
330	3 large (30 oz) sanitary cans, 2 hole-and-cap score strip/key meat or fish cans, and 2 (9 oz) sanitary cans; along bench edge overlooking canyon; possible lunch spot.
333	1 tobacco can, 1 sanitary can (10 oz), and scattered charcoal (nothing definable as a hearth), near edge of flat bench on west side of Coyote Canyon.
Nipple Bench	
920	1 horse shoe.
945	Post-1950 camp containing 15-20 steel beer cans, 2 milk cans with embossed rings on top (Type 19; 1930-1975), 3 "Spam" cans, 20+ large sanitary food cans, 1 mustard jar, 1 gallon cider (?) jar, wood and steel rings from a small barrel; 40-50 fencing staples (perhaps carried in the barrel?).
947	Two 55-gallon barrels, galvanized 5-gallon tub, 4 rusted cans, 1 plastic knife
955	1 small milk can opened with knife punches (Type 13; 1917-1930), 1 flattened tobacco can.
East Clark Bench	
197	2 food cans (ca. 28 oz size, stamped "SANITARY") at SW corner of unit; corner marker is 1916, so cans may be associated; also more recent lath and 4 X 4 post, perhaps a mining claim?
198	4 x 4 post with rusted Price Albert can attached with wire, post was braced with sandstone slabs (now fallen); probably mining claim maker, along power line access road.
342	3 milk cans (Type 9: 1915–1930) on flat-topped bench with good view; 1 tobacco can ca.120 m away.
351	1 milk can (Type 9; 1915–1930).
408	Inscription on white sandstone cliff face: ART CHYNOWETH APRIL 22, 1920 and HERMAN CHYNOWETH APRIL 14, 1938; around the corner is another signature (same date) and with Herman in cursive.

small outcrop, a modern storage facility on the range. In a few cases, resources that do not meet the 50-year guideline for historic sites were recorded as IOs to illustrate the range of recent activity in the project area, but to minimize recording time for these nonsignificant resources. In this vein, the isolated plastic alarm clock found far from the nearest road on Fourmile Bench presented an opportunity for much speculation as to its origin. The mangled U.S. government vehicle license plate found on John Henry Bench also must have an interesting story, as the nearest road is almost a half-mile away, across rugged badland terrain.

Collector's piles were documented both as IOs and on prehistoric sites (42GA4746, 42KA4578, 42 KA4817, 42KA4827, and 42KA5391) in the survey area. Although the artifacts in the piles are prehistoric, the behavior is most likely recent. Three isolated artifact collections were documented, two on Collet Top and one on Smoky Mountain, the result of cowboys or other travelers pausing to admire the talents of past peoples. The artifacts were probably picked up from nearby sites, and then deposited in small piles or on a stump. When found on sites, concentrations of artifacts typically contain the most visually interesting items at the site—colorful lithic materials, decorated ceramics, and formal tools. Although less destructive than removing the artifacts, the behavior that produces collector's piles compromises site integrity and inhibits interpretation. Documenting intentional artifact concentrations on sites is useful in assessing the extent of impact from visitors, because sites with collector's piles are more likely to have lost diagnostic tools (see Chapter 10).

Seven historic IOs reflect activity associated with cadastral surveys and resource exploration in the region during the twentieth century. Land survey activity produced a surveyor's blaze on a tree on Collet Top, rebar and a stake possibly marking a survey station on Long Flat, and a rock cairn on a canyon rim along a section line on Fourmile Bench. Two probable mining claim markers on East Clark Bench and a coal prospecting drill hole in Fourmile Bench, marked with an inscribed metal pipe, document mineral exploration across the area. Drill holes marked with rebar or metal posts are common on Fourmile Bench, Nipple Bench, and Smoky Mountain, reflecting the intensive exploration for coal reserves in the 1960s and 1970s. Most of these were quickly plotted on survey unit forms but were not formally recorded. A unique IO associated with mineral exploration is a concentration of 44 cans found next to a bladed road on Fourmile Bench. The painted cans, rusted but still legible, held paper and developing solutions for linagraph prints, which were used to document seismic surveys completed in search of coal or oil deposits. The types of solutions and cans indicate that the activity took place between the early 1960s and mid 1970s, during the height of the coal exploration in the Kaiparowits region.

Among resources that do not meet the 50-year guideline for historic sites, of particular interest are a series of small recent camps that are probably associated with modern adventurers imitating prehistoric activity. As noted in the description of sites on Collet Top, locales with evidence of human activity but no material remains pose an interpretive challenge for archaeologists. The survey documented several of these "sites" as isolated occurrences, in the interest of exposing a potential source of inflated archaeological site inventories in an expedient manner. In all cases where the resources were likely to be prehistoric (i.e. hearths containing degraded charcoal; presence of lithic debitage or ceramics), they were recorded as sites.

DISCUSSION OF HISTORIC THEMES AND RESOURCE TYPES

Nearly all of the historic resources recorded during the Kaiparowits Plateau Survey appear to fit within the theme of ranching. Although only a minority of the sites have artifacts or features that specifically relate to livestock economy, such as corrals, fences, or barbed wire, the tight clustering of most sites between 1905 and the late 1930s, and the similarities among the sites, strongly suggest that most represent the same historic context. Survey and archival research clearly indicated that the first four decades of the twentieth century saw the most intensive ranching-related use of the Kaiparowits Plateau and surrounding areas (cf. Kearns 1982:276, Table 26).

Most sites exhibit small, homogeneous artifact assemblages, a situation influenced by a number of factors. The availability of canned and bottled food, beverages, and medicine was probably restricted to more populous regions in the early part of the century, and these items may have been too expensive for general use by rural ranchers or hired range hands. As discussed below, the number of cans is generally larger at later sites, with the exception of a few camps that were used for extended periods or multiple times. The logistics of packing significant quantities of

cans and bottles prior to construction of roads that could accommodate wagons or trucks may also have been a factor, as the rugged Kaiparowits country was not easily accessible until after roads were built for coal exploration in the 1960s and 1970s.

Mineral Exploration

The economic potential of the mineral resources in the Kaiparowits region was recognized in the early 1900s, but few large-scale efforts to develop the resources have been successful. Oil wells in the Upper Valley near Escalante produce a substantial amount of petroleum products (Sargent 1984), but coal deposits in the region have been less extensively exploited. Small-scale coal mining for domestic use began soon after settlement of Escalante and other communities in the 1870s. By the 1920s, about eight mines supplied coal to town residents, and mines north of Henrieville produced coal for local use as late as 1964 (Gregory and Moore 1931; Sargent 1984). Kearns (1982:255) noted small coal mines in the vicinity of the Escalante Project Tracts I and II, particularly around Coal Bed Canyon. Inscriptions promoting coal use indicate that the mines were in use between 1911 and 1915 (Kearns 1982:255).

The Kaiparowits Plateau and adjacent benches overlie one of the largest buried coal fields in the American Southwest, estimated to contain up to 20 billion tons of coal. Most of the coal is found in the Cretaceous-age Dakota Sandstone and Straight Formation, and individual seams can reach 30 to 40 m (Sargent 1984). The most intense period of mineral exploration around the plateau occurred during the late 1960s and early 1970s, when a consortium of utility companies proposed to mine coal on Smoky Mountain and build coal-burning power plants on Fourmile or Nipple Benches. Impacts cited in the EIS for this project included "degradation of air quality, land subsidence above the coal mine, marked increase in population, reduced grazing, degradation of recreational experience at Lake Powell and surrounding parks and scenic areas, and mercury release into Lake Powell from plant emissions" (Sargent 1984:8). Numerous challenges and lawsuits by environmental groups, as well as questions about the economic feasibility of the project, resulted in eventual dissolution of the consortium. Subsequent versions of the plan touted coal mines coupled with long-distance transport of the coal by road, rail, or slurry line to generating stations in areas closer to existing infrastructure. Designation of the area as part of the Grand Staircase–Escalante National Monument (Heath 1998; Sargent 1984) effectively ended the chance for development of extensive coal extraction systems. Although a number of coal and oil leases within the GSENM boundaries remain active, production is unlikely due to prohibitions against developing infrastructure and tight restrictions on environmental disturbance.

Material remains associated with energy exploration during the middle of the century do not meet the 50-year age requirement for historic resources, but are a highly visible part of the archaeological record in the region. Fourmile Bench, Paradise Bench (Horse Mountain stratum), Smoky Mountain, and parts of Nipple Bench were heavily impacted by the exploration, and offer a relatively robust record of the activity. Bladed roads dissect the terrain, leading to drill holes marked with rebar and metal posts. Camps used by the seismic and drilling crews are marked by trash scatters and clusters of oil cans near the roads. NNAD crews expediently documented the range of features and artifacts associated with the recent mineral exploration, mainly by recording a representative sample of trash scatters as IOs and plotting drill holes on unit forms. Several IOs document activities related to the exploration, such as cadastral surveys and development of linagraph prints from seismic studies. More detailed recording of these recent resources was not justified within the scope of the project, although the activity forms an important chapter in the history of the area.

Camps

Historic camps recorded during the Kaiparowits Plateau Survey generally represent short-term occupations, although a few substantial camps were documented. Several of the camps contain artifacts that suggest repeated use, perhaps over a series of years, and inscriptions verify this pattern in two cases. Camps are located in a variety of topographic settings, many in sheltered places on the lee side of a ridge or dune, but others are exposed on slopes or ridgetops that offer no protection from sun or wind. Camps are often situated in wooded locations, and at several sites there are trees with branches removed to provide a sheltered area that could support a tarp or tent. A good view seems to be an important criterion in campsite choice, as nearly all of the historic camps, particularly those on Smoky Mountain, offer stunning vistas. Small can scatters

recorded as IOs, probably the remains of a single meal, are also typically found in locations with panoramic views.

Immediate access to water does not appear to be a major component in camp site selection, and many camps are more than a half-mile from a reliable water source. This is perhaps not surprising at camps used for just a single night, when a full canteen would suffice. Occupants of longer-term camps, however, must have made daily trips to a spring. Several lines of evidence, including archival sources (e.g., Gregory and Moore 1931:34; Woolsey 1964) and inscribed dates found during the survey, indicate that the lower benches around the Kaiparowits Plateau were used as winter or spring range for livestock, so the importance of permanent water sources may have been lessened by cool temperatures and snow or rain that might fill tinajas and small bedrock potholes. Current grazing allotments reflect the traditional seasonal movements of livestock, with the benches south and west of the Kaiparowits Plateau and the Escalante Desert to the east used mainly between October and May and the higher reaches of Collet Top, Fiftymile Mountain, and the Aquarius Plateau to the north used for summer range (Gregory and Moore 1931; USDI 1999:Appendix 6).

Short-term historic camps were found in all of the survey strata except East Clark Bench. These sites are typified by a lack of substantial modifications to the camp locale; a few branches may be removed from trees to accommodate a tent or work area, rocks may be collected to stake down a tarp, a shallow hearth may be dug, but the impacts to the site are minimal and ephemeral. The main evidence of the camp is generally a sparse trash scatter, usually comprising fewer than 20 artifacts. At 42KA5359, for example, four piles of rocks probably held down a tarp or tent, and a small pile of wood was brought into the tent area to be kept dry (Figure 9.11). A shallow hearth lies just outside the tent area, and a few artifacts are the only other evidence of the camp. At 42KA4560 a ring of rocks between two junipers could have stabilized the base of a tarp or tent, and the pole used as a support for the tent was left within the stone circle. Again, a few artifacts are the only other evidence of the camp. At 42KA4577, a juniper log was lashed to two trees to form a bench. A possible hearth and sparse artifacts scattered along a small wash comprise the other remains of the site. Occupants of one short-term camp, 42KA4593, took advantage of a small overhang along a cliff near Wahweap Creek. A charcoal stain occurs at the mouth of the shelter and two inscriptions on the rock indicate that the site was used twice during 1938. The scatter of 40–50 cans at this site is anomalously large for a temporary camp, but is probably the result of multiple uses. The camp at 42KA5489 has a hearth, but the sparse artifact inventory belies the brief time spent by the occupant. Similar temporary camps were relatively common in Tracts I and II of the Escalante Project (Kearns 1982:Table 26), suggesting that the entire region has witnessed a homogeneous pattern of use during the historic period.

Longer-term camps are designated by a greater variety and quantity of artifacts, as well as more substantial modifications to the site. An extended stay or repeated use justifies the expenditure of effort to make a camp more comfortable and functional. A good example of this pattern is 42KA5318 on Smoky Mountain, which may have functioned as a base camp for a season or more. Construction of a windbreak wall of juniper branches and a wood-and-wire equipment hanger in a ceiling alcove (Figure 9.10) bespeaks of a desire for comfort and convenience, and the sheltered location and large hearth suggest use during cooler seasons. The quantity of cans scattered in front of the shelter imply extended use of the site by a single person or small group. At sites like 42KA5310 and 42KA4680, the large amount of trash probably reflects the presence of numerous individuals, as well as a longer period of use. The investment of time and energy necessary to build a corral also suggests that a site was used more than once, and may reflect multiple episodes over a year or more. The large corrals on Long Flat and Horse Mountain are probably related to activities such as branding or movement of livestock between ranges, which are typically undertaken each year.

Corrals

Five corrals of various sizes were recorded during the Kaiparowits Plateau Survey. Four are constructed of juniper and pinyon logs and branches that are stacked horizontally between standing trees to form walls (Figure 9.6). The corrals incorporate large and small axe-cut branches as well as large branches and trunks scavenged from dead trees in the vicinity. The corral at 42KA5361, on Smoky Mountain, was constructed of juniper logs and branches piled into a curved wall to block a bedrock embayment, and was less substantial than corrals recorded on Long Flat and Horse Mountain. The piled wood at this site has partially collapsed and compressed over time, leaving a "wall" that ranges from a few centimeters to 70 cm high. Walls at the more substantial

corrals are generally 1–1.5 m high and rarely contain significant amounts of wire to lash branches together or to standing trees. Corrals range in size from two connected lobes of 3 x 4 m and 5 x 8 m to one containing three connected lobes that individually measure up to 58 x 33 m. Except for the corral on Smoky Mountain, the other features are in fairly good condition and could be serviceable with the addition of a few branches.

As argued above, the presence of a corral, which requires a substantial investment of time and energy, suggests that a site was associated with more than one use episode and likely for an activity such as branding that requires control of animals. Such an interpretation is supported at 42KA4546 by the three separate lobes of the feature and the presence of multiple can dumps. Sites 42KA4718 and 42KA4757 contain smaller corrals with a single enclosure, but both sites exhibit upward of 30 cans, as well as woodchip scatters and a hearth at the latter site. Artifacts at 42KA4757 reflect two episodes of use separated by at least five years, and the corral was probably used both times. The camp at 42KA4546 is located nearly 160 m to the northwest of the corral. Camp areas were also separated from corrals at three other sites, but by shorter distances, ranging from 30 to 70 m.

A pattern noted throughout the survey area was the lack of close association of corrals with reliable water sources. Many of the permanent springs in the area currently have evidence of livestock use, and modern line shacks are generally near these water sources. Four of the five historic sites with corrals are more than 0.5 km (1/3 mile) from a permanent water source. The riparian zone along Tommy Smith Wash lies just over half a mile to the east of 42KA4582 and there are small drainages choked with tamarisk near 42KA4546. It is possible that reliable water sources not marked on USGS quadrangle maps lie outside the sample units, in which case the survey crews may not have found them. But it is also possible that the corrals reflect use during the cooler or wetter seasons, when livestock could be taken to water every few days but the camp need not be situated directly adjacent to a water source. In this regard it is interesting that 12 of the 14 historic inscriptions indicate use of the area during the winter or early spring months.

Thermal Features

Most of the historic hearths are small concentrations of charcoal and charcoal-stained sand that represent fires on the surface or in shallow basins. Several of the hearths have been partially buried by eolian sand and others were probably dispersed or mixed with sand upon leaving the camp, making them difficult to define. Hearths range in size from less than 50 cm in diameter to over 1.5 m. Only one hearth contains significant amounts of burned rock, and that feature (at 42KA4572) is not definitely of historic age, but may be associated with prehistoric artifacts in the vicinity. The general lack of burned rock in historic hearths probably reflects the use of Dutch ovens and other metal utensils rather than cooking by baking or roasting. Fires were probably built both for cooking and for warmth, especially considering the indications of winter occupation. In this aspect the dearth of substantial hearths is puzzling, since winter evenings would be far more pleasant around a crackling blaze.

Ten sites contain scatters of axe-cut woodchips, presumably due to procuring firewood, and at one site a pile of wood was found within the tent area. Half of the sites with woodchip scatters do not exhibit defined hearth areas, but some type of fire was surely present, perhaps a surface fire that was dispersed when the site was abandoned. A small surface fire used for a brief period could quickly be eradicated by natural forces. Several sites contain logs that were evidently used as seating, sometimes situated close to the hearths and sometimes at a distance. Whether this relates to season of occupation or just the final configuration of the site is unknown. It is possible, for instance, that logs were moved away from the fire at night to make a sleeping area, so that a greater distance between logs and hearth does not indicate use in the warm season.

Artifact Scatters

The most common manifestations of historic activity in the Kaiparowits Plateau Survey sample units are the small scatters of cans that result from brief camps, perhaps just for lunch or a single night. In many cases a few other artifacts are present, perhaps a broken bottle, the remains of a wooden crate, some pieces of wire, fragments of a worn-out boot, or empty cartridge casings. A small fire may reflect preparation of a hot meal. Most temporary camps are quite regular in their artifact inventory, comprising 2–6 milk cans, 3–8 food cans, a lard bucket or baking powder can, and perhaps a spice can, Mason jar, or medicine bottle. The cans and bottles left behind by those who traveled through the Kaiparowits region

reflect a standard field menu common throughout the West in the late 1800s and early 1900s. Biscuits leavened with baking powder were a staple. Coffee and milk were standard beverages, as well as tea in some cases. Although small game could be procured and easily prepared during excursions, meat cans indicate that basic provisions were also carried. It is likely that foods such as dried beans, flour, sugar, dried or smoked meat (e.g., bacon or ham), and dried fruit or vegetables were also consumed, but were packaged in containers such as canvas bags that seldom enter the archaeological record. Several sites contain the remains of wooden crates, which may have been used to carry canned or perishable foods. Crates, which are easily attached to pack saddles, could also have been used to pack equipment, and could have served as chairs or tables.

A distinctive aspect of camps in the Kaiparowits area is the frequent lack of tobacco and coffee cans, and the complete absence of liquor bottles, probably a reflection of the Mormon faith among at least a segment of the local range hands or other travelers. Tenets of the LDS faith discourage use of caffeine and nicotine, so the presence of these items in a largely Mormon region raises the question of site affiliation. It is possible that Mormon ranchers chose not to observe the prohibitions against these substances during expeditions to the hinterlands, where these lapses might be less noticed and more accepted. Equally plausible is that the range camps were occupied by non-Mormon hired hands, who might have been more likely to use caffeine and nicotine. The documented presence of "nonresident" cattlemen in Mormon towns (e.g., Chesher 2000:81; Gregory and Moore 1931:30) supports this scenario. The presence of coffee and tobacco cans does not correlate with the age of the sites and there is no clear association of other types of artifacts with coffee or tobacco cans. Size or duration of use may be correlated, as all of the larger camps had tobacco cans and most had coffee cans. Tobacco cans were found at 15 sites and coffee cans at 8, both representing fewer than half of the recorded sites. At two sites and one isolated occurrence, embossed tea can lids provide evidence of alternative forms of caffeine. No sites in the project area produced liquor bottles, another substance prohibited by the Mormon faith. The complete absence of commercial liquor is interesting in light of the presence of other shunned substances, but may be explained simply by the difficulty of transporting quantities of glass containers over rough country by horse, mule, or wagon. The lack of specific artifact types that are common at sites in adjacent regions represents a tangible pattern of behavior offered by simple archaeological observation, and a chance to explore the connection between material remains and belief systems or living conditions in the past.

As noted previously, there is a wide range of more recent trash scattered across the project area as a result of mineral exploration in the 1960s and 1970s. Much of this debris was not documented by the current survey, but a representative sample was recorded as IOs in the interest of illuminating the full history of human exploitation of the Kaiparowits region. Common in the recent artifact inventory are oil cans, a variety of plastic items, sanitary food cans, potted meat tins, and aluminum beer and soda cans. Trash from recent activity was particularly visible on Fourmile Bench, Smoky Mountain, and parts of Nipple Bench, which were to be the locations of coal mines and coal-fired power plants.

Historic Petroglyphs

By far the most common historic petroglyphs documented during the Kaiparowits Plateau Survey are inscriptions of names or initials, usually accompanied by a date and occasionally by a brand. Inscriptions were recorded both as isolated occurrences of one or more names carved into a rock face and as part of larger sites (Table 9.4). More than one name is present at five of seven inscription panels, and three panels exhibit inscriptions from more than one date. Inscriptions occur within a small overhang that was also used as a camp site, on a cliff face at the junction of two canyons, along a ledge in a small canyon, and on rock faces along major washes (Blue Wash and Wahweap Creek). One unique inscription is a name and date carved into a piece of milled lumber and left in the lower branches of a juniper tree. In cases where the inscriptions are associated with a camp, dated carvings always correlate with dates for the site occupation indicated by artifact types. Inscriptions are isolated, rather than associated with camps, and probably served to establish informal use rights to an area or simply to notify later travelers that they were not the first to tred that path. Carving served as a way to pass time on the range or to record personal impressions, like the apparent despair expressed by W. Clark in 1930: "All is not gold that glitters."

It is possible to track the movements of a few individuals through the project area based on

Table 9.4. Listing of historic inscriptions recorded during the Kaiparowits Plateau Survey (as drawn).

Site/IO No.	Name/Initials	Date	Comments
42KA4593	S. T. Graff	Dec. 1, 1938	Associated with small overhang, hearth, and artifact scatter; "H" and "X" below name may be brands.
42KA4593	HC	11/1/38	Associated with small overhang, hearth, and artifact scatter.
42KA4637	(unreadable)	Feb, 11, 1919	On Panel 1.
42KA4637	S. T. GRAFF	APRIL 21 1931	On Panel 1; "H" and "X" may be brands.
42KA4637	ART CHYNOWETH	JAN 28.1919	On Panel 1.
42KA4637	ELMER, SMITH	DEC, 16, 1927	On Panel 2; brand mark next to date.
42KA4682	Gates	Nov. 3, 1933.	Inscription on milled wood board; associated with tent area, woodchip scatter, and can scatter.
IO72	W CLARK ALL IS NOT GOLD THAT GLITTERS	JAN 26, 1930	Long Flat
IO127	SEARS WILLIS	NOV 24, 1914	Long Flat
IO127	EDSON ALVEY	JAN 20	Long Flat
IO328	LEE SAVAGE	May 1 1920	Jack Riggs Bench
IO328	ART CHYNOWETH	May 1 1920	Jack Riggs Bench; name/date appears two places on panel.
IO408	ART CHYNOWETH	APRIL 22. 1920	East Clark Bench
IO408	HERMAN CHYNOWETH	APRIL 14–1938	East Clark Bench; panel has two signatures (same date), one with "Herman" in cursive.

inscriptions. Both S. T. Graff and Art Chynoweth left their mark on more than one panel recorded during the survey. Two panels signed by S. T. Graff contain a stylized "X" that appears to be a brand (Figure 9.12a), and the same stylized inscription also occurs along the Escalante River (Chesher 2000:83) and on East Clark Bench (Collette and Spurr 2001). The panel signed by S. T. Graff on East Clark Bench was marked on "Jan 6 1915" and also contains the inscriptions "C. J. Henderson 4/17/20" and "JOS GRAF." Also on East Clark Bench is a panel that records the passage of two generations of a family, Art Chynoweth in 1920 and Herman Chynoweth in 1938 (Figure 9.13.). The elder Chynoweth also marked his passage across Jack Riggs Bench in 1919 and 1920 (Figure 9.14). Edson Alvey, who left an inscription on Long Flat, was a teacher from Escalante who worked as a field research assistant for the Glen Canyon Archaeological Project in the late 1950s (Fowler et al. 1959:vii).

Table 9.5 provides biographical information about some of the individuals who recorded their passing in the project area. A query of FamilySearch, the on-line genealogy database of the Church of Jesus Christ of Latter-day Saints (www.familysearch.org) produced records for Samuel Traugott Graff, born in 1889, who lived most of his life in Cannonville, and died in Kanab in 1966. This man is probably the "S. T. Graff" whom surveyors tracked through the project area. The inscription "JOS GRAF" on the East Clark Bench panel presumably belongs to Samuel Graff's older brother, Joseph, born in 1883 in Santa Clara, Utah (the different spellings of the surname by various family members was indicated in the FamilySearch database). Samuel Graff's second wife was Martha Jane Henderson, possibly a relative of the C. J. Henderson who also marked the rock on East Clark Bench 5 years after Graff.

Historic inscriptions are a relatively common occurrence in the region, and have been noted by numerous other researchers. A single historic petroglyph was recorded by MNA archaeologists at the head of a canyon near the south end of Nipple Bench (Fish n.d.:117). The site (NA12,877) consisted of a name, Sam Lacy, and date, "Jan th 10 1920," scratched into a sandstone cliff at the canyon head. MNA interpreted the site as the result of cowboys exploring an adjacent prehistoric rock shelter site. Kearns (1982:254) reported two historic petroglyph panels, one dated 1920 and the

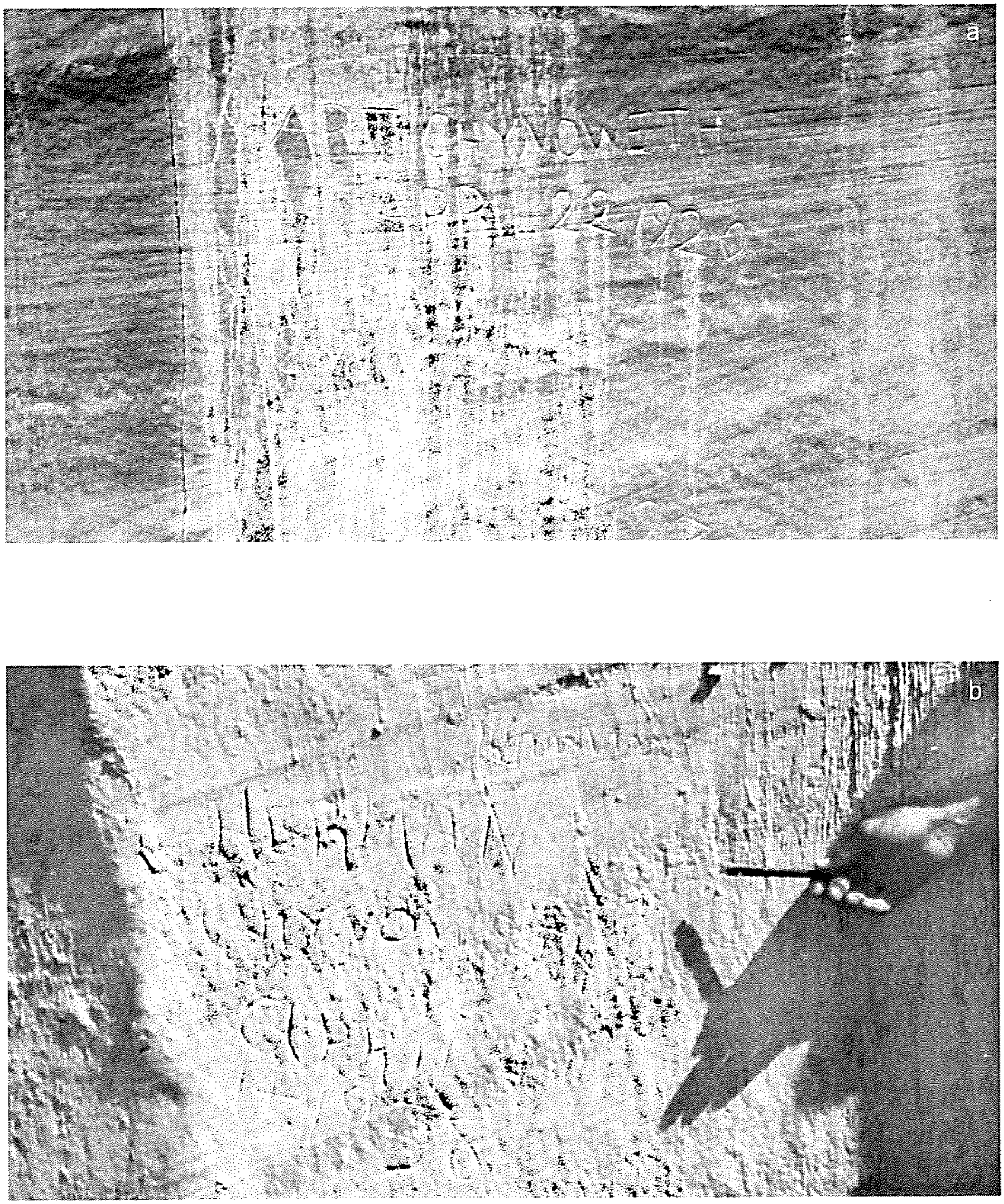


Figure 9.13. Historic inscriptions at IO408 on East Clark Bench: a) Art Chynoweth in 1920 and Herman Chynoweth in 1938; b) Herman Chynoweth in 1938.

Figure 9.14. Historic inscriptions at IO328 on Jack Riggs Bench: a) Art Chynoweth in 1920; b) Lee Savage in 1920.

Table 9.5. Biographical information for individuals named on inscriptions in the Kaiparowits Plateau Survey project area; based on the LDS geneology Web site (www.familysearch.com).

Name	Born	Died	Mother	Father	Married	Spouse
Arthur Chynoweth	Jan 28, 1884 Junction, UT	Nov 9, 1926 Henrieville, UT	Mary Chynoweth	Sampson Vi Chynoweth	Mar 13, 1906 Ingram	Rosella
Herman Ingram Chynoweth	Nov 6, 1914 Henrieville, UT	Aug 11, 1964 Salina, UT	Rosella Ingram	Arthur Chynoweth	?	?
Samuel Traugott Graff	Oct 31, 1889 Cannonville, UT	July 19, 1966 Kanab, UT	Lucy May Bramall	Johann Jacob Graff	June 12, 1912 Oct 13, 1916	Mary Ethna Clark Martha Jane Henderson
Sears Merrill Willis	Mar 29, 1894 Henrieville, UT	May 2, 1965 Henrieville, UT	Mary Eliza Merrill	William Patterson Willis	Feb 24, 1915	Julia Fern McBride

other with dates of 1904 and 1925, the latter associated with initials. Lone Rock, a stone monolith in the broad lower canyon of Wahweap Creek, was a favored camping place, marked by numerous inscriptions, now submerged beneath Lake Powell (Crampton 1994:20). Many inscriptions are probably associated with stock trails, some of which were documented on the west side of Glen Canyon before the water rose in Lake Powell (Crampton 1994). Steep trails dropped into the canyons at Gunsight Pass and Klondike Bar, and prior to the 1930s livestock ranged in lower Last Chance Creek and Warm Creek (Crampton 1994).

SYNTHESIS OF HISTORIC RESOURCES

Euro-American settlement of the area surrounding the Kaiparowits Plateau began in the 1870s, but activity beyond the small communities has mainly involved exploitative activities such as ranching and mining, rather than permanent settlement and farming. The scarcity of permanent water sources and rugged dissected topography delayed exploration and inhibited occupation during most of the historic period. The majority of the historic resources documented during the Kaiparowits Plateau Survey, as well as those recorded during previous surveys in the surrounding region, indicate that use of the area was perhaps greatest between 1900 and the middle 1930s (cf. Kearns 1982:255), with another spike of activity in the 1960s and 1970s. The earlier period corresponds to the height of reliance on livestock by residents of the surrounding towns (Geary 1992:164–168; Woolsey 1964). Kearns (1982:254) reported sites related to ranching, most of which dated between about 1910 and 1935, in both the Circle Cliffs and Kaiparowits Plateau project areas. According to Woolsey (1964) livestock husbandry was most common in the Escalante area through World War I, after which the number of families involved and the size of the herds began to decline. In the 1920s, however, Gregory commented that "during the summer about one third of the population is absent from the villages [of Escalante, Cannonville, Tropic, Henrieville, and Boulder], caring for stock and raising feed in outlying ranches" (Gregory and Moore 1931:34). Geary (1992:165) also stated that herd sizes increased in the 1920s and then decreased dramatically during the Great Depression, and that by the 1940s and 1950s only a limited number of individuals were involved in livestock as a primary economic pursuit. Escalante ranchers used Fiftymile Mountain, the high country east of Last Chance Creek, as summer range, and the lower elevations of the Escalante Desert for winter range (Topping 1997; Woolsey 1964). During his geologic reconnaissance, Gregory specifically noted that livestock "owned by residents of Escalante and Boulder uses the broad Escalante Basin, the Kaiparowits Plateau, and the lands east of the Waterpocket Fold" (Gregory and Moore 1931:34). Evidence of this orientation is the presence of S. T. Graff's brand mark on panels along the Escalante River, as well as in the low benches southwest of Fiftymile Mountain.

Evidence of livestock was noted in most sample units during both phases of the Kaiparowits Plateau Survey. Few animals were seen, but trampled springs, copious amounts of excrement beneath trees and rock shelters, and expanses of grass missing the nutritious seed heads reflect the

recent presence of cattle. Cheat grass and Russian thistle infestations attest to overgrazing in some areas. Most sample units on Horse Flat and Collet Top bear evidence of the chaining programs in the 1950s and 1960s, which intended to clear trees and promote grass growth. As Geary (1992:164) noted, the presence of ample forage for livestock in the first years of use led local stockmen to overestimate the carrying capacity of the land. Most range grasses in the Southwest reproduce by seed, rather than by underground runners. If stock continually graze a limited area, or if the number of animals is great enough to consume most of the seed produced, the grasses will not regenerate, and a decline in forage will be the result. This was exactly the fate suffered by many grazing areas that seemed lush to the early ranchers. Assessing the range conditions in the early 1920s, Gregory stated that "the Escalante and Paria Valleys and the Kaiparowits Plateau have deteriorated as pasture lands during the last decade, and it seems unlikely that they can be restored to the state existing during the period 1875–1890" (Gregory and Moore 1931:35; cf. Chesher 2000:85). This decline in productivity, particularly for grasses, was a major factor in the loss of traditional subsistence patterns and lifeways for the local Paiute (Euler 1966; Kelley and Fowler 1986).

There is ample archival evidence supporting the patterns of behavior documented at historic sites during the Kaiparowits Plateau Survey. Both short- and longer-term camps were recorded, as well as small trash scatters left after lunch breaks. Ranching is the dominant historic theme across the entire project area, with additional resources related to cartographic surveys and geological exploration. The intensive seismic studies, drilling, and geologic mapping activity during the 1960s and early 1970s in anticipation of large-scale coal mining are clearly evident. On Fourmile Bench, in particular, the survey crews witnessed extensive road construction and numerous drill holes associated with mineral exploration. On Paradise Bench surveyors noted an airstrip, several trash scatters, numerous roads, and the subtle remains of several buildings dating to this period. None of these remains were recorded as sites because they do not meet the 50-year age guideline for National Register eligibility, and are not of exceptional significance. They are, however, evidence of an important chapter in the regional history, and should not be simply dismissed as modern trash or thoughtless disturbance to the environment.

Travelers through unfamiliar terrain are often quick to assume that they are the first to reach a rugged topographic vantage point (cf. Gregory 1939). Cowboy camps, historic inscriptions, archival references, and the widely scattered drill holes related to mineral exploration indicate that the Kaiparowits Plateau region was probably known and visited by more individuals during the first half of the twentieth century than today (Gregory and Moore 1931; Topping 1997). The rugged terrain and relative lack of access routes, however, has insulated the region, which still offers solitude and an escape from the confines of civilization. Gregory reported that "during the course of geologic field work in 1900, 1915, 1918, 1921, 1922, and 1924, the only human beings seen outside of settlements were a family in camp at Paria, cattlemen engaged in a round-up on Halls Creek, and a few sheep herders within the national forest and on the Kaiparowits Plateau" (Gregory and Moore 1931:27). This situation is little changed at the end of the twentieth century, for the members of the Kaiparowits Plateau Survey encountered only a few tourists and BLM employees in nearly 6 months of field work spread over two summers. But it would be wrong to assume that this area is unknown to all, for the intriguing patterns of human activity are evident to those who choose to observe them.

CHAPTER 10

SUMMARY AND CONCLUSIONS

PROJECT SYNOPSIS

The Kaiparowits Plateau encompasses roughly 800,000 acres of tablelands, benches, escarpments, and rugged canyons along the southern margin of the high plateaus section of south-central Utah. The plateau is one of three distinct geographic regions that make up the new Grand Staircase–Escalante National Monument. To effectively manage this new monument, the BLM requires information on the density, distribution, and diversity of its cultural resources. To obtain these data for the Kaiparowits Plateau the BLM issued a solicitation for proposals to design and conduct a sample inventory. The Navajo Nation Archaeology Department (NNAD) was awarded the contract and implemented a stratified probability sample. The sample design used sampling frames that coincide with an ascending series of broad benches and tablelands that are separated from each other east to west by canyons and south to north by escarpments. These named geographic features effectively furnish self-defined strata for the Kaiparowits Plateau, being bounded and relatively homogeneous with respect to geology, soil, elevation, and vegetation. They allow study of site density, type, and diversity across the broad geographical features that make up the plateau. Each stratum can be treated as a population in its own right, or combined to make comparisons among strata or estimates for the project area as a whole. The design explicitly excluded three portions of the Kaiparowits Plateau: (1) Fiftymile Mountain because of prior inventory work and logistical problems, (2) most of the far northwest part of the plateau because it was the subject of a prior sample inventory (ESCA-Tech's Escalante Project, Tract II), and (3) rugged canyons and cliff scarps-slopes-badlands to avoid wasting time on accessing and locating units that contain no or few sites. By omitting inhospitable terrain and focusing on areas most conducive to human occupancy, NNAD archaeologists successfully maximized information return for the effort expended. The recorded number of sites is probably twice what it might have been had the entire Kaiparowits Plateau area been treated as a single sample frame. The sampling approach might have inherent potential biases against certain classes of remains because some types of terrain, such as canyons, were omitted from study. Should they exist, such biases can easily be overcome by carefully designed additional survey (see management recommendations below).

The Kaiparowits Plateau Survey was conducted during two separate phases. The first phase, during 1998, focused on five sampling strata that comprise the western portion of the plateau (Geib, Huffman and Spurr 1999). Two years later during 2000, the second phase focused on four sampling strata that comprise the central portion of the plateau (Geib, Spurr and Collette 2001). In all, NNAD archaeologists systematically surveyed 17,280 acres within 108 quarter sections and recorded 710 archaeological sites. Limited testing of 13 sites occurred between the two phases with the primary objective to bolster temporal assignments based on alternative dating criteria and refine survey observations of features prior to Phase 2 of the project.

Phase 1 of the Kaiparowits Plateau survey documented 307 archaeological sites and 330 isolated occurrences within 53 quarter sections (8480 acres). These 53 survey units were distributed within five sampling strata that in north to south sequence are Horse Mountain, Long Flat, Horse Flat, Brigham Plains, and East Clark Bench; this order also generally corresponds with decreasing elevation. The density of sites within the strata varies from a low of 0.7 per quarter section (2.8 sites per section) for East Clark Bench to a high of 12.1 per quarter section (48.4 sites per section) for Horse Mountain. The 307 sites consist of 284 that are prehistoric, 13 with both prehistoric and historic components, and 10 that are historic.

Phase 2 fieldwork involved surveying 55 quarter sections (8800 acres) distributed within four sampling strata that in north-south sequence are Collet Top, Fourmile Bench, Smoky Mountain, and Nipple Bench. By the end of the Phase 2

fieldwork NNAD archaeologists had documented 403 sites and 486 isolated occurrences. In addition to 399 newly recorded sites, NNAD archaeologists entirely redocumented four previously recorded sites. Site density ranged from a low of 2.9 sites per quarter section (11.6 sites per section) for Nipple Bench, to a high of 9.0 sites per quarter section (36.0 sites per section) for Fourmile Bench. Nipple Bench was actually the only stratum with a low density; the other three sampling strata were essentially identical: Collet Top and Smoky Mountain had 8.4 and 8.3 sites per quarter section, respectively, just under the number for Fourmile Bench. Of the 403 site total, 386 sites are prehistoric, 6 have both prehistoric and historic components, and 11 sites are historic only.

The 13 sites tested prior to the Phase 2 survey consist of five of Archaic age, three of Formative age, and five of Post-Formative affiliation. The focus of the effort was on surface-evident features, both to recover radiocarbon samples for dating and to gain information about feature preservation. Overall, the testing effort successfully met its stated objectives. Radiocarbon dating confirmed the general suspected ages of most sites based on several of the alternative dating methods that NNAD crews developed during Phase 1 from simple pattern recognition (see Chapters 5 and 7). As a result, the crews started Phase 2 of the survey effort armed with the knowledge that sites could be assigned to several broad temporal brackets despite the absence of traditional diagnostics.

Of particular importance, we believe, is the ability to identify probable Post-Formative (Paiute) sites. Sites of this period have been poorly represented in regional surveys. As an example, the ESCA-Tech survey of Tract II for the Escalante Project identified just three Paiute (Post-Formative) sites (Kearns 1982:273). This amounts to just 2 percent of their site sample or, perhaps more usefully, a density of Post-Formative sites of 0.07 per quarter section. The Kaiparowits Plateau Survey identified a total of 48 Post-Formative sites, which, although totaling just 6 percent of the site sample, is a density of 0.44 sites per quarter section. This is more than a six-fold increase in the density of Post-Formative sites.

ARCHAEOLOGICAL FINDINGS

The Kaiparowits Plateau Survey identified both Native American and Euro-American archaeological remains, both sites and isolated occurrences. The Euro-American remains all date to the 1900s, with no observed evidence to suggest use during the 1800s or earlier. Native American remains date from the early Archaic (ca. 8000 cal. B.C.) into the historic period, potentially overlapping with the Euro-American use of the area in the early 1900s (e.g., the tested site 42KA4662). Occupation may not have been continuous, but Native people appear to have used the area in some fashion during all major time periods. Surveyors located three possible Paleoindian points, with a large stemmed point perhaps the best candidate, but these have no obvious association with other remains. Still, they raise the possibility that additional survey on the Kaiparowits Plateau might eventually identify Paleoindian sites.

Of the 710 documented sites, 670 are Native American, 19 have Euro-American remains superimposed over Native American remains, and 21 have Euro-American remains alone. The superimposition of remains from different temporal intervals is also common for the Native American sites, with 55 of them containing obvious evidence of multiple components. Multiple components simply refer to evidence of broadly different temporal intervals, on the order of thousands of years for the Archaic, with no implication about multiple reuse of locations during a single interval. It is clear based on the testing results presented in Chapter 5 that our ability to correctly identify multiple-component sites is limited and, as we argue in Chapter 7, many of the large sites in the area no doubt result from unrecognized complex histories of site use.

Archaic sites are the most numerous and the 321 components assigned to this interval represent 43 percent of the 744 Native American components documented by the Kaiparowits Plateau Survey. Nonetheless, the Archaic sites cover a huge span of time, roughly 6000 years; thus after factoring in the relative lengths of the temporal periods, the sites of Post-Formative foragers actually have a greater density per unit of time. There are 0.05 Archaic sites per year, whereas there are 0.1 Post-Formative sites per year. Of course, there are many complicating factors with such figures, but they have heuristic value. No doubt many Archaic sites have been lost to the ravages of time, something that is not true for the Post-Formative sites, which seem to have a "crisp" archaeological expression with a tight spatial clustering of remains. But keeping in mind the length of time during which remains could have been deposited helps to keep our numbers in perspective. If we consider that we recorded 62 Anasazi sites on the survey, this represents a huge spike in the intensity of use of the Kaiparowits Plateau. The Anasazi sites likely correspond to a

comparatively brief span of use during the late Formative interval, on the order of 100 years or less. This means that the density of sites per unit of time is about 0.6 or even more, vastly different from other temporal periods. Certainly part of the reason for this is the temporal specificity that comes with ceramics, allowing the temporal bracket to be squeezed almost as tightly as is possible in archaeology. Regardless, the nature of the Anasazi remains on portions of the plateau is witness to an intensity of use of the area not seen before or after, even by Euro-Americans.

The remains from foragers at opposite ends of the temporal spectrum (Archaic and Post-Formative) appear quite different and give rise to the thought that the Paiute ethnographic record may *not* provide a good analogy for understanding Archaic hunter-gatherers, at least not in any simple, straightforward way, such as Archaic foragers were like Paiute foragers. Detailed comparisons of the records from these two temporal periods are presented in the descriptive chapters of Native American remains (especially Chapter 8). One main contrast is that Archaic sites often are large and contain numerous artifacts widely distributed across broad areas whereas most Post-Formative sites are small and even if the artifact count is high, the remains are concentrated. At the few large Post-Formative sites the remains occur as small tight clusters of debris separated by artifact-free space. Erosional dispersion of Archaic remains can only partially account for the observed differences, because several thousand years of erosion would not transform small and tidy Post-Formative sites into large and artifact-rich Archaic-like sites. Indeed, several thousand years of erosion likely would eradicate these sites. Despite thousands of years of erosion, there are many substantial Archaic sites but few comparable Post-Formative examples. This is just one example of potentially informative differences in archaeological records left by foragers at different ends of the temporal spectrum. By contrasting these records, it might be possible to tease out reasons for differences or similarities based on ethnographic knowledge that exists for those foragers on the Kaiparowits Plateau in the recent past. This is not analogy by another name, but a way to explore the variability in archaeological remains so that we can ponder reasons for differences and similarities. Evident contrasts in the nature of Archaic and Paiute sites and assemblages imply differences in settlement and subsistence strategies and in the organization of flaked stone technology. Some of the raw material patterns imply that Archaic foragers were perhaps ranging further or that they made residential moves to places infrequently used by the Paiute occupants of the area.

The Kaiparowits Plateau Survey documented the remains of both Fremont and Anasazi occupation during the Formative period. There are no Fremont structural sites, just scatters of stone artifacts with sparse sherds of Emery Gray. Most of the Fremont sites have few surface sherds, and seldom more than what are likely portions from a single vessel. Some of the Fremont sites appear to be temporary residential camps likely associated with foraging and hunting in the region and others are perhaps logistic hunting and processing camps. Fremont use of the area is seen mostly on Collet Top, Horse Mountain, and Long Flat. The benches further south may have been at the far periphery of Fremont territory, although one of the most substantial camps occurs on Nipple Bench. Fremont use of the area is thought to generally predate the time when Anasazi use became common, which happened sometime after A.D. 1100. Most of the sites with Fremont sherds lack Anasazi pottery, except a few shelters. Perhaps even more significant, virtually all of the Anasazi habitations appear to lack Fremont pottery.

Anasazi use of the Kaiparowits Plateau appears to postdate roughly A.D. 1100. The one possible exception to this is the presence of a few sherds of early plain utilitarian pottery on one site. This distinctive coarse sand-tempered pottery, which should not be confused with Lino Gray, occurs on early Formative sites of the Glen Canyon region. This sort of pottery is also known from sites of the Grand Staircase (Douglas McFadden, personal communication 1999). The pottery shares similarities with all initial pottery of the Southwest and likely has no social or ethnic implications (see Wilson and Blinman 1994; Reed, Wilson and Hays-Gilpin 2000).

Anasazi use of the survey area seems to have been much more intensive and varied than that of the Fremont, including semipermanent residential sites and granaries along with residential camps, processing camps, and hunting camps. We also know that Anasazi territory by about A.D. 1100 or shortly thereafter encompassed the entire Kaiparowits Plateau, with permanent residential sites established at most (perhaps all) of the best farming locations, especially Fiftymile Mountain and Collet Top. Because of this, it is likely that Anasazi use of the plateau was structured quite differently than was the case for Fremont use of the plateau.

NNAD's sample survey documented a small community of Anasazi residential sites on the portion of the Collet Top sampling stratum that is the stratum namesake—the moderately level sand-covered ridges just south of the headwaters of Lower Trail Canyon, a tributary to Left Hand Collet Canyon. In five units NNAD crews recorded 48 sites, 39 of which (ca. 80%) are Formative. Half of the sites have masonry and jacal structures in the form of single rooms and roomblocks, with up to at least eight rooms in one case (42KA5435). Except for Fiftymile Mountain, this is an unprecedented concentration of Formative sites on the Kaiparowits Plateau. University of Utah's Fiftymile Mountain survey was more akin to a reconnaissance on foot and horseback than an intensive inventory, so site density figures are not exactly comparable, but it appears that the 18 Formative sites in Unit 189 on Collet Top meet or exceed site density on Fiftymile Mountain. This must be balanced against the likelihood that we documented more examples of small, non-structural Formative sites (sherd and lithic scatters) than did the University of Utah. Considering just the structural sites, the density of these on Collet Top is perhaps somewhat less than for Fiftymile Mountain, perhaps because the lower elevation terrain of Collet Top was less productive for dry farming than Fiftymile Mountain, thus it supported a lower population density.

Our analysis of the Anasazi sherds from the Collet Top habitations and other Formative sites on the Kaiparowits Plateau led to results that closely parallel those obtained by Gunnerson (1959a) for Fiftymile Mountain. Both our field analysis and the laboratory analysis of collected sherds identified the overwhelming majority of the pottery within the Virgin Anasazi ceramic tradition: Shinarump Gray, White, and Red Ware, and the Virgin Series of Tusayan Gray and White Ware. There are decidedly few examples of sherds from vessels produced in the Kayenta Anasazi region. Our unwillingness to classify the Anasazi pottery as Kayentan is a product, no doubt, of having worked in the Kayenta region for some 20 years. In this sense, we are perhaps little different from Beals, Brainerd and Smith (1945:6) who concluded that the Anasazi pottery on Fiftymile Mountain differed from that of the Kayenta region. Our reasons for placing sherds within the Virgin tradition rather than the Kayentan is not based simply on subtle raw material differences that have a geological rather than behavioral origin. We also see distinctions in vessel finishing, surface treatment, and perhaps even design styles.

Ignoring pottery, there are other aspects of the Formative archaeological record on Collet Top that make us doubt the notion, popularized by Lister (1964), that Kayenta Anasazi migrants populated the Kaiparowits Plateau during late Pueblo II. Stone tool reduction techniques and goals, the nature of masonry construction, settlement layout, and interior features, among other aspects of the Anasazi remains on the Kaiparowits Plateau, suggest that the Kayenta region is an unlikely source of the population who occupied the plateau. The Kayenta groups closest to the Kaiparowits Plateau, those who would have provided the founding population for the purported migrants, occupied the Rainbow Plateau and the adjacent highlands of Cummings Mesa and Paiute Mesa. Late Pueblo II archaeological remains of these areas differ in many key respects from those on the Kaiparowits Plateau, differences that are difficult to reconcile with the migration hypothesis. Perhaps a few aspects might differ, something that is often found in migrant populations because they rarely reflect the full social complement of the home community (see Anthony 1990). The suite of traits evident on the Kaiparowits Plateau lacks counterparts in the Kayenta region and it seems unlikely that simply crossing a river and climbing a mesa would result in such multifaceted change.

But, if not Kayenta migrants then who? At present we favor an expansion of populations out of the west from the Grand Staircase. We use the term Virgin Anasazi for this population, but readily admit that an expert in Virgin Anasazi archaeology might not agree with such a label. Naming for the sake of naming is not our point; rather we seek to understand how Anasazi communities became established on the Kaiparowits Plateau in a region that lacked a local developmental trajectory for such communities. The direction of movement for such a population is important for understanding what technologies and social organization they might have brought with them and how these might have changed to fit the new setting.

The Kaiparowits Plateau Survey documented 48 Post-Formative sites and another 38 sites that may date anywhere from the Formative to the Post-Formative periods; these occur in all of the survey strata. We assume that Post-Formative sites are evidence of Southern Paiute use of the Kaiparowits Plateau because this is the principal group ethnographically reported in the area during the time of contact. The finding of Awatovi

Black-on-yellow (assumed to be a trade ware) on one site allows the possibility that Paiute use of the area began shortly after A.D. 1300. Small and briefly occupied camps used for processing and hunting are the most common types of Post-Formative sites, with few large residential camps. This suggests that the Kaiparowits Plateau was mainly used by single families who moved frequently and rarely created debris concentrations like the Archaic foragers who preceded them. The overall distribution of Post-Formative sites indicates that the focus of activity was centered on Fourmile Bench and Long Flat. It is perhaps no coincidence that this is much of the area that Kelly (1964) mapped as the core territory of the Kwaguiuavi economic unit of the Kaiparowits Band of the Southern Paiute. The heavy reliance on the local Paradise chert for the production of arrow points and other stone tools at Post-Formative sites is a perfect match for this mapped territory of the Kwaguiuavi economic unit because the boundary as shown by Kelly closely matches the natural distribution of this material. At least one of the Post-Formative sites was occupied near the beginning of the 1900s and there could well be other examples that overlap with the Euro-American presence within the region. A detailed study of the Post-Formative archaeological record on the Kaiparowits Plateau would not only provide a valuable point of comparison for understanding Archaic use of the region, but would allow us to examine the affects of European contact and the changes wrought in technology, settlement, subsistence, and perhaps social organization.

The lack of Paiute sites that date after the first decade of the twentieth century suggests that indigenous peoples were not living traditional lifestyles by the time Euro-American groups were widely using the Kaiparowits area. After the arrival of Euro-Americans and the severe ecological impacts of livestock, the traditional foraging economy of the Paiute offered less reliable subsistence, even in areas away from the newly established towns. By the turn of the century most Native groups in the West were settled on reservations, but the few small and poorly administered reservations set up for the Southern Paiute proved inadequate in terms of food resources or arable land. The Paiute instead lived on the periphery of Euro-American communities and were largely dependent on the local Mormon economic and social system by the early portion of the twentieth century (Fowler and Matley 1979:86).

Evidence of Euro-American activity on the Kaiparowits Plateau consists of 19 sites with both prehistoric and historic components and 21 sites that have only historic debris. At least seven sites exhibit evidence of more than one episode of use during the historic period, based on dated inscriptions on rock faces or on artifact types. In addition, the survey recorded 62 historic or recent isolated occurrences (IOs). Historic sites were recorded in all of the sample frames except East Clark Bench, but the majority of the sites are on Long Flat (13) and Smoky Mountain (10). Comparison between the expected number of historic sites and the observed frequency (see Table 9.2) indicates that the sites are not randomly distributed across the survey area, but are clustered in specific areas to take advantage of desirable resources. Appealing characteristics might include relatively gentle topography, access to water, abundant vegetation for livestock, and ease of access. The large number of historic sites recorded on Long Flat and Smoky Mountain indicates more intensive use of those areas by ranchers.

The majority of the historic sites and IOs documented during the survey reveal that Euro-American use of the area was greatest between 1900 and the middle 1930s, with another flurry of activity in the 1960s and 1970s (remains from this later interval were not documented as sites). Nearly all of the historic sites dating to the earlier period appear related to ranching, whereas the later resources reflect mineral exploration. Most historic sites exhibit small, homogeneous artifact assemblages that include a few cans and broken bottles, bits of scrap metal and wood from crates, and perhaps the remains of personal items such as shoes. The number of artifacts is generally larger at later sites, reflecting the difficulty of transporting quantities of cans and bottles prior to construction of roads that could accommodate wagons or trucks. Few sites contain artifacts or features that directly relate to livestock economy, such as corrals, fences, or barbed wire, but the similarities in site layout and artifact assemblages strongly suggest that most represent the same historic activity. The clustering of most sites in the first four decades of the century, a period that saw the most intensive ranching-related use of the Kaiparowits Plateau and surrounding areas (Gregory and Moore 1931; Kearns 1982; Topping 1997; Woolsey 1964), supports this interpretation.

SAMPLING

An overall objective of this project was to provide data about the density, distribution, and diversity of archaeological remains on the vast

Kaiparowits Plateau. NNAD's sampling design took advantage of a series of broad benches and tablelands that effectively furnished self-defined strata for dividing up the territory. This not only provided a way to maximize the amount of information for a given cost, but also allowed statistical examination of the distribution of sites across the principal geographical features that make up the Kaiparowits Plateau (excluding Fiftymile Mountain). A key aspect of maximizing our effort was to explicitly omit inhospitable terrain and focus the survey on those areas most conducive to human occupancy. This approach might be viewed as a form of high-grading, and we make no claim that our sample accurately reflects the entire Kaiparowits Plateau, just those large areas of seemingly habitable terrain that had the greatest potential for past use. Award of the survey project to NNAD indicates that BLM managers also had a greater interest in learning about such areas than to a further demonstration that horrible terrain is often poorly suited to cultural use. Prior surveys for the general region (Hauck 1979; Kearns 1982) provide ample verification that survey parcels on steep and dissected land often contain no sites, or at most, a site or two (see footnote 1 of Chapter 1). Should the need arise, the results of earlier surveys of rugged terrain can be usefully extrapolated to the similarly rugged portions of the Kaiparowits Plateau project area that we excluded.

Because the survey was split into two phases that focused on different sample frames with different total sample sizes, the sampling fractions for the various strata are not equal. The fractions for Phase 1 varied from 9.8 to 10.8 (proportional allocation of units) whereas the Phase 2 fractions varied from 8.4 to 9.0 (optimal allocation). There is nothing inherently adequate or inadequate about these sampling fractions, because this depends upon acceptable limits on the error of estimation (these have not been specified) and the underlying population variability. Sample adequacy is statistically evaluated in Chapter 4 and shown to be deficient, something common to nearly all regional archaeological sample surveys. Nonetheless, sampling fractions of 8–10 percent are sufficient to provide reasonable first-order estimations of the cultural remains for each sampling stratum and to highlight where future inventory work is most needed. If additional funding becomes available, then sampling units can be examined in one or all of the nine frames (using the extended sample draws of Appendix D) to provide larger sampling fractions and better estimates.

One of the most significant benefits of the sampling approach was the wealth of information obtained about sites and isolated occurrences on the Kaiparowits Plateau. As a conservative estimate, we believe that the resulting site sample is probably twice what it might have been had we treated the entire Kaiparowits Plateau as a single sample frame and included all of the rugged terrain. As an estimate of how significantly fewer sites might have been recorded, we can use the numbers from Tract II of the Escalante Project (Kearns 1982:Table 14). Based on recording 120 sites in 46 units, if inclusion of rugged terrain had similarly reduced our average site density then we would have recorded just 282 sites instead of 710. The impact conceivably might have been greater because our sample frames included far drier and more desolate terrain of low-elevation benches than was true for Tract II of the Escalante Project.

The most serious bias of NNAD's sampling design, but fortunately one that is easily remedied, might result from the omission of canyons. By excluding these features we may have systematically excluded a small but important portion of the region's archaeological record. Canyons likely contain most of the region's rockshelters. It is in canyons, if anywhere, that rock art is likely to occur (though the friability of local sandstones makes for poor preservation). Canyons may contain agricultural niches and thus harbor farmer residences and hidden granaries. Travel routes are more likely to be observed in canyons; indeed, we identified one such route in Paradise Canyon (see IO165). Canyons also contain springs, seeps, and small catchments, which are likely to have increased the intensity of use in closely adjoining terrain. In future inventories we recommend that some means be devised to survey canyon terrain and areas around springs and seeps to enable a more complete record of the archaeological remains on the Kaiparowits Plateau.

Site density calculations show that portions of the Kaiparowits Plateau contain vast numbers of sites. In general, higher elevation benches (such as Fourmile and Collet Top) contain significantly more sites than the lower elevation benches. The density of sites varies from a low of 0.7 per quarter section (2.8 sites per section) for East Clark Bench to a high of 12.1 per quarter section (48.4 sites per section) for Horse Mountain. Nipple Bench, the survey stratum that is second lowest in elevation, has 2.9 sites per quarter section (11.6 sites per section), whereas the slightly higher Brigham Plains has 4.0 sites per quarter section (16 sites per sec-

tion). Except for Horse Flat, the other frames have 7 or more sites per quarter section, with the extensive Fourmile Bench in the middle of the project area having a site density of 9.0 per quarter section (36.0 sites per section). For the project area as a whole the calculated site density is 6.6 per quarter section. Based on the survey data, we estimate that there are approximately 7730 sites within the nine sampling frames, with the vast majority of these of Native American affiliation (7364); the estimated total number of Euro-American sites is 432. NNAD's sample frames comprise a significant portion of the project area but given the excluded terrain the actual site count for the Kaiparowits Plateau excluding Fiftymile Mountain likely exceeds 10,000.

MANAGERIAL CONCLUSIONS

Eligibility Determinations

NNAD crew chiefs considered the majority of archaeological sites (514 of 710, or 72.4%) documented during the Kaiparowits Plateau Survey as eligible for nomination to the National Register (Table 10.1). Eligibility in virtually all cases stems from criterion (d) of the National Register, specifically the clause, "likely to yield information important in prehistory or history." The information that sites might yield principally relates to (1) helping in the reconstruction of local and regional culture history, (2) testing alternative models of subsistence-settlement organization, and (3) describing and understanding changes in adaptation to the diverse canyon-plateau environments of the Grand Staircase–Escalante National Monument. The sites that we considered eligible represent a diverse cross-section of site types on the Kaiparowits Plateau, sites with a mixed ability to provide information. Crew chiefs did not automatically consider small, sparse surface scatters of flaked stone artifacts as not eligible, nor did they necessarily consider large, complex scatters of artifacts as Register eligible. Because the vast majority of the sites are surface scatters of flaked stone artifacts, one of the chief characteristics considered by crew chiefs was the extent of post-depositional impact to and displacement of the lithic assemblages. Wildfires have resulted in some of the worst damage, by fragmenting flakes and tools into small undiagnostic pieces (undiagnostic of reduction technology and even raw material) and obscuring use-wear traces. Indeed, some sites were so heavily fire damaged that even despite numerous artifacts and temporal diagnostics they were not considered Register eligible. Erosion is another important consideration; many of the sites listed as not eligible are those that appear heavily impacted by a combination of both deflation and sheet washing. A lack of vertical context usually was not sufficient cause to consider a site as not eligible, because many of the lithic scatters of Archaic age on the Kaiparowits Plateau appear to be lag deposits. Rather, it was a lack of evident horizontal integrity, where remains had eroded downslope and mostly occurred in washes or where assemblages were obviously size-sorted—large artifacts in one place and small artifacts in another place. Recent tree-chaining is another type of damage that has compromised site integrity and led to some determinations of ineligibility.

Table 10.1. National Register status of all sites.

Register Status	Count	Percent
Eligible	514	72.4
Not Eligible	196	27.6
Total	710	100.0

Site Condition and Impacts

In terms of condition, 52 percent (n = 366) of the sites were evaluated as good, though only 20 sites (3%) were considered to be in excellent condition (Table 10.2). The remaining sites were in fair (n = 228, 32%) to poor (n = 96, 14%) condition. Such evaluations are inherently subjective and must be made with regard to the type of resource being evaluated. A diffuse surface scatter of flaked stone artifacts might have always been like this, thus it is in good or even excellent condition, whereas a rubble pile of a masonry pueblo obviously looked different initially so it might be considered to be in fair or even poor condition. For a pueblo we have some basis for knowing what its original condition actually was, but with a surface lithic scatter we usually lack such knowledge. Nonetheless, we expect any open masonry pueblo to be reduced to a ruin by natural causes, thus the evaluation of this site type is really of how well the ruin is preserved—has it been chained, is it being lost to an arroyo cut, are looters actively digging the site? With open lithic scatters we often lack a point of reference for making an informed judgment of condition. Some

of these sites might have begun their existence in the same state that we now judge them—fair to poor.

Table 10.2. Evaluation of condition for all sites.

Condition	Count	Percent
Excellent	20	2.8
Good	366	51.5
Fair	228	32.1
Poor	96	13.5
Total	710	100.0

Looting on the Kaiparowits Plateau seems largely restricted to sheltered sites. NNAD crews observed two examples of extensive disturbance to rockshelters. One of these is Tibbet Cave (42KA 13123) on Nipple Bench. MNA archaeologists originally recorded this site in 1974 and at that time they observed "extensive vandalism." Douglas McFadden rerecorded the site in 1999 and noted that it looked to be in much the same condition as in 1974 with the addition of a few shallow looter holes in more recent times. Based on our visit to the site, it appears that the original looting involved shoveling out the deposits along the front side of the shelter across an area that measures about 7 by 3 m. The looted area might have been taken down into sterile. In the dark back portion of the shelter there is an intact area of roughly 4 by 3 m and some portions in the front of the shelter might also be intact, especially areas covered by looter backdirt and a large roof spall. The lack of recent disturbance (since 1974) of this shelter might be because little of it remains intact—proficient looters can tell from the surface that it is probably not worth their effort. Such an appraisal does not extend to the scientific realm, because no doubt significant data remain in the shelter. The important point in this context is that it illustrates what has likely happened to many shelters on the Kaiparowits Plateau and what will unfortunately continue to happen at those shelters still preserved.

The truth of this last statement is borne out by our redocumentation of site 42KA2253 on Collet Top. This site was recorded during the Escalante Project in 1981, at which time only a single looter hole was observed (Kearns 1982:Figure 124). The rest of the dry midden deposits in the shelter were mapped as intact and described as well preserved. In 1991 when NNAD crews visited the site there were signs of extensive looting; much of the midden deposits within the shelter had been churned, especially along the dry front of the shelter where deposits were thickest. Indeed, it appeared that most areas of the shelter surface had been damaged to some degree. Moreover, the looting activity was not the scattered shallow holes of desultory digging, but the more systematic broadside digging of proficient, serious looters. As with Tibbet Cave, science can still learn much from this shelter, although far less than was the case back in 1981.

Other impacts at sheltered sites are from livestock (e.g., 42KA5543 and 42KA5555), rodents (primarily packrats), and deterioration (granaries) or deposit slumping from dripline erosion. A good example of the latter is Rose Shelter (42KA4794), where dripline erosion had exposed a 20 cm deep section of stratified deposits (laminated ash and sand containing artifacts, bone, and organics) and part of a basin hearth containing burned bone. Fortunately in this particular case, we were able to build a retaining wall and stabilize the deposits from further erosion after limited testing of the deposits (see Chapter 5).

In contrast to rockshelters, open sites on the Kaiparowits Plateau exhibited little to no evidence of recent illicit digging. Of course, few of the open sites are the sort that looters are ever interested in, consisting almost entirely of surface scatters of flaked stone artifacts. Yet even at the Anasazi structural habitations signs of looting are absent, including at sites right next to roads, such as 42KA5379. It is worth pointing out, however, that Eaton (1998) reported a looted masonry pueblo (temporary number 98-1) on Collet Top within a small parcel that she examined. She saw increased illicit digging and artifact collection at this site between 1995 and 1998.

Surface collection is a serious problem on the Kaiparowits Plateau, one we will return to in a moment, but before moving on it is important to note that more of the Anasazi structural sites have been impacted by tree-chaining than by looting. Evidence of widespread chaining occurs on Collet Top and Horse Flat, and apparently was in vogue as recently as the early 1980s. Uprooting trees seriously damages structural sites, even ones not directly driven over by the bulldozers. Of course, those sites driven over by heavy machinery are often in worse shape, especially if tracked equipment turned on a site. In some cases the tree debris piles were burned, either on purpose or later by natural fire, and when these piles occurred on sites even more damage resulted. Part of the reason that chaining can be so damaging on the Kaiparowits Plateau is the lack of sediment

accumulation over most sites. Sites are situated on very thin soils or on bedrock and there is seldom an accumulation of more recent eolian sand to function as a protective barrier.

Chaining can be equally destructive to open flaked stone scatters. In many of the chained areas of Horse Flat and Collet Top, we found artifact scatters that were difficult to interpret. Similar sites were found elsewhere as well, but in the chained areas there was a nagging question about whether the odd assemblages of remains were the result of disturbance. The dragging of artifacts in chained areas has doubtless destroyed much spatial patterning of remains and perhaps even created some of the large amorphous scatters that are problematic for managers and likely have little scientific value. Chaining likely obscured or completely eradicated small features such as hearths.

Collection of projectile points and other artifacts is a problem at several locations of the Kaiparowits Plateau, with the most obvious evidence for this practice occuring on Collet Top, Fourmile Bench, and Paradise Bench of the Horse Mountain stratum. Part of the evidence for this is the occurrence of modern collectors' piles on sites (e.g., 42GA4746, 42KA4578, 42KA4817, 42KA4827, and 42KA5391) as well as collectors' piles not associated with sites and recorded as isolated occurrences (see Chapter 9). Even lacking such direct evidence, collection can be inferred for sites and areas based on survey findings, or, more correctly, on what we did not find. For example, at some of the large flaked stone scatters on Paradise Bench that are closest to old mineral exploration roads and often criss-crossed by ORV tracks (quads and three-wheelers), NNAD crews rarely found projectile points. This lack was notable on sites with hundreds or thousands of bifacial thinning flakes, sites that in more remote settings always contained projectile points, even on Paradise Bench in settings away from roads and heavy ORV traffic. Surface collection is only likely to worsen with time, and road closures are unlikely to have little positive effect unless people actually obey the signs. Education is perhaps the best cure, so that people finally learn that tools from the past are not scattered on the landscape for them to pilfer.

Other types of typical impacts at open sites included water and wind erosion, livestock trampling, drill pad and road construction, ORV use, and historic or recent camping. Livestock trampling is a widespread, ongoing impact at nearly all sites, with some of the worst damage occurring to historic camps from the crushing of cans and the breaking of bottles. Stone tool damage can also occur, especially for items located on or near bedrock.

RECOMMENDATIONS

Additional Survey

Chapter 4 presents two different measures that reveal that additional survey is called for in each of the nine sampling strata in order to refine the estimates of site density. One of these is the two-sigma confidence interval, which provides a relative measure of how precise are the estimates of sites per survey unit and sites per sampling stratum with regard to population variability and sample size. Narrow confidence intervals suggest that the sample estimate is likely a close approximation of the total number of sites within sampling strata and that the amount of area currently surveyed may be adequate for making certain inferences. Wide confidence intervals indicate that the sample estimate is likely to be way off because of greater population variance. The intervals for many of the sample frames are quite wide, suggesting that larger sample fractions are needed for more precise estimates. On East Clark Bench, for example, there is the ridiculous possibility of the total site population being 61 ± 76 (a negative 15 sites). The interval for Long Flat is relatively narrow because of low population variability (i.e., most units had nearly the same number of sites), but even here the total number of sites within the stratum is 1284 ± 335 (between 949 and 1619).

An alternative way to evaluate whether and how much additional survey is needed in an area is to calculate the number of survey units required to achieve a specific bound on the error of estimation. The bound is simply whatever value managers might decide is acceptable, and in Tables 4.10 and 4.11 we give five different values ranging from 100 to 500 sites. In Table 4.10 a bound of 500 sites means that the estimate of total sites for the project area would be plus or minus this figure with 95 percent probability, whereas in Table 4.11 the bounds are specific to each stratum so that the 500 site bound applies to each stratum individually. For the project area as a whole (all nine strata), if 500 sites was an acceptable bound then we would need to survey 20 units on Nipple Bench (12 were surveyed), 48 units for Long Flat (18 were surveyed), and 56 units of Horse Mountain (8 were surveyed). Another way of looking at this is that we are currently 60 percent of the way

to achieving this bound on Nipple Bench, 40 percent of the way for Long Flat, but just 14 percent on Horse Mountain. Overall we are almost one-third of the way (32%) toward achieving this goal. Of course, an estimate of 500 sites might not be considered adequate in relation to the total number of sites projected to be within the project area (7730). If the desired level of specificity is set at 300 sites then considerably more sample units should be surveyed.

The figures of Table 4.11 provide a useful alternative way of looking at the need for additional survey and where it might be most profitably employed. It is evident from this table that some sampling strata currently have adequate coverage or near adequate coverage, whereas other strata are woefully lacking. If money becomes available for just a small survey project, this table could be used to suggest where the new acreage might have the greatest impact. For example, just another 8 units on Brigham Plains could result in reducing the bound on the error of estimation from about 275 sites to 200 sites. The sample frames and sample draws presented in this report will facilitate survey of any or all of these strata should additional survey funding become available. Future survey in the project area could be directed toward developing a model of site location and testing the assumptions and findings of the current project.

Aside from augmenting the sample fraction for the nine strata, we also advocate survey of at least four additional portions or zones of the Kaiparowits Plateau. One of these is the canyons that we explicitly excluded from our sample frames. The canyons might contain certain types of sites or sites of certain temporal affiliations that went underrepresented in the sample inventory. It would be best to conduct a program of canyon survey on either a reconnaissance basis or, if intensively, then by units that are defined by canyon walls and floors rather than quarter sections. It would be possible to design and execute such a survey by a simple random sample so that the canyons could be considered a tenth sample stratum for the area. The various canyon systems could be cut into sections and numbered sequentially to allow such an approach.

Another useful survey would be to intensively examine blocks around all springs and major seeps within the area. Many of these are within canyons, so there would be some overlap with the canyon survey, but this work should proceed irrespective of whether or not survey of canyons is done. Survey around water sources would be important for several reasons. One of these has to do with simple management of resources. Water sources are the focal points for cattle and much modern human activity, from camping to spring development for livestock. This results in greatly increased impacts to archaeological remains within the vicinity of water sources. An example of this is the badly looted shelter of 42KA2253, which was just down canyon from an intensive spring development. It could be that those who put in the water tanks and pipe had nothing to do with looting the shelter, but they easily could have. Regardless, the intensified modern activity around water sources seldom enhances the quality and integrity of cultural remains; thus there is considerable value to making a record of those remains as soon as possible. Just as springs and seeps are the focus of modern activity, they were also a focus of much prehistoric activity as well. Camps are likely to be preferentially located close to water sources. This does not mean right next to such sources, but within several hundred meters. Quarter sections or sections around springs and seeps should be intensively inventoried for cultural remains. Many of the major springs are located on the USGS topographic quadrangles, but some are not, and no seeps are plotted. For a water source inventory to be as comprehensive as possible it would be best to use aerial photos to ensure that most important springs and seeps are identified.

A third useful survey would be a focused program of inventory on Collet Top where several of our sample units documented a community of small Anasazi settlements similar to what occurs on Fiftymile Mountain. More needs to be learned about this community, such as its spatial and temporal parameters and whether our observations on artifact assemblages, architecture, and settlement layout are valid. At present there appears to be some spatial clustering of settlements without an obvious ecological basis (i.e., habitations occur in some areas but not in other areas that look equal in terms of resources—potential farm land, water, etc.). This raises the possibility that the community on Collet Top consisted of several scattered components that might represent different social groups (community segments). Another important reason for conducting such a survey is because some portions of this area were chained without the benefit of prior survey. We learned first hand of this in one of our sample units where several pueblos had been disturbed to an unknown extent. The destruction from tree chaining extends over a large expanse of the mesa top that has

never been examined and in all likelihood other Anasazi settlements have been disturbed. Such an ex post facto inventory would help meet management needs by documenting what was disturbed while at the same time providing much useful information about the Anasazi community on this portion of the Kaiparowits Plateau.

As a final survey recommendation, we believe that a reconnaissance of portions of Fiftymile Mountain would be quite beneficial. The motivation for this arises directly from the findings from the Anasazi community on Collet Top, which has raised a series of questions regarding the relationships and cultural identities of the Anasazi population on the Kaiparowits Plateau. We believe that a reappraisal of selected Fiftymile Mountain sites is in order, with specific attention to the flaked stone technology and the incidence of heat treatment, the nature of pueblo construction and layout, and aspects of ceramic production that are less dependant on geology. All of these aspects could provide circumstantial evidence for the "direction" of the Fiftymile Mountain "immigration." This work should go hand in hand with a laboratory reanalysis of a sampling of the collections from previous survey and excavation on Fiftymile Mountain by the University of Utah.

Additional Testing

Although additional survey is called for, we believe that well-designed and focused testing and excavation programs could considerably enhance archaeological interpretation and management decisions. Limited testing of 13 Phase 1 survey sites in 2000 produced excellent results with regard to the stated objectives (see Chapter 5) and similar success could be achieved with other excavation endeavors. On the heels of our second phase of survey, we have identified three additional testing and excavation projects, all of which have the potential to secure data important for both research and management purposes, and two of which involve studying previously impacted sites.

Open Anasazi Sites

The community of small Anasazi settlements on Collet Top is one of the most important cultural manifestations on the Kaiparowits Plateau. Study of this community could help resolve important questions concerning the cultural affiliation, function, and timing of Anasazi habitation for this portion of the monument. Unfortunately, some of the structural remains from a portion of this community have been impacted by past tree chaining. Unit 132 on Collet Top documented some of this disturbance to several Anasazi habitations (42KA 5434, 42KA5436, 42KA5437, and 42KA5438) north of the main east-west road through this area. The rooms or roomblocks and trash deposits at each of the sites have been mildly to seriously disturbed, but intact portions remain for study. Similar Anasazi structural sites likely exist within other unsurveyed but chained portions of Collet Top. We recommend a focused excavation program at select examples of the Anasazi habitations within the chained areas. The management objective of this work will be to determine the extent of disturbance from tree clearance. More important will be the research objectives, which should involve chronological refinement, settlement and subsistence practices, determining the source area for the population that created the Collet Top community, and analyzing the degree of interaction (if any) with Fremont populations. The former objective has the possibility of being met with tree-ring dates, which would greatly help to refine local chronology. Several of the recorded Collet Top structural sites such as 42KA5434 have burned, preserving large fragments of jacal and roof mortar with post and beam impressions. These sites have good potential for partially intact, carbonized structural timbers that could be tree-ring dated to provide important temporal placement for the sites and the Anasazi settlement on Collet Top at large. The architectural features and artifactual remains at these sites should provide sufficient information for testing the hypothesis presented in Chapter 8 that the Anasazi who populated the Kaiparowits Plateau during the twelfth century A.D. did not originate in the adjacent Kayenta Anasazi region. Moreover, the artifactual remains from small single-component habitations should allow assessment for the degree of interaction with the Fremont populations. Finally, subsistence remains from the architectural features and trash deposits as well as tool assemblages should allow inferences regarding subsistence practices.

Looted Rockshelters

Another opportunity to salvage well-preserved remains comes from two partially disturbed rockshelters in the project area—one known to have been heavily damaged prior to 1974 and the other evidently damaged relatively recently (between 1981 and 2000). The first is Tibbet Cave (42KA1323), located on Nipple Bench just west of an unnamed spring at the head of Tibbet Canyon. This shelter had been extensively

looted at the time the site was first recorded in 1974, but an inspection by NNAD personnel in 2000 showed that portions of the fill remain intact. In fact, a rather large area of the shelter floor is completely undisturbed, as it lies beneath a sizeable roof spall. Pottery at the site indicates use during the Formative period by both the Fremont and Anasazi, and earlier use is also possible. The second rockshelter (42KA2253) is on the east side of a small side canyon of Long Canyon on Collet Top. The shelter is approximately 25–30 m wide at the mouth and extends up to 17 m behind the drip line. Looters have disturbed the northern portion of the shelter in particular, but significant intact cultural deposits remain. Features include a bell-shaped pit, slab-lined cists, and a dry-laid structure. Ceramics suggest use by Fremont peoples, but a dart point introduces the possibility of earlier use of the shelter. Abundant parched and cracked pinyon nut shells along with several grinding tools (metates and manos) suggest that the site was used, at least in part, as a processing camp for this resource.

We recommend a limited testing program to determine what portions of the shelters remain intact and to sample their undisturbed deposits. As the limited testing of Rose Shelter demonstrates (see Chapter 5), even highly restricted excavation can retrieve important data before it is lost. The management objective of this work will be to determine the extent of disturbance from looting as a guide to what might remain at similar damaged shelters on the Kaiparowits Plateau. The research objectives should involve chronological refinement, determining settlement and subsistence practices, and helping to elucidate patterns of differential use of the benches that comprise the Kaiparowits Plateau. Both sites appear to have played roles as limited activity camps for Formative populations. What activities were conducted at the sites and how do these reflect use of the general terrain that the shelters are situated within? Nipple Bench and Collet Top have markedly different environmental characteristics. It is therefore expectable that Formative populations might have used these shelters for quite different purposes or during different seasons. Testing of these sites might also help to establish a preceramic through Formative sequence for the Kaiparowits Plateau.

Post-Formative (Paiute) Sites

The final recommended testing program concerns sites from the last period of Native American use of the Kaiparowits Plateau—those of the Southern Paiute. Remains from this interval have been poorly documented in previous inventory work on the Kaiparowits Plateau and in the surrounding region. The alternative dating criteria that NNAD surveyors employed on the Kaiparowits Plateau Survey enabled far more sites to be assigned to this interval than would have been possible based on traditional temporal diagnostics. Even though most sites of this period seem to be surface phenomena with little depth, they appear quite well preserved with tight spatial clustering of remains; also many contain hearths and testing has shown that they can have well-preserved faunal and floral assemblages. We recommend limited testing of sites of this period selected to cover the range of settlement variability that is evident. The study of Post-Formative sites has several research objectives. One is to refine our understanding of Paiute adaptation and lifeways on the Kaiparowits Plateau, especially with regard to changes wrought by contact with Euro-Americans or the other historic impacts such as slave raids. To what extent do expectations drawn from existing ethnographic data about patterning in the Post-Formative archaeological record differ from the results obtained from testing? Does the archaeological record reflect changes resulting from contact and to what extent is the post-contact record different from that of the pre-contact record? The other important aspect of this study will be using the Post-Formative record as a tool for helping us to understand Archaic use of the Kaiparowits Plateau. This derives from the comparison of Archaic and Paiute archaeological records presented in Chapter 8 and the discussion of reasons for evident differences. To further this sort of investigation it will be important to establish a detailed record of Post-Formative forager use of the Kaiparowits Plateau as a comparative baseline.

REFERENCES CITED

Adams, W.Y., A.J. Lindsay, Jr., and C.G. Turner, III

1961 *Survey and Excavations in Lower Glen Canyon, 1952–1958.* Museum of Northern Arizona Bulletin No. 36. Northern Arizona Society of Science and Art, Flagstaff.

Adavasio, J.M., and D.R. Pedler

1994 A Tisket, a Tasket: Looking at the Numic Speakers through the "Lens" of the Basket. In *Across the West: Human Population Movement and the Expansion of the Numa*, ed. by D.B. Madsen and D. Rhode, pp. 114–123. University of Utah Press, Salt Lake City.

Ahler, S.A.

1979 Functional Analysis of Nonobsidian Chipped Stone Artifacts: Terms, Variables, and Quantification. In *Lithic Use Wear Analysis*, edited by B. Hayden, pp. 301–328. Academic, New York.

Ahler, S.A. (editor)

1994 *A Working Manual for Field and Laboratory Techniques and Methods for the 1992–1996 Lake Ilo Archaeological Project.* Copy on file, U.S. Fish and Wildlife Service, North Dakota.

Aikens, C.M.

1962 *The Archaeology of the Kaiparowits Plateau, Southeastern Utah.* Unpublished Master's thesis, University of Chicago, Chicago.

1963 Appendix II: Kaiparowits Survey, 1961. In *1961 Excavations, Kaiparowits Plateau, Utah*, by D.D. Fowler and C.M. Aikens, pp. 70–100. Anthropological Papers No. 66. University of Utah Press, Salt Lake City.

1970 *Hogup Cave.* Anthropological Papers No. 93. University of Utah Press, Salt Lake City.

Allison, M.L.

1998 The Geography and Geology. In *Visions of the Grand Staircase–Escalante*, edited by R.B. Keiter, S.B. George, and J. Walker, pp. 3–12. Utah Museum of Natural History and Wallace Stegner Center, Salt Lake City.

Altschul, J.H., and H.C. Fairley

1989 *Man, Models, and Management: An Overview of the Archaeology of the Arizona Strip and the Management of its Cultural Resources.* Report prepared for USDA Forest Service and USDI Bureau of Land Management.

Ambler, J.R.

1985 Northern Kayenta Ceramic Chronology. In *Archaeological Investigations near Rainbow City, Navajo Mountain, Utah*, by P.R. Geib, J.R. Ambler, and M.M. Callahan, pp. 28–68. Northern Arizona University Archaeological Report No. 576. Flagstaff.

1996 Dust Devil Cave and Archaic Complexes of the Glen Canyon Area. In *Glen Canyon Revisited*, pp. 40–52. Anthropological Papers No. 119. University of Utah Press, Salt Lake City.

Ambler, J.R., H.C. Fairley, and P.G. Geib

1983 *Kayenta Anasazi Utilization of Canyons and Plateaus in the Navajo Mountain District.* Paper presented at the Second Anasazi Symposium, Farmington, New Mexico.

Ambler, J.R., A.J. Lindsay, Jr., and M.A. Stein

1964 *Survey and Excavations on Cummings Mesa, Arizona and Utah, 1960–1961.* Museum of Northern Arizona Bulletin No. 42. Northern Arizona Society of Science and Art, Flagstaff.

Amsden, C.A.
1935 The Pinto Basin Artifacts. In *The Pinto Basin Site*, by E.W.C. Campbell and W.H. Campbell, pp. 33–51. Southwest Museum Paper 9. Los Angeles.

Anthony, D.W.
1990 Migration in Archaeology: The Baby and the Bathwater. *American Anthropologist* 92:895–914.

Arnold, D.E.
1985 *Ceramic Theory and Cultural Process.* Cambridge University Press, Cambridge.

Atwood, W.D., C.L. Pritchett, R.D. Porter, and B.W. Wood
1980 Terrestrial Vertebrate Fauna at the Kaiparowits Basin. *Great Basin Naturalist* 40:303–350.

Ayres, J.E.
1966 A Clovis Fluted Point from the Kayenta, Arizona Area. *Plateau* 38:76–78.

Bachman, G.O., and M.N. Machette
1977 *Calcic Soils and Calcretes in the Southwestern United States.* U.S. Geological Survey Open File Report 77–794.

Bachtell, T.W., and M.S. Johnson
1998 Private Industry and its Access Rights. In *Visions of the Grand Staircase–Escalante*, edited by R.B. Keiter, S.B. George, and J. Walker, pp. 121–125. Utah Museum of Natural History and Wallace Stegner Center, Salt Lake City.

Baldwin, G.C.
1944 An Occurrence of Jeddito Black on Yellow Pottery in Northwestern Arizona North of the Grand Canyon. *Plateau* 17:14–16.

1950 The Pottery of the Southern Paiute. *American Antiquity* 16:50–56.

Beaglehole, E.
1937 *Notes on Hopi Economic Life.* Yale University Publications in Anthropology No. 15. Yale University Press, New Haven.

Beals, R.L., G.W. Brainerd, and W. Smith
1945 *Archaeological Studies in Northeast Arizona: A Report on the Archaeological Work of the Rainbow Bridge–Monument Valley Expedition.* Publications in American Archaeology and Ethnology Vol. 44, No. 1. University of California Press, Berkeley and Los Angeles.

Belnap, J.
1989 The Biota and Ecology. In *Visions of the Grand Staircase–Escalante*, edited by R.B. Keiter, S.B. George, and J. Walker, pp. 21–30. Utah Museum of Natural History and Wallace Stegner Center, Salt Lake City.

Benson, L.
1982 *The Cacti of the United States and Canada.* Stanford University Press, Stanford.

Benson, M.P.
1982 The Sitterud Bundle: A Prehistoric Cache from Central Utah. In *Archaeological Investigations in Utah*, assembled by D.B. Madsen and R.E. Fike. Cultural Resources Series No. 12. Utah State Office, USDI Bureau of Land Management, Salt Lake City.

Berry, C.F., and M.S. Berry
1986 Chronological and Conceptual Models of the Southwestern Archaic. In *Anthropology of the Desert West. Essays in Honor of Jesse D. Jennings*, edited by C.J. Condie and D.D. Fowler, pp. 252–327. Anthropological Papers No. 110. University of Utah Press, Salt Lake City.

Bettinger, R.L., J.F. O'Connell, and D.H. Thomas
1991 Projectile Points As Time Markers in the Great Basin. *American Anthropologist* 93:166–172.

Binford, L.R.
1978 Dimensional Analysis of Behavior and Site Structure: Learning from an Eskimo Hunting Stand. *American Antiquity* 43:330–361.

1979 Organizational and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35(3):255–273.

1980 Willow Smoke and Dog's Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45:4–20.

1981 *Bones: Ancient Man and Modern Myths.* Academic Press, New York.

1982 The Archaeology of Place. *Journal of Anthropological Archaeology* 1:5–31.

Black, K.D., and M.D. Metcalf
1986 *The Castle Valley Archaeological Project: An Inventory and Predictive Model of Selected Tracts.* Cultural Resource Series No. 19. USDI Bureau of Land Management, Utah State Office, Salt Lake City.

Bogan, M.A., and C.A. Ramotnik
1998 Mammalian Species Diversity of the Grand Staircase–Escalante National Monument. In *Learning from the Land: Grand Staircase–Escalante National Monument Science Symposium Proceedings*, edited by L.M. Hill, pp. 153–159. USDI Bureau of Land Management, Salt Lake City, Utah.

Bolton, H.E.
1950 Pageant in the Wilderness: The Story of the Escalante Expedition into the Interior Basin, 1776, Including the Diary and Itinerary of Father Escalante. *Utah Historical Quarterly* 18(1–4):1–265.

Bradford, J.E.
1974 *Archaeological Clearance Investigations, El Paso Natural Gas Company, Kaiparowits Project, Utah Bureau of Land Management, Kanab District and State of Utah Lands, Kane County, Utah.* Final report on file at the Museum of Northern Arizona, Flagstaff.

Bradley, B.
1974 Comments on the Lithic Technology of the Casper Site Materials. In *The Casper Site*, edited by G.C. Frison, pp. 191–197. Academic, New York.

Bradley, B.A., and G.C. Frison
1996 Flaked-Stone and Worked-Bone Artifacts from the Mill Iron Site. In *The Mill Iron Site*, edited by G.C. Frison, pp. 43–70. University of New Mexico Press, Albuquerque.

Brand, M.J.
1994 *Prehistoric Anasazi Diet: A Synthesis of Archaeological Evidence.* Master's thesis, University of British Columbia, Vancouver.

Brown, G.M.
1987 Review of Black and Metcalf (1986). *The UPAC News* 4(4):6–7.

1988 Appendix 3: Chipped Stone Raw Material Descriptions. In *Cultural Resource Investigations on the Kaibab Plateau, Northern Arizona: The Highway 67 Data Recovery Project*, compiled by Alan Schroedl. Cultural Resources Report 420-1-8819, P-III Associates, Salt Lake City, Utah.

Brown, D.E., and C.H. Lowe
1980 *Biotic Communities of the Southwest.* USDA Forest Service General Technical Report RM-78. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado.

1983 *Biotic Communities of the Southwest, Map, Scale 1:1,000,000.* USDA Forest Service General Technical Report RM-78. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colorado.

Brugge, D.M.
1968 *Navajos in the Catholic Church Records of New Mexico, 1694–1875.* Navajo Tribal Parks and Recreation Department, Research Section Report 1. Window Rock, Arizona.

Bryan, K., and J.H. Toulouse, Jr.
1943 The San Jose Non-ceramic Culture and its Relation to Puebloan Culture in New Mexico. *American Antiquity* 8:269–280.

Buikstra, J.E., and M. Swegle
1989 Bone Modification Due to Burning: Experimental Evidence. In *Bone Modification*, edited by R. Bonnichsen and M.H. Sorg, pp. 247–258. Center for the Study of the First Americans, University of Main, Orono.

Bungart, P.W.
1996 Dating Aceramic Sites in the Orange Cliffs Area. In *Glen Canyon Revisited*, by P.R. Geib, pp. 126–135. Anthropological Papers No. 119. University of Utah, Salt Lake City.

Bungart, P.W., and P.R. Geib
1987 Archaeological Testing in Bowns Canyon. In *Archaeological Investigations Along the Lower Escalante Drainage: Glen Canyon Year 2 Report, 1985–1986*, by P.R. Geib, P.W. Bungart, and H.C. Fairley, pp. 50–109. Northern Arizona University Archaeological Report 1000. Copy on file, Rocky Mountain Regional Office, National Park Service, Denver, Colorado.

Bungart, P.W., J.H. Collette, and K. Spurr
2001 *A Better Road Ahead: Archaeological Excavations Along Navajo Route 21 near White Mesa, Arizona.* Navajo Nation Archaeological Report No. 01-237. On file at Navajo Nation Historic Preservation Department, Window Rock, Arizona.

Bunte, P.A., and R.J. Franklin
1987 *From the Sands to the Mountain: Change and Persistence in a Southern Paiute Community.* University of Nebraska Press, Lincoln.

Busch, J.
1981 An Introduction to the Tin Can. *Historical Archaeology* 15(1):95–104.

2000 Second Time Around: A Look at Bottle Reuse. In *Approaches to Material Culture Research of Historical Archaeologists.* 2nd ed. Compiled by D.R. Brauner, pp. 175–188. Society for Historical Archaeology, California University of Pennsylvania, California, Pennsylvania.

Callahan, E.
1979 The Basics of Biface Knapping in the Eastern Fluted Point Tradition: A Manual for Flintknappers and Lithic Analysts. *Archaeology of Eastern North America* 7:1–180.

Castetter, E.F.
1935 *Uncultivated Native Plants Used As Sources of Food.* Biological Series 4(1). University of New Mexico Bulletin 266, Albuquerque.

Castetter, E.F., and W.H. Bell
1942 *Pima and Papago Indian Agriculture.* University of New Mexico Press, Albuquerque.

Castetter, E.F., and R.M. Underhill
1935 *The Ethnobiology of the Papago Indians.* Biological Series 4(3). University of New Mexico Bulletin 275, Albuquerque.

Chesher, G.K.
2000 *Heart of the Desert Wild: Grand Staircase–Escalante National Monument.* Bryce Canyon Natural History Association, Bryce Canyon, Utah.

Christenson, A.L., and W.J. Parry
1985 *Excavations on Black Mesa, 1983: A Descriptive Report.* Research Paper No. 46. Center for Archaeological Investigations, Southern Illinois University at Carbondale.

Clemmer, R.O., and O.C. Stewart
1986 Treaties, Reservations, and Claims. In *Handbook of North American Indians, Great Basin, Vol. 11*, edited by W.L. D'Azevedo, pp. 525–557. Smithsonian Institution, Washington, D.C.

Cochran, W.G.
1977 *Sampling Techniques.* John Wiley and Sons, New York.

Collette, J.H., and K. Spurr
2001 *An Archaeological Sample Survey of the Big Water Trust Land Block, East Clark Bench, Utah.* Navajo Nation Archaeology Department Report No. 00-56. On file at Utah School and Institutional Trust Lands Administration, Salt Lake City.

Colton, H.S.
1952 *Pottery Types of the Arizona Strip and Adjacent Areas in Utah and Nevada.* Museum of Northern Arizona Ceramic Series No. 1. Northern Arizona Society of Science and Art, Flagstaff.

1955 *Pottery Types of the Southwest: Wares 8A, 8B, 9A, and 9B.* Museum of Northern Arizona Ceramic Series No. 3. Northern Arizona Society of Science and Art, Flagstaff.

1956 *Pottery Types of the Southwest: Wares 5A, 5B, 6B, 7A, 7B, 7C, San Juan Red Ware, Homolovi Orange Ware, Winslow Orange Ware, Awatovi Yellow Ware, Jeddito Yellow Ware, Sichomovi Red Ware.* Museum of Northern Arizona Ceramic Series No. 3C. Northern Arizona Society of Science and Art, Flagstaff.

Copeland, J.M., and RE. Fike
1988 Fluted Projectile Points in Utah. *Utah Archaeology 1988* 1(1):5–28.

Cosgrove, C.B.
1947 *Caves of the Upper Gila and Hueco Areas in New Mexico and Texas.* Papers of the Peabody Museum of American Archaeology and Ethnology Vol. 24, No. 2. Cambridge, Massachusetts.

Crabtree, D.E.
1972 *An Introduction to Flintworking.* Occasional Papers of the Idaho State Museum 28. Pocatello.

Crampton, C.G.
1959 *Outline History of the Glen Canyon Region, 1776–1922.* Anthropological Papers No. 42 (Glen Canyon Series No. 9). University of Utah Press, Salt Lake City.

1983 *Standing Up Country: The Canyon Lands of Utah and Arizona.* Peregrine Smith, Salt Lake City, Utah.

1994 *Ghosts of Glen Canyon: History Beneath Lake Powell.* Rev. ed. Tower Productions, Salt Lake City, Utah.

Cronquist, A., A.J. Holmgren, N.H. Holgren, and J.L. Reveal
1972 *Intermountain Flora, Vol. 1. Geological and Botanical History of the Region, its Plant Geography and Glossary. The Vascular Cryptogams and the Gymnosperms.* Hafner, New York.

Crosswhite, F.S.
1981 Desert Plants, Habitat and Agriculture in Relation to the Major Pattern of Cultural Differentiation in the O'odham People of the Sonoran Desert. *Desert Plants* 3(2):47–76.

Curtin, L.S.M.
1965 *Healing Herbs of the Upper Río Grande.* Southwest Museum, Los Angeles.

1984 *By the Prophet of the Earth, Ethnobotany of the Pima.* Reissue of 1st ed. (1949), San Vicente Foundation, Santa Fe, by University of Arizona Press, Tucson.

Cushing, F.H.
1920 *Zuni Breadstuff.* Museum of the American Indian, Heye Foundation, New York.

Davidson, H.M.
1974 *Archaeological Clearance Investigations, Resources Company – Kaiparowits Power Project, Bureau of Land Management, Kanab District and State of Utah Land, Kane County, Utah.* Addendum to final report on file at the Museum of Northern Arizona, Flagstaff.

1975 *Archaeological Investigations, Kaiser Engineers Kaiparowits Power Project, Bureau of Land Management, Kanab District, and State of Utah Land, Kane County, Utah.* Copy on file at the Museum of Northern Arizona, Flagstaff.

Davis, W.E.
1985 The Montgomery Folsom Site. *Current Research in the Pleistocene* 2:11–12.

1989 The Lime Ridge Clovis Site. *Utah Archaeology 1989* 2(1):66–76.

Davis, W.E., and G.M. Brown
1986 The Lime Ridge Clovis Site. *Current Research in the Pleistocene* 3:1–3.

Davis, W.E., D. Sack, and N. Shearin
1996 The Hell 'n Moriah Clovis Site. *Utah Archaeology 1996* 9(1):55–70.

Decker, K.W., and L.L. Tieszen
1989 Isotopic Reconstruction of Mesa Verde Diet from Basketmaker III to Pueblo III. *Kiva* 55:33–46.

Doebley, J.
1984 "Seeds" of Wild Grasses: A Major Food of Southwestern Indians. *Economic Botany* 38(1):52–64.

Doelling, H.H., and F.D. Davis
1989 *The Geology of Kane County, Utah: Geology, Mineral Resources, Geologic Hazards.* Sections on petroleum and carbon dioxide by C.J. Brandt. Utah Geological and Mineral Survey, Salt Lake City.

Doelling, H.H., and R.L. Graham
1972 *Southwestern Utah Coal Fields—Alton, Kaiparowits Plateau and Kolob-Harmony.* Utah Geological and Mineralogical Survey Monograph I, Salt Lake City.

Dunnell, R.C., and W.S. Dancey
1983 The Siteless Survey: A Regional Scale Data Collection Strategy. In *Advances in Archaeological Method and Theory*, vol. 6, edited by M.B. Schiffer, pp. 267–287. Academic, New York.

Durrant, S.D.
1952 *Mammals of Utah: Taxonomy and Distribution*. Museum of Natural History Vol. 6. University of Kansas, Lawrence.

Dutton, C.E.
1880 *Report on the Geology of the High Plateaus of Utah*. United States Geological Service. U.S. Government Printing Office, Washington, D.C.

Eaton, L.B.
1998 Collet Top Archaeological Survey Report. Copy on file, USDI Bureau of Land Management, Kanab Resource District, Cedar City, Utah.

Ebeling, W.
1986 *Handbook of Indian Foods and Fibers of Arid America*. University of California Press, Berkeley.

Ebert, J.I.
1988 Modeling Human Systems and "Predicting" the Archaeological Record: The Unavoidable Relationship of Theory and Method. *American Archaeology* 7:3–8.

1992 *Distributional Archaeology*. University of New Mexico Press, Albuquerque.

Ebert, J.I., and T.A. Kohler
1988 The Theoretical Basis of Archaeological Predictive Modeling and a Consideration of Appropriate Data-Collection Methods. In *Quantifying the Present and Predicting the Past: Theory, Method, and Application of Archaeological Predictive Modeling*, edited by W.J. Judge and L. Sebastian, pp. 97–171. U.S. Department of the Interior, Bureau of Land Management, Denver, Colorado.

Eccles, C., and B.A. Walling-Frank
1998 Stone Implements Analysis. In *Excavation/Mitigation Report. Three Sites Near Hildale, Utah, 42WS2195, 42WS2196, AZ B:1:35(BLM) (Reservoir Site)*. Baseline Data, Inc., Orem Utah. Ms on file, USDI Bureau of Land Management, Cedar City District, Utah.

Elmore, F.H.
1944 *Ethnobotany of the Navajo*. University of New Mexico and the School of American Research Monograph 8. University of New Mexico Press, Albuquerque.

1976 *Shrubs and Trees of the Southwest Uplands*. Southwest Parks and Monuments Association, Globe, Arizona.

Euler, R.C.
1964 Southern Paiute Archaeology. *American Antiquity* 29:379–381.

1966 *Southern Paiute Ethnohistory*. Anthropological Papers No. 78 (Glen Canyon Series No. 28). University of Utah Press, Salt Lake City.

Fairley, H.C., P.W. Bungart, C.M. Coder, J. Huffman, T.L. Samples, and J.R. Balsom
1994 *The Grand Canyon River Corridor Survey Project: Archaeological Survey Along the Colorado River Between Glen Canyon Dam and Separation Canyon*. Prepared in cooperation with Glen Canyon Environmental Studies. Copy on file at National Park Service, Grand Canyon National Park, Grand Canyon.

Felger, R.S., and M.B. Moser
1985 *People of the Desert and Sea, Ethnobotany of the Seri Indians*. University of Arizona Press, Tucson.

Firebaugh, G.S.
1983 An Archaeologist's Guide to the Historical Evolution of Glass Bottle Technology. *Southwestern Lore* 49(2):9–29.

Firor, J.
1994 *Excavation of Two Prehistoric Southern Paiute Sites Near Kanab, Utah. Alpine Archaeological Consultants.* Copy on file, USDI Bureau of Land Management, Kanab Resource District, Cedar City, Utah.

Fish, P.
n.d. *Southern California Edison Company Kaiparowits Power Project. State, Private, and Federal Lands, Coconino and Mohave Counties, Arizona, Washington and Kane Counties, Utah.* Copy on file, Museum of Northern Arizona, Flagstaff.

Fisher, J.W.
1995 Bone Surface Modifications in Zooarchaeology. *Journal of Archaeological Method and Theory* 2:7–68.

Flenniken, J.J., and T.L. Ozbun
1988 Experimental Analysis of Plains Grooved Abraders. *Plains Anthropologist* 33:37–52.

Flenniken, J.J., and P.J. Wilke
1989 Typology, Technology and Chronology of Great Basin Dart Points. *American Anthropologist* 91(1):149–158.

Foley, R.
1977 Space and Energy: A Method for Analysing Habitat Value and Utilization in Relation to Archaeological Sites. In *Spatial Archaeology*, edited By D.L. Clarke, pp. 163–187. Academic Press, New York.

1981 Off-Site Archaeology: An Alternative Approach for the Short-Sited. In *Pattern of the Past: Studies in Honour of David L. Clark*, edited by I. Hodder, G. Isaac, and N. Hammond, pp. 157–183. Cambridge University Press, Cambridge, England.

Fowler, C.S.
1994 Material Culture and the Proposed Numic Expansion. In *Across the West: Human Population Movement and the Expansion of the Numa*, edited by D.B. Madsen and D. Rhode, pp. 103–113. University of Utah Press, Salt Lake City.

Fowler, C.S., and L.E. Dawson
1986 Ethnographic Basketry. In *Handbook of North American Indians, Great Basin, Vol. 11*, edited by W.L. D'Azevedo, pp. 705–737. Smithsonian Institution, Washington, D.C.

Fowler, D.D.
1963 *1961 Excavations, Harris Wash, Utah.* Anthropological Papers No. 64. University of Utah Press, Salt Lake City.

Fowler, D.D., and C.M. Aikens
1963 *1961 Excavations, Kaiparowits Plateau, Utah.* Anthropological Papers No. 66. University of Utah Press, Salt Lake City.

Fowler, D.D., and C.S. Fowler
1971 *Anthropology of the Numa: John Wesley Powell's Manuscripts on the Numa Peoples of Western North America, 1868–1880.* Smithsonian Contributions to Anthropology No. 14, Washington, D.C.

Fowler, D.D., and J.F. Matley

1978 *The Palmer Collection from Southwestern Utah, 1875*. Miscellaneous Paper 20, Anthropological Paper No. 99. University of Utah Press, Salt Lake City.

1979 *Material Culture of the Numa: the Powell Collection from Southern Utah and Northern Arizona, 1868–1880*. Smithsonian Contributions to Anthropology No. 26, Washington, D.C.

Fowler, D.D., J.H. Gunnerson, J.D. Jennings, R.H. Lister, D.A. Suhm, and T. Weller

1959 *The Glen Canyon Archaeological Survey*. Anthropological Papers No. 39, Part II. University of Utah Press, Salt Lake City.

Freethey, G.W.

1997 Hydrology of the Grand Staircase–Escalante National Monument. Paper presented at the Learning from the Land symposium, Cedar City, Utah.

Frison, G.C.

1968 A Functional Analysis of Certain Chipped Stone Tools. *American Antiquity* 33:149–155.

1974 *The Casper Site*. Academic, New York.

1978 *Prehistoric Hunters of the High Plains*. Academic, New York.

Frison, G.C., M. Wilson, and D.J. Wilson

1976 Fossil Bison and Artifacts from an Early Altithermal Period Arroyo Trap in Wyoming. *American Antiquity* 41:28–57.

Gasser, R.E.

1982a Anasazi Diet. In *The Coronado Project Archaeological Investigations, the Specialists' Volume: Biocultural Analyses*, edited by R.E. Gasser, pp. 8–95. Museum of Northern Arizona Research Paper No. 23, Coronado Series No. 3, Flagstaff.

1982b Are Roasting Pits Always Roasting Pits? *The Kiva* 47:171–176.

Gasser, R.E., and S.M. Kwiatkowski

1991 Food for Thought: Recognizing Patterns in Hohokam Subsistence. In *Exploring the Hohokam*, edited by G.J. Gumerman, pp. 417–459. 1st ed. Amerind Foundation and University of New Mexico Press, Dragoon, Arizona and Albuquerque.

Geary, E.A.

1992 *The Proper Edge of the Sky: The High Plateau Country of Utah*. University of Utah Press, Salt Lake City.

Geib, P.R.

1985 Lithic Artifacts. In *Archaeological Investigations near Rainbow City, Utah*. Northern Arizona University Archaeological Report No. 576, Flagstaff, Arizona.

1986 *Metate Production Along the Lower Colorado River: Archaeological Investigations at the Riviera Substation*. Northern Arizona University Archaeological Report No. 478. Flagstaff.

1989 *Archaeological Survey of Lower Glen Canyon Benches and a Descriptive Model of General Site Location*. Northern Arizona University Archaeological Report No. 1011. Copy on file, Rocky Mountain Regional Office, National Park Service, Denver, Colorado.

1995 Two Fluted Points from the Kaibito Plateau, Northeastern Arizona. *Kiva* 61(1):89–97.

1996 *Glen Canyon Revisited*. Anthropological Papers No. 119. University of Utah Press, Salt Lake City.

2000a Early Archaic Square-Stem Dart Points from Southeastern Utah. *Utah Archaeology 2000* 13:51–61.

2000b Basketmaker II Horn Flakers and Dart Point Production: Technological Change at the Agricultural Transition. *Proceedings of the Southwest Symposium 2000*. University Press of Colorado, Boulder. (In press)

Geib, P.R., and J.R. Ambler
1991 Sand Dune Side-Notched: An Early Archaic Projectile Point of the Northern Colorado Plateau. *Utah Archaeology* 4:17–22.

Geib, P.R., and J.M. Bremmer
1996 Problems with Inferring Site Function. In *Glen Canyon Revisited*, by P.R. Geib, pp. 136–154. Anthropological Papers No. 119. University of Utah Press, Salt Lake City.

Geib, P.R., and D. Davidson
1994 Anasazi Origins: A Perspective from Preliminary Work at Old Man Cave. *Kiva* 60:191–202.

Geib, P.R., and H.C. Fairley
1986 An Archaeological Survey of Bowns Canyon, Utah. In *Archaeological Survey in the Glen Canyon National Recreation Area: Year 1 Descriptive Report, 1984–1985*, by P.R. Geib, H.C. Fairley, and P.W. Bungart, pp. 91–171. Northern Arizona University Archaeological Report No. 999. Copy on file, Rocky Mountain Regional Office, National Park Service, Denver, Colorado.

1992 Radiocarbon Dating of Fremont Anthropomorphic Rock Art in Glen Canyon, South-Central Utah. *Journal of Field Archaeology* 19:155–168.

1996 A Pueblo III Community in Glen Canyon. In *Glen Canyon Revisited*, by P.R. Geib, pp. 185–194. Anthropological Papers No. 119. University of Utah Press, Salt Lake City.

1998 Archaeological Research in the New Monument: Lessons from Glen Canyon. In *Learning from the Land: Grand Staircase–Escalante National Monument Science Symposium Proceedings*, edited by L.M. Hill, pp. 53–63. USDI Bureau of Land Management, Salt Lake City, Utah.

Geib, P.R., and M.M. Lyneis
1996 Sources of Igneous Temper for Fremont Ceramics. In *Glen Canyon Revisited*, by P.R. Geib, pp. 167–179. Anthropological Papers No. 119. University of Utah Press, Salt Lake City.

Geib, P.R., and S.J. Smith
1998 Whence Corn Pollen at Archaeological Sites? An Experimental Study of Maize Ear Washes. Paper presented at the 21st Annual Conference, Society of Ethnobiology, Reno.

Geib, P.R., and K. Spurr
2000 The Basketmaker II–III Transition on the Rainbow Plateau. In *Foundations of Anasazi Culture: The Basketmaker-Pueblo Transition*, edited by P.F. Reed, pp. 175–200. University of Utah Press, Salt Lake City.

Geib, P.R., and M. Warburton
1991 *A Class 1 Cultural Resources and Ethnographic Overview of the Glen Canyon–Shiprock Transmission Line Corridor*. Copy on file, Navajo Nation Archaeology Department Report No. 91-016, Window Rock, Arizona.

Geib, P.R., H.C. Fairley, and P.W. Bungart
1986 *Archaeological Survey in the Glen Canyon National Recreation Area: Year 1 Descriptive Report, 1984–1985*. Northern Arizona University Archaeological Report No. 999. Copy on file, Rocky Mountain Regional Office, National Park Service, Denver, Colorado.

Geib, P.R., H.C. Fairley, and M. Davenport
1987 An Archaeological Survey of Cow Canyon. In *Archaeological Investigations Along the Lower Escalante Drainage: Glen Canyon Year 2 Report, 1985–1986*, by P.R. Geib, P.W. Bungart, and H.C. Fairley, pp. 4–49. Northern Arizona University Archaeological Report No. 1000. Copy on file, Rocky Mountain Regional Office, National Park Service, Denver, Colorado.

Geib, P.R., J. Huffman, and K. Spurr
1999 *An Archaeological Sample Survey of the Western Kaiparowits Plateau*. Copy on file, Navajo Nation Archaeology Department Report No. 98-112, Window Rock, Arizona.

Geib, P.R., J. Huffman, and M. Warburton
1998 *Class II Cultural Resource Inventory, Kaiparowits Plateau*. Copy on file, Navajo Nation Archaeology Department, Northern Arizona University Branch Office, Flagstaff.

Geib, P.R., J. Huffman, and M. Warburton
1999 *The Kaiparowits Plateau Study: Archaeological Testing and Continuation of Class II Cultural Resource Inventory. Volume II Technical Proposal*. Copy on file, Navajo Nation Archaeology Department, Northern Arizona University Branch Office, Flagstaff.

Geib, P.R, K. Spurr, and J. Collette
2001 *An Archaeological Sample Survey of the Central Kaiparowits Plateau*. Copy on file, Navajo Nation Archaeology Department Report No. 00-211, Window Rock, Arizona.

Geib, P.R., V.H. Clark, J. Huffman, K Spurr, M. Warburton, and K.A. Hays-Gilpin
1995 *Excavations at Nine Sites along Segment 3 of N16: An Interim Report of Data Recovery Findings*. Navajo Nation Archaeology Department Report No. 95-130, Window Rock.

Geib, P.R., J. Huffman, K. Spurr, L.T. Neff, V.H. Clark, M. Warburton, and K.A. Hays-Gilpin
1997 *Excavations at Nine Sites Along Segment 4 of N16: An Interim Report of Data Recovery Findings*. Navajo Nation Archaeology Department Report No. 95-131, Window Rock, Arizona.

Gifford-Gonzalez, D.P.
1989 Ethnographic Analogues for Interpreting Modified Bones: Some Cases from East Africa. In *Bone Modification*, edited by R. Bonnichsen and M.H. Sorg, pp. 43–52. Center for the Study of the First Americans, University of Maine, Orono.

Gile, L.H., F.F. Peterson, and R.B. Gossman
1966 Morphological and Genetic Sequences of Carbonate Accumulation in Desert Soils. *Soil Science* 101:347–360.

1979 *The Desert Project Soil Monograph*. U.S. Soil Conservation Service, Washington, D.C.

Gillette, D.D.
1998 Paleontological Resources. In *Visions of the Grand Staircase–Escalante*, edited by R.B. Keiter, S.B. George, and J. Walker, pp. 13–20. Utah Museum of Natural History and Wallace Stegner Center, Salt Lake City.

Gillette, D.D., and M.C. Hayden
1997 *A Preliminary Inventory of Paleontological Resources Within the Grand Staircase–Escalante National Monument, Utah*. Utah Geological Survey Circular 96, Salt Lake City.

Gilpin, D.
1994 Salina Springs and Lukachukai: Late Archaic/Early Basketmaker Habitation Sites in the Chinle Valley, Northeastern Arizona. *Kiva* 60:203–18.

Goodyear, A.C.
1979 *A Hypothesis for the Use of Cryptocrystalline Raw Materials Among Paleo-Indian Groups of North America.* Research Manuscript No. 156. University of South Carolina, Columbia.

Goss, J.A.
1965 Ute Linguistics and Anasazi Abandonment of the Four Corners Area. In *Contributions of the Wetherill Mesa Archaeological Project,* assembled by Douglas Osborne, pp. 73–81. Memoirs of the Society for American Archaeology 19. Salt Lake City, Utah.

Goudie, A.
1973 *Duricrusts in Tropical and Subtropical Landscapes.* Clarendon Press, Oxford.

Gould, R.A., D.A. Koster, and A.H.L. Sontz
1971 The Lithic Assemblage of the Western Desert Aborigines of Australia. *American Antiquity* 36:149–69.

Grayson, D.K.
1988 *Danger Cave, Last Supper Cave, and Hanging Rock Shelter: The Faunas.* Anthropological Paper 66. American Museum of Natural History, New York.

Greer, J.W.
1967 Midden Circles Versus Mescal Pits. *American Antiquity* 32:108–109.

Gregory, H. (editor)
1939 Diary of Almon Harris Thompson. *Utah Historical Quarterly* 7(1–3):1–140.

Gregory, H.E., and R.C. Moore
1931 *The Kaiparowits Region: A Geographic and Geologic Reconnaissance of Parts of Utah and Arizona.* U.S. Geological Survey Professional Paper 164. U.S. Government Printing Office, Washington, D.C.

Gruhn, R.
1961 *The Archaeology of Wilson Butte Cave, South Central Idaho.* Occasional Papers No. 6. Idaho State College Museum, Pocatello.

Guernsey, S.J., and A.V. Kidder
1921 *Basket Maker Caves of Northeastern Arizona.* Papers of the Peabody Museum of American Archaeology and Ethnology Vol. 8, No. 2. Harvard University, Cambridge.

Gunnerson, J.H.
1956 Fremont Ceramics. In *Papers of the Third Great Basin Archaeological Conference,* pp. 54–62. Anthropological Papers No. 26. University of Utah Press, Salt Lake City.

1959a Archaeological Survey of the Kaiparowits Plateau. In *The Glen Canyon Archaeological Survey,* by D.D. Fowler, J.H. Gunnerson, J.D. Jennings, R.H. Lister, D.A. Suhm, and T. Weller, pp. 318–471. Anthropological Papers No. 39, Part II. University of Utah Press, Salt Lake City.

1959b *1957 Excavations, Glen Canyon Area.* Anthropological Papers No. 43. University of Utah Press, Salt Lake City.

Hack, J.T.
1942 *The Changing Physical Environment of the Hopi Indians of Arizona.* Reports of the Awatovi Expedition, No. 1. Papers of the Peabody Museum of American Archaeology and Ethnology Vol. 35, No. 1. Harvard University, Cambridge.

Hackman, R.J., and D.G. Wyant
1973 *Geology, Structure, and Uranium Deposits of the Escalante Quadrangle Utah and Arizona.* Map I-744. Reprinted 1979. Miscellaneous Investigations Series, U.S. Geological Survey, Denver, Colorado.

Halbirt, C.D., and C.A. Gualtieri
1981 *Archeological Investigations, Utah International, Inc., San Francisco Alton Coal Field Survey, Federal, State, and Private Lands, Kane County, Utah.* Report A-79-108. Copy on file, Museum of Northern Arizona, Flagstaff.

Halbirt, C.D., and T.K. Henderson (editors)
1993 *Archaic Occupation on the Santa Cruz Flats: The Tator Hills Archaeological Project.* Submitted to the USDI Bureau of Reclamation. Northland Research, Flagstaff.

Harrington, M.R.
1957 *A Pinto Site at Little Lake, California.* Southwestern Museum Papers No. 17. Los Angeles.

Hauck, F.R.
1979 *Cultural Resource Evaluation in South Central Utah 1977.* Cultural Resource Series No. 4. USDI Bureau of Land Management, Utah State Office, Salt Lake City.

Hayden, B.
1979 Snap, Shatter, and Superfractures: Use-Wear of Stone Skin Scrapers. In *Lithic Use Wear Analysis*, edited by B. Hayden, pp. 207–229. Academic, New York.

Hays, K.A.
1991 Ceramics. In *Homol'ovi II: Archaeology of an Ancestral Hopi Village, Arizona*, edited by E.C. Adams and K.A. Hays, pp. 23–48. Anthropological Paper No. 55. University of Arizona, Tucson.

Heath, S.H.
1998 A Historical Sketch of the Scientific Exploration of the Region Containing the Grand Staircase–Escalante National Monument. In *Learning from the Land: Grand Staircase–Escalante National Monument Science Symposium Proceedings*, edited by L.M. Hill, pp. 435–446. USDI Bureau of Land Management, Salt Lake City, Utah.

Heizer, R.F.
1954 *Notes on the Utah Utes by Edward Palmer, 1866–1877.* Anthropological Papers No. 17, pp. 1–8. University of Utah Press, Salt Lake City.

Heizer, R.F., and M.A. Baumhoff
1961 The Archaeology of Two Sites at Eastgate, Churchill County, Nevada: Wagon Jack Shelter. *University of California Anthropology Records* 20(4):119–149.

Heizer, R.F., M.A. Baumhoff, and C.W. Clewlow, Jr.
1968 *Archaeology of South Fork Rockshelter (NV-EL-11), Elko County, Nevada.* Archaeological Survey Reports 71. University of California, Berkeley.

Hesse, I.S.
1995 A Reworked Clovis Point Near Chevelon Ruin, Arizona. *Kiva* 61:83–88.

Hesse, I.S., W.J. Parry, and F.E. Smiley
1996 A Unique Late Paleoindian Site Near Inscription House, Northeastern Arizona. Paper presented at the Society for American Archaeology Meetings, New Orleans.

Hester, T.R.
1973 *Chronological Ordering of Great Basin Prehistory.* University of California Archaeological Research Facility Contributions No. 17. University of California Press, Berkeley.

Hettinger, R.D., L.N.R. Roberts, L.R.H. Biewick, and M.A. Kirschbaum
1996 *Preliminary Investigations of the Distribution and Resources of Coal in the Kaiparowits Plateau, Southern Utah.* U.S. Geological Survey Open File Report 96-539, Denver, Colorado.

Hofman, J.L., L.C. Todd, and M.B. Collins
1991 Identification of Central Texas Edwards Chert at the Folsom and Lindenmeier Sites. *Plains Anthropologist* 36(137):297–308

Holmer, R.N.
1978 *A Mathematical Typology for Archaic Projectile Points of the Eastern Great Basin.* Ph.D. dissertation, Department of Anthropology, University of Utah, Salt Lake City. University Microfilms, Ann Arbor.

1980a Projectile Points. In *Sudden Shelter*, edited by J.D. Jennings, A.R. Schroedl, and R.N. Holmer, pp. 63–83. Anthropological Papers No. 103. University of Utah Press, Salt Lake City.

1980b Chipped Stone Projectile Points. In *Cowboy Cave*, by J.D. Jennings, pp. 31–38. Anthropological Papers No. 104. University of Utah Press, Salt Lake City.

1986 Common Projectile Points of the Intermountain West. In *Anthropology of the Desert West. Essays in Honor of Jesse D. Jennings*, edited by C.J. Condie and D.D. Fowler, pp. 90–115. Anthropological Papers No. 110. University of Utah Press, Salt Lake City.

Holmer, R.N., and D.G. Weder
1980 Common Post-Archaic Projectile Points of the Fremont Area. In *Fremont Perspectives*, edited by D.B. Madsen, pp. 55–68. Antiquities Section Selected Papers Vol. 3, No. 16. Utah State Historical Society, Salt Lake City.

Horne, G., and G. Aiston
1924 *Savage Life in Central Australia.* Macmillan, London.

Huckell, B.B.
1986 *A Ground Stone Quarry on the Lower Colorado River, Northwestern Arizona.* Cultural Resource Series 3. USDI Bureau of Land Management, Phoenix, Arizona.

1995 *Of Marshes and Maize: Preceramic Agricultural Settlements in the Cienega Valley, Southeastern Arizona.* Anthropological Papers of the University of Arizona No. 59. University of Arizona Press, Tucson.

1996 The Archaic Prehistory of the North American Southwest. *Journal of World Prehistory* 10(3):305–372.

Huffman, J.
1993 *Between River and Rim: A Comparative View of Subsistence Systems in Grand Canyon, Arizona.* Master's thesis on file, Department of Anthropology, Northern Arizona University, Flagstaff.

Huffman, J., C.J. Phagan, G. Haynes, and T.W. Burchett
1990 *Archaeological Survey on the Kanab Plateau: 1989–90 Annual Technical Report.* Northern Arizona University Archaeology Report No. 1044. Submitted to Division of Resources Management and Planning, Grand Canyon National Park, Grand Canyon.

Hunt, R.
1974 *Archaeological Investigations, Kaiparowits Power Project, Southern California Edison Company, Bureau of Land Management Lands, Kanab District, Kane County, Utah.* Final report on file, Museum of Northern Arizona, Flagstaff.

1975a *Archaeological Investigations, Kaiparowits Power Project, Southern California Edison Company, Bureau of Land Management, Kanab District and State of Utah Lands, Kane County, Utah.* Preliminary report on file, Museum of Northern Arizona, Flagstaff.

1975b *Archaeological Investigations, El Paso Energy Resources Company, Kaiparowits Coal Project, Bureau of Land Management, Kanab District, and State of Utah Lands, Kane County, Utah.* Final report on file, Museum of Northern Arizona, Flagstaff.

1975c *Archaeological Investigations, Southern California Edison Company, Kaiparowits Power Project, State of Arizona, Private, and Bureau of Land Management Lands, Mohave County, Arizona.* Final report on file, Museum of Northern Arizona, Flagstaff.

1975d *Archaeological Investigations, Kaiser Engineers, Kaiparowits Coal Mining Project, Bureau of Land Management, Kanab District Lands, Kane County, Utah.* Addendum to final report on file, Museum of Northern Arizona, Flagstaff.

Hunt, A.
1960 *Archaeology of the Death Valley Salt Pan, California.* Anthropological Papers No. 47. University of Utah, Salt Lake City.

Huscher, B.H., and H.A. Huscher
1940 Potsherds from a Pinon Tree! *The Masterkey* 14:137–142.

Irwin-Williams, C.
1973 *The Oshara Tradition: Origins of Anasazi Culture.* Contributions in Anthropology 5(1). Eastern New Mexico University, Portales.

James, S.R.
1997 Methodological Issues Concerning Screen Size Recovery Rates and Their Effects on Archaeofaunal Interpretations. *Journal of Archaeological Science* 24:385–397.

Janetski, J.C.
1993 The Archaic to Formative Transition North of the Anasazi: A Basketmaker Perspective. In *Anasazi Basketmaker: Papers from the 1990 Wetherill–Grand Gulch Symposium*, edited by V.M. Atkins, pp. 223–241. Cultural Resources Series No. 24. USDI Bureau of Land Management, Salt Lake City, Utah.

Janetski, J.C., R. Crosland, and J.D. Wilde
1991 Preliminary Report on Aspen Shelter: An Upland Deer Hunting Camp on the Old Woman Plateau. *Utah Archaeology 1991* 4:32–43.

Jennings, J.D.
1957 *Danger Cave.* Anthropological Papers No. 27. University of Utah Press, Salt Lake City.

1966 *Glen Canyon: A Summary.* Anthropological Papers No. 81. University of Utah Press, Salt Lake City.

1980 *Cowboy Cave.* Anthropological Papers No. 104. University of Utah Press, Salt Lake City.

Jennings, J.D., A.R. Schroedl, and R.N. Holmer
1980 *Sudden Shelter.* Anthropological Papers No. 103. University of Utah Press, Salt Lake City.

Jochim, M.A.
1976 *Hunter Gatherer Subsistence and Settlement: A Predictive Model.* Academic Press, New York.

Jones, A.T.
1986 *A Cross Section of Grand Canyon Archaeology: Excavations at Five Sites Along the Colorado River.* Western Archaeological and Conservation Center, Publications in Anthropology No. 28. Tucson, Arizona.

Jones, V.H.

1931 *The Ethnobotany of the Isleta Indians.* Master's thesis, University of New Mexico, Albuquerque.

1938 An ancient Indian food plant. *El Palacio* 44(5-6):41–52.

Judd, N.M.

1926 *Archaeological Observations North of the Rio Colorado.* Bureau of American Ethnology Bulletin No. 82. Smithsonian Institution, Washington, D.C.

Kearney, T.H., and R.H. Peebles

1960 *Arizona Flora.* University of California Press, Berkeley.

Kearns, T.M.

1982 *The Escalante Project: A Class II Cultural Resource Inventory of Preference Right Coal Lease Tracts in South Central Utah.* 2 vols. Copy on file, USDI Bureau of Land Management, Kanab, Utah.

Keller, D.R.

1974 *Archaeological Clearance Investigations, Resources Company – Kaiparowits Power Project, Bureau of Land Management, Kanab District, Kane County, Utah.* Copy on file, Museum of Northern Arizona, Flagstaff.

1976 *Archaeological Investigations, Kaiser Engineers/Kaiparowits Power Project, U.S. Bureau of Land Management Federal and State Lands, Kane County, Utah.* Copy on file, Museum of Northern Arizona, Flagstaff.

1987 *Archaeological Investigations, Utah International, Inc., Alton Coal Project, Kane County, Utah.* Report A-86-50. Copy on file, Museum of Northern Arizona, Flagstaff.

2000 Archaeological Study of the Escalante River Canyon, Highway 12 to the Glen Canyon NRA, Garfield County, Utah. Paper presented at the Katharine Bartlett Symposium, Museum of Northern Arizona, Flagstaff.

Kelly, R.L.

1983 Hunter-Gatherer Mobility Strategies. *Journal of Anthropological Research* 39(3):277–306.

1988 The Three Sides of a Biface. *American Antiquity* 53:717–734.

Kelly, I.T.

1934 Southern Paiute Bands. *American Anthropologist* 36(4):547–560.

1964 *Southern Paiute Ethnography.* Anthropological Papers No. 69. University of Utah Press, Salt Lake City.

Kelly, I.T., and C.S. Fowler

1986 Southern Paiute. In *Handbook of North American Indians, Great Basin, Vol. 11,* edited by W.L. D'Azevedo, pp. 368–397. Smithsonian Institution, Washington, D.C.

Kent, S.

1991 The Relationship Between Mobility Strategies and Site Structure. In *The Interpretation of Spatial Patterning Within Stone Age Archaeological Sites,* edited by E. Kroll and T.D. Price, pp. 33–59. Plenum, New York.

1992 Studying Variability in the Archaeological Record: An Ethnoarchaeological Model for Distinguishing Mobility Patterns. *American Antiquity* 57:635–660.

Klein, R.G., and K. Cruz-Uribe
1984 *The Analysis of Animal Bones from Archaeological Sites.* University of Chicago Press, Chicago.

Kluckhohn, C.
1933 *Beyond the Rainbow.* Christopher Publishing House, Boston.

Kohl, R.B.
1991 Fluted Projectile Points in Southwestern Utah. *Utah Archaeology 1991*: 79–83.

Lanner, R.M.
1981 *The Piñon Pine: A Natural and Cultural History.* University of Nevada Press, Reno.

Lanning, E.P.
1963 Archaeology of the Rose Spring Site, INY-372. *University of California Publications in American Archaeology and Ethnology* 43:237–336. Berkeley.

LaRue, E.C.
1925 *Water Power and Flood Control of the Colorado River Below Green River, Utah.* USGS Water Supply Paper No. 556. U.S. Government Printing Office, Washington D.C.

Latady, W.R
1999 A Cultural Resource Inventory of the Proposed Escalante Campground, Escalante State Park, Garfield County, Utah. Ms. on file, Division of Parks and Recreation, Salt Lake City.

Lehr, J.H.
1978 *A Catalogue of the Flora of Arizona.* Desert Botanical Garden, Phoenix.

Lentz, D.L.
1984 Utah juniper (*Juniperus osteosperma*) cones and seeds from Salmon Ruin, New Mexico. *Journal of Ethnobiology* 4(2):191–200.

Leonard, R.D., and G.T. Jones
1989 *Quantifying Diversity in Archaeology.* Cambridge University Press, Cambridge.

Lindsay, L.W.
1974 *A Preliminary Survey of Archaeological Values and Recreation Potentials of the Kaiparowits Impact Area, Kane County, Utah.* Copy on file, Museum of Northern Arizona, Flagstaff.

Lindsay, L.W., and C.K. Lund
1976 *Pint Size Shelter.* Antiquities Section, Selected Papers Vol. III, No. 10. Utah State Historical Society, Salt Lake City.

Lindsay, A.J., Jr., J.R. Ambler, M.A. Stein, and P.M. Hobler
1968 *Survey and Excavation North and East of Navajo Mountain, Utah 1959–1962.* Museum of Northern Arizona Bulletin No. 45. Northern Arizona Society of Science and Art, Flagstaff.

Lipe, W.D.
1967 Anasazi Culture and its Relationship to the Environment in the Red Rock Plateau Region, Southeastern, Utah. Ph.D. dissertation, Yale University. University Microfilms, Ann Arbor.

1970 Anasazi Communities in the Red Rock Plateau, Southwestern Utah. In *Reconstructing Prehistoric Pueblo Societies*, edited by W.A. Longacre, pp. 84–139. University of New Mexico Press, Albuquerque.

Lister, F.C.
1960 Pottery. In *The Coombs Site, Part II*, by R.H. Lister, J.R. Ambler, and F.C. Lister, pp.182–238. Anthropological Papers No. 41. University of Utah Press, Salt Lake City.

1962 *The Kaiparowits Plateau in the Right Bank Ceramic Picture.* Master's thesis, Department of Anthropology, University of Utah, Salt Lake City.

1964 *Kaiparowits Plateau and Glen Canyon Prehistory: An Interpretation Based on Ceramics.* Anthropological Papers No. 71. University of Utah Press, Salt Lake City.

Lister, R.H.
1958 *The Glen Canyon Survey in 1957.* Anthropological Papers No. 30. University of Utah Press, Salt Lake City.

Lobdell, J.E.
1974 The Scoggin Site: A Study in McKean Typology. *Plains Anthropologist* 19:123–128.

Lowie, R.H.
1924 Notes on Shoshonean Ethnography. *Anthropological Papers of the American Museum of Natural History* 20(3):185–314. New York.

Lyman, R.L.
1994 *Vertebrate Taphonomy.* Cambridge University Press, Cambridge.

Lyneis, M.M.
1992 *The Main Ridge Community at Lost City: Virgin Anasazi Architecture, Ceramics, and Burials.* Anthropological Papers No. 117. University of Utah Press, Salt Lake City.

1994 East and Onto the Plateaus? An Archaeological Examination of the Numic Expansion in Southern Nevada, Northern Arizona, and Southern Utah. In *Across the West: Human Population Movement and the Expansion of the Numa,* pp. 141–149, edited by D.B. Madsen and D. Rhode. University of Utah Press, Salt Lake City.

1995 The Virgin Anasazi, Far Western Puebloans. *Journal of World Prehistory* 9(2):199–241.

1998 *Shinarump Problem 2: Plain Ware and Red Ware Adrift on a Sea of Sand.* Copy on file, Navajo Nation Archaeology Department, Northern Arizona University Branch Office, Flagstaff.

Machette, M.N.
1985 Calcic Soils of the Southwestern United States. In *Soils and Quaternary Geology of the Southwestern United States.* Special Paper 203. Geological Society of America, Boulder, Colorado.

Madsen, D.B.
1982 Salvage Excavations at Ticaboo Town Ruin (42Ga2295). In *Archaeological Investigations in Utah,* assembled by D.B. Madsen and R.E. Fike. Cultural Resource Series 12. USDI Bureau of Land Management, Utah State Office, Salt Lake City.

1989 *Exploring the Fremont.* Occasional Publication No. 8. Utah Museum of Natural History, University of Utah, Salt Lake City.

1997 *A Preliminary Assessment of Archaeological Resources Within the Grand Staircase–Escalante National Monument, Utah.* Circular 95. Utah Geological Survey, Salt Lake City.

Madsen, D.B., and D. Rhode
1994 *Human Population Movement and the Expansion of the Numa.* University of Utah Press, Salt Lake City.

Madsen, D.B., and S.R. Simms
1998 The Fremont Complex: A Behavioral Perspective. *Journal of World Prehistory* 12:255–336.

Madsen, R.E.
1977 *Prehistoric Ceramics of the Fremont.* Museum of Northern Arizona Ceramic Series No. 6. Northern Arizona Society of Science and Art, Flagstaff.

Matson, R.G.
1991 *Origins of Southwest Agriculture.* University of Arizona Press, Tucson.

McDougall, W.B.
1973 *Seed Plants of Northern Arizona.* Museum of Northern Arizona, Flagstaff.

McFadden, D.A.
1982 Archaeological Clearance Investigation of the Window Sash Bench Chaining, Kaiparowits Plateau. Copy on file, USDI Bureau of Land Management, Kanab Resource Area, Cedar City, Utah.

1996 Virgin Anasazi Settlement and Adaptation on the Grand Staircase. *Utah Archaeology 1996* 1(1):1–34.

1998 Formative Settlement on the Grand Staircase–Escalante National Monument: A Tale of Two Adaptations. In *Learning from the Land: Grand Staircase–Escalante National Monument Science Symposium Proceedings,* edited by L.M. Hill, pp. 91–102. USDI Bureau of Land Management, Salt Lake City, Utah.

2000 *Formative Chronology and Site Distribution on the Grand Staircase–Escalante National Monument.* Draft report on file, USDI Bureau of Land Management, Kanab Resource District, Cedar City, Utah.

Meals for Millions/Freedom from Hunger Foundation
1985 *O'odham I:waki, Wild Greens of the Desert People.* Meals for Millions/Freedom from Hunger Foundation, Tucson.

Mera, H.P.
1933 "Mescal Pits"—A Misnomer. *Science* 77:168–169.

1938 Reconnaissance and Excavation in Southwestern New Mexico. *Memoirs of the American Anthropological Association* 51:15–20.

Metcalfe, D.
1982 *The Cockscomb Project.* University of Utah Archaeological Center, Reports of Investigations 80–2. Salt Lake City.

Miller, G.L., and C. Sullivan
2000 Machine Made Containers and the End of Production for Mouth Blown Bottles. In Approaches to Material Culture Research for Historical Archaeologists. 2nd ed. Compiled by D.R. Brauner, pp. 161–174. Society for Historical Archaeology, California University of Pennsylvania, California, Pennsylvania.

Minnis, P.E.
1981 Seeds in Archaeological Sites: Sources and Some Interpretive Problems. *American Antiquity* 46(1):143–152.

1989 Prehistoric Diet in the Northern Southwest: Macroplant Remains from Four Corners Feces. *American Antiquity* 54:543–563.

Miller, A.R.
2000 *Basketmaker II Faunal Procurement: A Comparison of Rockshelters and Open-Air Sites Across the Northern Southwest.* Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Moffitt, K., S. Rayl, and M. Metcalf
1978 *Archaeological Investigations along the Navajo-McCullough Transmission Line, Southern Utah & Northern Arizona.* Anthropology Research Paper No. 10. Museum of Northern Arizona, Flagstaff.

Morris, E.A.
1958 A Possible Early Projectile Point from the Prayer Rock District, Arizona. *Southwestern Lore* 24(1):1–5.

Morss, N.
1931 *The Ancient Culture of the Fremont River in Utah.* Papers of the Peabody Museum of American Archaeology and Ethnology Vol. 12, No. 3. Harvard University, Cambridge.

Mulvaney, D.J.
1969 *The Prehistory of Australia.* London.

Murdock, J.R., S.L. Welsh, and B.W. Wood
1974 *Navajo-Kaiparowits Environmental Baseline Studies, Summary Report.* Center for Health and Environmental Studies. Botany and Range Science Department, Brigham Young University, Provo, Utah.

Neff, H., D.O. Larson, and M.D. Glascock
1997 The Evolution of Anasazi Ceramic Production and Distribution: Compositional Evidence from a Pueblo III Site in South-Central Utah. *Journal of Field Archaeology* 24:473–492.

Nelson, F.W., and R.D. Holmes
1979 *Trace Element Analysis of Obsidian Sources and Artifacts from Western Utah.* Antiquities Section Selected Papers No. 15. Utah State Historic Society, Salt Lake City.

Nickens, P.R., and K.L. Kvamme
1981 Archaeological Investigations at the Kanab Site, Kane County, Utah. In *Excavations of Two Anasazi Sites in Southern Utah 1979–1980,* assembled by R.E. Fike and D.B. Madsen. Cultural Resource Series No. 9. USDI Bureau of Land Management, Utah State Office, Salt Lake City.

Nielson, A.S.
1989 *An Archaeological Inventory of the Garkane Power Association, Inc., Glen Canyon to Paria Power Line Upgrade, Kane County, Utah Section.* Research Report No. 89-19. Nielson Consulting Group, Orem, Utah.

1993a *An Archaeological Inventory of the Proposed Garkane Power Association Glen Canyon to Paria Power Line Upgrade, Coconino County, Arizona.* Research Report No. A93-1. Nielson Consulting Group, Orem, Utah.

1993b *An Archaeological Inventory of the Proposed Garkane Power Association Glen Canyon to Paria Power Line Upgrade, Kane County, Utah.* Research Report No. 93-8. Nielson Consulting Group, Orem, Utah.

Nusbaum, J.L.
1922 *A Basket Maker Cave in Kane County, Utah.* Indian Notes and Monographs, Miscellaneous Series No. 29. Museum of the American Indian, Heye Foundation, New York.

Ockenfels, R.A., C.L. Ticer, A. Alexander, and J.A. Wennerlund
1996 *A Landscape-Level Pronghorn Antelope Habitat Evaluation Model for Arizona: A Final Report.* Arizona Game and Fish Department, Research Branch, Technical Report No. 19, Phoenix, Arizona.

Palmer, W.R.
1933 Paiute Indian Homelands. *Utah Historical Society Quarterly* 6(3):88–102. Salt Lake City.

Pattison, N.B., and L.D. Potter
1977 *Prehistoric and Historic Steps and Trails of Glen Canyon–Lake Powell.* Lake Powell Research Project Bulletin No. 45. Ms. on file, National Park Service, Page, Arizona.

Payne, S.
1982 Partial Recovery and Sample Bias: The Results of Some Sieving Experiments. In *Papers in Economic Prehistory*, edited by E.S. Higgs, pp. 49–64. Cambridge University Press, Cambridge.

Pearsall, D.
1989 *Paleoethnobotany: A Handbook of Procedures.* Academic Press, San Diego.

Peterson, K.L.
1987 Tree-Ring Transfer Functions for Estimating Corn Production. In *Dolores Archaeological Program: Supporting Studies: Settlement and Environment*, compiled by K.L. Peterson and J.D. Orcutt, pp. 217–231. Dolores Archaeological Program, University of Colorado, Boulder.

Phagan, C.J.
1988 Projectile Point Analysis, Part I: Production of Statistical Types and Subtypes. In *Dolores Archaeological Program: Supporting Studies: Additive and Reductive Technologies*, compiled by E. Blinman, C.J. Phagan, and R.H. Wilshusen, pp. 9–56. U.S. Bureau of Reclamation, Denver, Colorado.

Pielou, E.C.
1966 The Measurement of Diversity in Different Types of Biological Collections. *Journal of Theoretical Biology* 13:131–144.

Pierson, L.M.
1981 *Cultural Resource Summary of the East Central Portion of the Moab District.* Cultural Resource Series No. 10. USDI Bureau of Land Management, Salt Lake City, Utah.

Plog, F.
1979 Prehistory: Western Anasazi. In *Handbook of North American Indians, Great Basin, Vol. 9*, edited by A. Ortiz, pp. 108–130. Smithsonian Institution, Washington, D.C.

Plog, S., and M. Hegmon
1993 The Sample Size–Richness Relation: The Relevance of Research Questions, Sampling Strategies, and Behavioral Variation. *American Antiquity* 58:489–496.

1997 An Anthropological Perspective on the Sample Size–Richness Relation: A Response to Leonard. *American Antiquity* 62:717–718.

Plog, S., and J.N. Hill
1971 Cultural Materialism: A Theoretical Review. *American Antiquity* 47:709–741.

Plog, S., J.S. Dean, R. Effland, and S.W. Gaines
1978 SARG: Future Research Directions. In *Investigations of the Southwestern Anthropological Group: An Experiment in Archeological Cooperation*, edited by R.C. Euler and G.J. Gumerman, pp. 177–186. Museum of Northern Arizona, Flagstaff.

Price, D.
1987 *Hydrology of Area 57, Northern Great Plains and Rocky Mountain Coal Provinces, Utah and Arizona.* U.S. Geological Survey, Salt Lake City.

Rappaport, R.A.
1971 Nature, Culture, and Ecological Anthropology. In *Man, Culture and Society*, edited by H.L. Shapiro, pp. 237–267. Oxford University Press, New York.

Raven, C.

1990 *Prehistoric Human Geography in the Carson Desert: Part II: Archaeological Field Tests of Model Predictions.* U.S. Fish and Wildlife Service Cultural Resource Series No. 4, Portland, Oregon.

1991 Settlement Patterns and Foraging Strategies. In *Looking for the Marsh: Past, Present, and Future Archaeological Research in the Carson Desert.* U.S. Fish and Wildlife. Report on File with U.S. Fish and Wildlife Service, Portland, Oregon.

Raven, C., and R.G. Elston

1989 *Prehistoric Human Geography in the Carson Desert: Part I: A Predictive Model of Land-use in the Stillwater Wildlife Management Area.* U.S. Fish and Wildlife Service Cultural Resource Series No. 3, Portland, Oregon.

Reed, L.S., C.D. Wilson, and K. Hays-Gilpin

2000 From Brown to Gray: The Origins of Ceramic Technology in the Northern Southwest. In *Foundations of Anasazi Culture: The Basketmaker-Pueblo Transition,* edited by P.F. Reed, pp. 203–220.

Richards, M.

1997 *Deerskins into Buckskins: How to Tan with Natural Materials.* Backcountry Publishing, Cave Junction, Oregon.

Rogge, A.E., and T.R. Lincoln

1987 Predicting the Distribution of Archaeological Sites: A Case Study from the Central Arizona Project. *American Archaeology* 6:140–150.

Robbins, W.W., J.P. Harrington, and B. Freire-Marreco

1916 *Ethnobotany of the Tewa.* Bureau of American Ethnology Bulletin 55. Smithsonian Institution, Washington, D.C.

Rock, J.

1981 *Tin Can Notes and Comments.* Copy on file, Klamath National Forest, Region 5. USDA Forest Service, Oregon.

Rogers, M.J.

1939 *Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas.* Museum Papers 3. San Diego, California.

Root, M.J., S.A. Ahler, C.R. Falk, J.E. Foss, H. Haas, and J.A. Artz

1986 *Archaeological Investigations in the Knife River Flint Primary Source Area, Dunn County, North Dakota: 1982–1986 Program.* Contribution No. 234. Department of Anthropology, University of North Dakota, Grand Forks.

Roth, B.J., and B.B. Huckell

1992 Cortaro Points and the Archaic of Southern Arizona. *Kiva* 57:353–370.

Rottlander, R.

1975 The Formation of Patina on Flint. *Archaeometry* 17:106–110.

Sapir, E.

1930 The Southern Paiute Language. *Proceedings of the American Academy of Arts and Sciences* 65(1–3). Boston.

Sargent, K.A.

1984 *Environmental Geologic Studies of the Kaiparowits Coal-Basin Area, Utah.* U.S. Geological Survey Miscellaneous Investigations Series Map I-1033-G, Scale 1:125,000. Denver, Colorado.

Scheaffer, R.L., W. Mendenhall, and L. Ott
1979 *Elementary Survey Sampling*. 2nd ed. Duxbury Press, North Scituate, MA.

Schaefer, P.D.
1969 Prehistoric Trade in the Southwest and the Distribution of Pueblo IV Hopi Jeddito Black-on-yellow. *Kroeber Anthropological Papers* 41:54–77.

Schaffer, B.S. and J.L.J. Sanchez
1993 Comparison of 1/8"- and 1/4"-mesh Recovery of Controlled Samples of Small-to-Medium-Sized Mammals. *American Antiquity* 59:525–530.

Schilz, A.J.
1979 *The Desha Caves: Two Basketmaker Sites in Southeast Utah*. Master's thesis, California State University, Long Beach. University Microfilms, Ann Arbor.

Schmalz, R.F.
1960 Flint and the Patination of Flint Artifacts. *Proceedings of the Prehistoric Society* 26:44–49.

Schroeder, A.H.
1965 A Brief History of the Southern Utes. *Southwestern Lore* 30:53–78.

Schroedl, A.R.
1976 *The Archaic of the Northern Colorado Plateau*. Ph.D. dissertation, University of Utah, Salt Lake City.

1991 Paleo-Indian Occupation in the Eastern Great Basin and Northern Colorado Plateau. *Utah Archaeology 1991* 4:1–15.

1989 *Kayenta Anasazi Archaeology and Navajo Ethnohistory on the Northwestern Shonto Plateau: The N-16 Project*. P-III Associates, Inc. Salt lake City, Utah.

Schroedl, A.R., and N.J. Coulam
1994 Cowboy Cave Revisited. *Utah Archaeology* 7(1):1–34.

Scott, D.
1928 *Notes on a Reconnaissance of the Kaiparowits Plateau and Adjacent Regions*. Copy on file, Department of Anthropology, Harvard University, Cambridge.

Shafer, H.J.
1976 Belize Lithics: "Orange Peel" Flakes and Adze Manufacture. In *Maya Lithic Studies: Papers from the 1976 Belize Field Symposium*, edited by T.R. Hester and N. Hammond, pp. 21–34. Special Report No. 4. Center for Archaeological Research, University of Texas, San Antonio.

Sharrock, F.W., K.C. Day, and D.S. Dibble
1963 *1961 Excavations, Glen Canyon Area*. Anthropological Papers No. 63. University of Utah Press, Salt Lake City.

Shepherd, W.
1972 *Flint: Its Origins, Properties, and Uses*. Faber and Faber, London.

Simms, S.R.
1979 A Cultural Resource Inventory of the Glen Canyon to Sigurd Transmission Line, Arizona and Utah. *Western Anasazi Reports* 2(3):256–299.

1983 The Effects of Grinding Stone Reuse on the Archaeological Record in the Eastern Great Basin. *Journal of California and Great Basin Anthropology* 5:98–102.

Simms, S.R., and L.W. Lindsay
1989 42Md300, an Early Holocene Site in the Sevier Desert. *Utah Archaeology 1989* 2(1):56–66.

Simon, H.A.
1957 *Models of Man: Social and Rational.* John Wiley and Sons, New York.

Simonis, D.
1997 The Simonis Milk Can Guide. In *NewsMAC*, the Newsletter of the New Mexico Archaeological Council, Albuquerque.

Smiley, F.E.
1994 The Agricultural Transition in the Northern Southwest: Patterns in the Current Chronometric Data. *Kiva* 60:165–189.

1997 Toward Chronometric Resolution for Early Agriculture in the Northern Southwest. In *Early Farmers in the Northern Southwest: Papers on Chronometry, Social Dynamics, and Ecology*, pp. 13–42, edited by F.E. Smiley and M.R. Robins. Animas–La Plata Archaeological Project Research Paper No. 7. Copy on file, U.S. Bureau of Reclamation, Upper Colorado Region.

1998 Old Wood: Assessing Age Overestimation. In *Archaeological Chronometry: Radiocarbon and Tree-Ring Models and Applications from Black Mesa, Arizona*, by F.E. Smiley and R.V.N. Ahlstrom, pp. 49–64. Occsasional Paper No. 16. Center for Archaeological Investigations, Southern Illinois University, Carbondale.

Smiley, F.E., and M.R. Robins (editors)
1997 *Early Farmers in the Northern Southwest: Papers on Chronometry, Social Dynamics, and Ecology*. Animas–La Plata Archaeological Project Research Paper No. 7. Northern Arizona University, Flagstaff.

Smith, S.J., and Geib, P.R.
1999 *An Experimental Study of Grinding Tool Pollen Washes: Bridging the Inferential Gap Between Pollen Counts and Past Behavior*. Paper presented at the 64th Annual Meeting of the Society for American Archaeology, Chicago.

Spier, L.
1928 *Havasupai Ethnography*. American Museum of Natural History, New York.

Springer, C.H.
2001 *Big Water Residential & Industrial Development Project Parcels: A Cultural Resource Inventory, Kane County, Utah*. University of Utah Museum of Natural History Field Investigations. On file at Utah School and Institutional Trust Lands Administration, Salt Lake City.

Spurr, K.C.
1993 *Compositional Analysis of Temper in Emery Gray and Sevier Gray Ceramics of the Fremont Culture*. Master's thesis, Department of Anthropology, Northern Arizona University, Flagstaff.

Spurr, K., and K. Hays-Gilpin
1996 New Evidence for Early Basketmaker III Ceramics from the Kayenta Area. Paper presented at the 69th Pecos Conference, Flagstaff, Arizona.

Stevenson, M.C.
1915 *Ethnobotany of the Zuñi Indians*. Thirtieth Annual Report of the Bureau of American Ethnology, 1908–1909. Smithsonian Institution, Washington, D.C.

Steward, J.H.
1938 *Basin-Plateau Aboriginal Sociopolitical Groups*. Bulletin No. 120. Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.

1941 *Archaeological Reconnaissance of Southern Utah.* Bulletin No. 128. Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.

Stewart, O.C.
1942 Culture Element Distributions, XVIII: Ute-Southern Paiute. *University of California Anthropological Records* 6(4):231–356. Berkeley.

Sullivan, A.P., III
1992 Investigating the Archaeological Consequences of Short-Duration Occupations. *American Antiquity* 57:99–115.

Sullivan, A.P., and K.C. Rozen
1985 Debitage Analysis and Archaeological Interpretation. *American Antiquity* 50:755–779.

Szuter, C.R.
1991 *Hunting by Prehistoric Horticulturalists in the American Southwest.* Garland, New York.

Szuter, C.R., and F. Bayham
1989 Sedentism and Animal Procurement Among Desert Horticulturalists of the North American Southwest. In *Farmers As Hunters: The Implications of Sedentism,* edited by S. Kent, pp. 80–95. Cambridge University Press, Cambridge.

Tai, S.W.
1978 *Social Science Statistics: Its Elements and Applications.* Goodyear, Santa Monica, California.

Talbot, R.K., L.D. Richens, S.A. Baker, and J.C. Janetski
1999 *Broken Arrow Cave (42Ka4356): 1997 Testing Results.* Technical Series No. 99-5. Brigham Young University, Museum of Peoples and Cultures, Provo, Utah.

Thomas, D.H.
1969 Great Basin Hunting Patterns: A Quantitative Method for Treating Faunal Remains. *American Antiquity* 34:392–401.

1981 How to Classify the Projectile Points from Monitor Valley, Nevada. *Journal of California and Great Basin Anthropology* 3(1):7–43.

1983 *The Archaeology of Monitor Valley 1. Epistemology.* Anthropological Papers 58, Part 1. The American Museum of Natural History, New York.

1985 *The Archaeology of Hidden Cave, Nevada.* Anthropological Papers Vol. 61, Part 1. The American Museum of Natural History, New York.

1986a Contemporary Hunter Gatherer Archaeology in America. In *American Archaeology: Past and Future,* edited by D.J. Meltzer, D.D. Fowler, and J.A. Sabloff, pp. 237–276. Smithsonian Institution Press, Washington, D.C.

1986b Points on Points: Reply to Flenniken and Raymond. *American Antiquity* 51:619–627.

Thoms, A.V.
1988 A Survey of Predictive Locational Models: Examples from the Late 1970s and Early 1980s. In *Quantifying the Present and Predicting the Past: Theory, Method, and Application of Archaeological Predictive Modeling,* ed. by W.J. Judge and L. Sebastian, pp. 581–645. USDI Bureau of Land Management, Denver, Colorado.

Tipps, B.L.
1984 *The Captains Alcove: Test Excavations in Glen Canyon National Recreation Area, Kane County, Utah.* Midwest Archaeological Center, Lincoln, Nebraska.

1987 *Archaeological Investigations in the Lone Rock and Wahweap Development Areas, Glen Canyon National Recreation Area, Near Page, Arizona*. Occasional Studies in Anthropology No. 21. Midwest Archaeological Center, Lincoln, Nebraska.

1988 *The Tar Sands Project: An Inventory and Predictive Model for Central and Southern Utah*. Cultural Resource Series No. 22. USDI Bureau of Land Management, Utah State Office, Salt Lake City.

1992 *The Burr Trail Archaeological Project: Small Site Archaeology on the Escalante Plateau and Circle Cliffs, Garfield County, Utah*. P-III Associates, Salt Lake City. Submitted to the USDI Bureau of Land Management, Kanab Resource District, Cedar City, Utah.

1995 *Holocene Archaeology Near Squaw Butte, Canyonlands National Park, Utah*. Selections from the Division of Cultural Resources No. 7. National Park Service, Rocky Mountain Region, Denver, Colorado.

1998 Archaeology in the Grand Staircase–Escalante National Monument: Research Prospects and Management Issues. In *Learning from the Land: Grand Staircase–Escalante National Monument Science Symposium Proceedings*, edited by L.M. Hill, pp. 133–150. USDI Bureau of Land Management, Salt Lake City, Utah.

Tipps, B.L., and N.J. Hewitt
1989 *Cultural Resource Inventory and Testing in the Salt Creek Pocket and Devils Lane Area, Needles District, Canyonlands National Park, Utah*. Selections from the Division of Cultural Resources No. 1. Rocky Mountain Region, National Park Service, Denver, Colorado.

Tipps, B.L., and A.R. Schroedl
1988 Site Typology and Function. In *The Tar Sands Project: An Inventory and Predictive Model for Central and Southern Utah*, by B.L. Tipps, pp. 45–51. Cultural Resource Series No. 22. USDI Bureau of Land Management, Utah State Office, Salt Lake City.

Tipps, B.L., N.J. Hewitt, and W.A. Lucius
1989 Summary of the Artifacts and Features. In *Cultural Resource Inventory and Testing in the Salt Creek Pocket and Devils Lane Area, Needles District, Canyonlands National Park, Utah*, by B.L. Tipps and N.J. Hewitt, pp. 81–122. Selections from the Division of Cultural Resources No. 1. Rocky Mountain Region, National Park Service, Denver, Colorado.

Titmus, G.L.
1985 Some Aspects of Stone Tool Notching. In *Stone Tool Analysis. Essays in Honor of Don E. Crabtree*, edited by M.G. Plew, J.C. Woods, and M.G. Pavesic, pp. 243–263. University of New Mexico Press, Albuquerque.

Topping, G.
1997 *Glen Canyon and the San Juan Country*. University of Idaho Press, Moscow.

Toulouse, J.H.
1971 *Bottle Makers and Their Marks*. T. Nelson, New York.

Tyler, H.A.
1975 *Pueblo Animals and Myths*. University of Oklahoma Press, Norman.

U.S. Department of the Interior
1999 *Grand Staircase–Escalante National Monument Proposed Management Plan, Final Environmental Impact Statement*. USDI Bureau of Land Management, Cedar City, Utah.

Van Ness, M.A., and E. Hansen
1996 Archaic Subsistence in the Glen Canyon Region. In *Glen Canyon Revisited*, by P.R. Geib, pp. 117–125. Anthropological Papers No. 119. University of Utah Press, Salt Lake City.

VanNest, J.
1985 Patination of Knife River Flint Artifacts. *Plains Anthropologist* 30:325–339.

Ward, A.E., E.K. Abbink, and J.R. Stein
1977 Ethnohistorical and Chronological Basis of the Navajo Material Culture. In *Settlement and Subsistence Along the Lower Chaco River: The CGP Survey*, edited by C.A. Reher, pp. 217–278. University of New Mexico Press, Albuquerque.

Walling, B.A., and R.A. Thompson
1988 *Archaeology of the Dead Raven Site.* Copy on file, Intersearch, Cedar City, Utah.

Walling, B.A., R.A. Thompson, G.F. Dalley, and D.G. Weder
1986 *Excavations at Quail Creek.* Cultural Resource Series No. 20. USDI Bureau of Land Management, Salt Lake City, Utah.

Weber, S.A., and P.D. Seaman (editors)
1985 *Havasupai Habitat: A.F. Whiting's Ethnography of a Traditional Indian Culture.* University of Arizona Press, Tucson.

Weder, D., and D. Sammons-Lohse
1981 Chipped Stone Artifacts. In *Bull Creek*, by J.D. Jennings and D. Sammons-Lohse, pp. 65–75. Anthropological Papers No. 105. University of Utah Press, Salt Lake City.

Weigand, P.C.
1970 Huichol Ceremonial Reuse of a Fluted Point. *American Antiquity* 35:365–367.

Wells, S.J.
1991 *The Shivwits Plateau Survey: Archaeology at Lake Mead National Recreation Area.* Publications in Anthropology 56. Western Archaeological and Conservation Center, USDI National Park Service, Tucson, Arizona.

Welsh, S.L., N.D. Atwood, L.C. Higgins, and S. Goodrich
1987 *A Utah Flora.* Memoir No. 9. Great Basin Naturalist. Brigham Young University, Provo, Utah.

Wendrich, W.
1991 *Who Is Afraid of Basketry: A Guide to Recording Basketry and Cordage for Archaeologists and Ethnographers.* Publication No. 6. Center for Non-Western Studies, Leiden University, Leiden, Netherlands.

Westfall, D.A., W.E. Davis, and E. Blinman
1987 *Green Spring: An Anasazi and Southern Paiute Encampment in the St. George Basin of Utah.* Cultural Resource Series No. 21. USDI Bureau of Land Management, Salt Lake City, Utah.

Westwood, R.
1992 *Rough-Water Man: Elwyn Blake's Colorado River Expeditions.* University of Nevada Press, Reno.

Wheat, M.M.
1967 *Survival Arts of the Primitive Paiutes.* University of Nevada Press, Reno.

Whiting, A.F.
1966 *Ethnobotany of the Hopi.* Northland Press, Flagstaff, Arizona.

Whittaker, J.C.
1994 *Flintknapping: Making and Understanding Stone Tools.* University of Texas Press, Austin.

Wilcox, D.R., and W.B. Masse

1981 *The Protohistoric Period in the North American Southwest, A.D. 1450–1700.* Anthropological Research Paper No. 24. Arizona State University, Tempe.

Wills, W.H.

1988 *Early Prehistoric Agriculture in the American Southwest.* School of American Research Press, Santa Fe.

1995 Archaic Foraging and the Beginning of Food Production in the American Southwest. In *Last Hunters First Farmers: New Perspectives on the Prehistoric Transition to Agriculture,* edited by T.D. Price and A.B. Gebauer, pp. 215–242. School of American Research Press, Santa Fe, New Mexico.

Wilson, C.D., and F. Blinman

1994 Early Anasazi Ceramics and the Basketmaker Transition. In *Anasazi Symposium 1991,* compiled by A. Hutchinson and J.E. Smith, pp. 199–214. Mesa Verde Museum Association, Cortez, Colorado.

Winter, J., and H.G. Wylie

1974 Paleoecology and Diet of Clyde's Cavern. *American Antiquity* 39:303–315.

Wood, J.J.

1978 Optimal Location in Settlement Space: A Model for Describing Location Strategies. *American Antiquity* 43:258–270.

Woodbury, R.B.

1954 Prehistoric Stone Implements of Northeastern Arizona. *Papers of the Peabody Museum of American Archaeology and Ethnology,* Vol. XXXIV. Cambridge.

Woolsey, N.G.

1964 *The Escalante Story: A History of the Town of Escalante, and Description of the Surrounding Territory, Garfield County, Utah, 1875–1964.* Art City, Springville, Utah.

Yellen, J.E.

1977 *Archaeological Approaches to the Present.* Academic, New York.

Zar, J.H.

1974 *Biostatistical Analysis.* Prentice Hall, Englewood Cliffs, New Jersey.

Zier, C.J.

1974a *Archaeological Clearance Investigations, El Paso Natural Gas Company Kaiparowits Project, Bureau of Land Management and State of Utah Lands, Kane County, Utah.* Copy on file, Museum of Northern Arizona, Flagstaff.

1974b *Archaeological Clearance Investigations, Southern California Edison Company Kaiparowits Power Project, Bureau of Land Management Land, Kanab District, Kane County, Utah.* Copy on file, Museum of Northern Arizona, Flagstaff.

Zier, C.J., and H.M. Davidson

1974 *Archaeological Clearance Investigations, Southern California Edison Company Kaiparowits Power Project, Bureau of Land Management, Kanab District and State of Utah Lands, Kane County, Utah.* Copy on file, Museum of Northern Arizona, Flagstaff.

Appendix A

Concordance Between IMACS and NNAD Site Numbers and List of all Remains Collected from Sites

NNAD Site #	IMACS Site #	Collected items
1	42KA4544	N/A
2	42KA4545	N/A
3	42KA4546	1 dart point (P1), 1 sherd nip (S1), 1 metal can.
4	42KA4547	N/A
5	42KA4548	1 dart point (P1).
6	42KA4549	N/A
7	42KA4550	N/A
8	42KA4551	N/A
9	42KA4552	1 dart point (P1).
10	42KA4553	N/A
11	42KA4554	1 dart point (P1).
12	42KA4555	1 dart point (P1).
13	42KA4556	1 dart point (P1).
14	42KA4557	N/A
15	42KA4558	1 dart point (P1).
16	42KA4559	N/A
17	42KA4560	N/A
18	42KA4561	4 dart points (P1-4).
19	42KA4562	1 dart point (P1).
20	42KA4563	1 arrow point (P1), 5 dart points (P2-6), 1 sherd (S1).
21	42KA4564	2 dart points (P1-2).
22	42KA4565	N/A
23	42KA4566	1 dart point (P1).
24	42KA4567	11 dart points (P1-11).
25	42KA4568	N/A
26	42KA4569	N/A
27	42KA4570	N/A
28	42KA4571	N/A
29	42KA4572	1 obsidian flake, 1 sherd (S1).
30	42KA4573	N/A
31	42KA4574	1 dart point (P1).
32	42KA4575	N/A
33	42KA4576	2 sherd nips (S1-2).
34	42KA4577	N/A
35	42KA4578	1 arrow point (P1), 1 sherd (S1), 2 sherd nips (S2-3).
36	42KA4579	N/A
37	42KA4580	N/A
38	42KA4581	N/A
39	42KA4582	N/A
40	42KA4583	N/A
41	42KA4584	N/A
42	42KA4585	2 arrow points (P1-2), 3 obsidian flakes (F1-3).
43	42KA4586	2 dart points (P1-2), 1 chert flake (F1).
44	42KA4587	1 dart point (P1).
45	42KA4588	1 dart point (P1).
46	42KA4589	1 dart point (P1).
47	42KA4590	1 dart point (P1), 1 chert flake (F1).
48	42KA4591	3 dart points (P1-3).
49	42KA4592	1 arrow point (P1).
50	42KA4593	N/A

NNAD Site #	IMACS Site #	Collected items
51	42KA4594	1 dart point (P1).
52	42KA4595	N/A
53	42KA4596	N/A
54	42KA4597	1 dart point (P1).
55	42KA4598	1 dart point (P1).
56	42KA4599	N/A
57	42KA4600	N/A
58	42KA4601	N/A
59	42KA4602	N/A
60	42KA4603	N/A
61	42KA4604	N/A
62	42KA4605	N/A
63	42KA4606	N/A
64	42KA4607	1 dart point (P1).
65	42KA4608	N/A
66	42KA4609	4 dart points (P1-4).
67	42KA4610	N/A
68	42KA4611	N/A
69	42KA4612	N/A
70	42KA4613	N/A
71	42KA4614	2 sherd nips (S1-2).
72	42KA4615	N/A
73	42KA4616	1 dart point (P1).
74	42KA4617	N/A
75	42KA4618	N/A
76	42KA4619	2 dart points (P1-2).
77	42KA4620	1 dart point (P1).
78	42KA4621	N/A
79	42KA4622	N/A
80	42KA4623	N/A
81	42KA4624	N/A
82	42KA4625	N/A
83	42KA4626	N/A
84	42KA4627	1 dart point (P1).
85	42KA4628	N/A
86	42KA4629	3 dart points (P1-3).
87	42KA4630	N/A
88	42KA4631	N/A
89	42KA4632	N/A
90	42KA4633	2 dart points (P1-2).
91	42KA4634	1 dart point (P1).
92	42KA4635	N/A
93	42KA4636	N/A
94	42KA4637	N/A
95	42KA4638	1 dart point (P1).
96	42KA4639	N/A
97	42KA4640	N/A
98	42KA4641	1 dart point (P1).
99	42KA4642	N/A
100	42KA4643	N/A

NNAD Site #	IMACS Site #	Collected items
101	42KA4644	2 dart points (P1-2).
102	42KA4645	1 dart point (P1).
103	42KA4646	3 dart points (P1-3).
104	42KA4647	N/A
105	42KA4648	N/A
106	42KA4649	N/A
107	42KA4650	N/A
108	42KA4651	N/A
109	42KA4652	N/A
110	42KA4653	N/A
111	42KA4654	N/A
112	42KA4655	N/A
113	42KA4656	N/A
114	42KA4657	N/A
115	42KA4658	1 dart point (P1).
116	42KA4659	N/A
117	42KA4660	N/A
118	42KA4661	N/A
119	42KA4662	N/A
120	42KA4663	N/A
121	42KA4664	N/A
122	42KA4665	1 dart point (P1).
123	42KA4666	N/A
124	42KA4667	N/A
125	42KA4668	N/A
126	42KA4669	1 dart point (P1).
127	42KA4670	N/A
128	42KA4671	N/A
129	42KA4672	N/A
130	42KA4673	N/A
131	42KA4674	1 arrow point (P1).
132	42KA4675	9 sherd nips (S1-9).
133	42KA4676	1 arrow point (P1), 3 sherds (S1,3,4).
134	42KA4677	N/A
135	42KA4678	N/A
136	42KA4679	1 dart point (P1).
137	42KA4680	N/A
138	42KA4681	1 dart point (P1).
139	42KA4682	N/A
140	42KA4683	N/A
141	42KA4684	2 dart points (P1-2).
142	42KA4685	2 dart points (P1-2).
143	42KA4686	1 dart point (P1).
144	42KA4687	N/A
145	42KA4688	1 arrow point (P1), 3 dart points (P2-4).
146	42KA4689	7 dart points (P1-7).
147	42KA4690	N/A
148	42KA4691	2 dart points (P1-2).
149	42KA4692	N/A
150	42KA4693	N/A

NNAD Site #	IMACS Site #	Collected items
151	42KA4694	N/A
152	42KA4695	N/A
153	42KA4696	N/A
154	42KA4697	N/A
155	42KA4698	N/A
156	42KA4699	N/A
157	42KA4700	1 dart point (P1).
158	42KA4701	3 dart points (P1-3).
159	42KA4702	N/A
160	42KA4703	N/A
161	42KA4704	N/A
162	42KA4705	1 dart point (P1).
163	42KA4706	N/A
164	42KA4707	N/A
165	42KA4708	N/A
166	42KA4709	1 dart point (P1).
167	42KA4710	N/A
168	42KA4711	N/A
169	42KA4712	N/A
170	42KA4713	N/A
171	42KA4714	1 arrow point (P1).
172	42KA4715	N/A
173	42KA4716	N/A
174	42KA4717	1 dart point (P1).
175	42KA4718	N/A
176	42KA4719	N/A
177	42KA4720	1 arrow point (P1).
178	42KA4721	N/A
179	42KA4722	2 dart points (P1-2).
180	42KA4723	N/A
181	42KA4724	1 dart point (P1).
182	42KA4725	1 dart point (P1).
183	42KA4726	N/A
184	42KA4727	N/A
185	42KA4728	N/A
186	42KA4729	N/A
187	42KA4730	N/A
188	42KA4731	1 shaft abrader.
189	42KA4732	N/A
190	42KA4733	1 sherd nip (S1).
191	42KA4734	N/A
192	42KA4735	N/A
193	42KA4736	N/A
194	42KA4737	N/A
195	42KA4738	2 dart points (P1-2).
196	42KA4739	N/A
197	42KA4740	N/A
198	42KA4741	1 dart point (P1).
199	42KA4742	N/A
200	42KA4743	N/A

NNAD Site #	IMACS Site #	Collected items
201	42KA4744	1 dart point (P1).
202	42KA4745	N/A
203	42KA4746	1 dart point (P1).
204	42KA4747	1 quartzite cobble tool (C1), 1 quartzite cobble flake (F1).
205	42KA4748	1 dart point (P1).
206	42KA4749	1 arrow point (P1).
207	42KA4750	1 arrow point (P1), 1 sherd nip (S1).
208	42KA4751	N/A
209	42KA4752	N/A
210	42KA4753	2 dart points (P1-2).
211	42KA4754	1 quartzite cobble tool (C1).
212	42KA4755	1 dart point (P1).
213	42KA4756	2 arrow points (P1-2), 1 dart point (P3).
214	42KA4757	N/A
215	42KA4758	N/A
216	42KA4759	N/A
217	42KA4760	N/A
218	42KA4761	N/A
219	42KA4762	N/A
220	42KA4763	N/A
221	42KA4764	N/A
222	42KA4765	N/A
223	42KA4766	N/A
224	42KA4767	1 dart point (P1).
225	42KA4768	3 dart points (P1-3).
226	42KA4769	1 dart point (P1).
227	42KA4770	1 dart point (P1).
228	42KA4771	N/A
229	42KA4772	N/A
230	42KA4773	N/A
231	42KA4774	5 dart points (P1-5).
232	42KA4775	3 dart points (P1-3).
233	42KA4776	N/A
234	42KA4777	1 dart point (P1).
235	42KA4778	N/A
236	42KA4779	2 arrow points (P1-2), 2 dart points (P3-4).
237	42KA4780	N/A
238	42KA4781	1 dart point (P1).
239	42KA4782	N/A
240	42KA4783	N/A
241	42KA4784	N/A
242	42KA4785	1 arrow point preform? (P1).
243	42KA4786	1 arrow point (P1).
244	42KA4787	2 arrow points (P1-2), 2 dart points (P3-4).
245	42KA4788	3 dart points (P1-3).
246	42KA4789	N/A
247	42KA4790	2 untyped reworked dart-size points (P1-2).
248	42KA4791	N/A
249	42KA4792	3 dart points (P1-3).
250	42KA4793	1 dart point (P1).

NNAD Site #	IMACS Site #	Collected items
251	42KA4794	1 arrow point (P1), 2 flakes, 1 bone, 1 organic sample.
252	42KA4795	1 dart point (P1), 1 sherd (S1).
253	42KA4796	N/A
254	42KA4797	2 arrow points (P1-2), 1 dart point (P3), 4 sherds (S1-4).
255	42KA4798	N/A
256	42KA4799	N/A
257	42KA4800	1 obsidian flake (F1).
258	42KA4801	N/A
259	42KA4802	1 dart point (P1).
260	42KA4803	1 dart point (P1).
261	42KA4804	1 biface (B1), 1 flake (F1).
262	42KA4805	N/A
263	42KA4806	N/A
264	42KA4807	1 dart point (P1).
265	42KA4808	About 20 flakes (total collection).
266	42KA4809	N/A
267	42KA4810	N/A
268	42KA4811	2 dart points (P1-2).
269	42KA4812	1 sherd (S1).
270	42KA4813	1 arrow point (P1).
271	42KA4814	2 dart points (P1-2).
272	42KA4815	N/A
273	42KA4816	N/A
274	42KA4817	1 dart point (P1).
275	42KA4818	N/A
276	42KA4819	1 arrow point (P1).
277	42KA4820	1 arrow point (P3).
278	42KA4821	N/A
279	42KA4822	N/A
280	42KA4823	1 maize cob fragment, 1 mortar chunk.
281	42KA4824	N/A
282	42KA4825	N/A
283	42KA4826	N/A
284	42KA4827	3 obsidian flakes (F1-3), 1 qtz. flake (F-4), 3 sherds (S1-3).
285	42KA4828	N/A
286	42KA4829	N/A
287	42KA4830	1 obsidian flake (F1).
288	42KA4831	N/A
289	42KA4832	N/A
290	42KA4833	N/A
291	42KA4834	1 dart point (P1).
292	42KA4835	N/A
296	42KA4836	1 dart point (P1).
297	42KA4837	1 dart point (P1).
298	42KA4838	N/A
299	42KA4839	N/A
300	42KA4840	2 dart points (P1-2).
301	42KA4841	2 dart points (P1-2).
302	42KA4842	N/A
303	42KA4843	1 dart point (P1).

NNAD Site #	IMACS Site #	Collected items
304	42KA4844	N/A
305	42KA4845	1 quartzite flake (F1).
306	42KA4846	N/A
307	42KA4847	1 dart point (P1).
308	42KA4848	2 dart points (P1-2), 1 used flake (F1), 1 metal can.
309	42KA4849	1 arrow point (P1), 1 dart point (P2), 1 chert flake (F1).
310	42GA4736	N/A
311	42GA4737	N/A
312	42GA4738	N/A
313	42GA4739	N/A
314	42GA4740	N/A
315	42GA4741	N/A
316	42KA4854	N/A
317	42GA4742	N/A
318	42GA4743	N/A
319	42GA4744	N/A
320	42GA4745	1 cobble tool flake (Ct1).
321	42GA4746	1 Elko Eared base (P5) and 1 refurbishing flake (Uf5).
322	42GA4747	1 Elko Corner-notched point (P1).
323	42GA4748	N/A
324	42GA4749	N/A
325	42GA4750	N/A
326	42GA4751	N/A
327	42GA4752	N/A
328	42GA4753	N/A
329	42GA4754	N/A
330	42GA4755	N/A
331	42GA4756	N/A
332	42GA4757	1 cobble flake scraper/plane (Ct1).
333	42GA4758	N/A
334	42GA4759	N/A
335	42KA5214	1 Northern Side-notched base (P1).
336	42KA5215	N/A
337	42KA5216	N/A
338	42KA5217	N/A
339	42KA5218	N/A
340	42KA5219	N/A
341	42KA5220	N/A
342	42KA5221	N/A
343	42KA5222	1 Elko Side-notched base (P1).
344	42KA5223	1 Emery Gray jar sherd (S1).
345	42KA5224	N/A
346	42KA5225	N/A
347	42KA5226	N/A
348	42KA5227	N/A
349	42KA5228	1 Elko Side-notched point (P1), 1 Cottonwood Triangular point (P2), and 1 Gypsum point base (P3).
350	42KA5229	1 Cottonwood Triangular point (P1) and 3 Bull Creek points (P2, P3, P4).
351	42GA4760	N/A
352	42GA4761	1 graver/perforator (Gp1).

NNAD Site #	IMACS Site #	Collected items
353	42GA4762	N/A
354	42GA4763	N/A
355	42GA4764	N/A
356	42GA4765	1 unifacial knife (Uk1) and 1 Desert Side-notched base (P3).
357	42GA4766	N/A
358	42GA4767	1 biface (B1).
359	42GA4768	1 Pinto point (P1) and 1 Northern Side-notched base (P2).
360	42GA4769	1 untyped stemmed point base (P1) and 1 obsidian flake (Of).
361	42GA4770	N/A
362	42GA4771	N/A
363	42GA4772	N/A
364	42GA4773	1 biface (B2).
365	42KA5230	1 Elko Corner-notched base (P1).
366	42KA5231	N/A
367	42KA5232	N/A
368	42KA5233	N/A
369	42KA5234	1 Desert Side-notched (P1), 1 untyped side-notched dart point (P2), 1 Elko Side-notched (P3), 1 side-notched dart point (P4), and 1 obsidian flake (Of).
370	42KA5235	N/A
371	42KA5236	1 side-notched hafted knife (P1) and 1 Emery Gray Fugitive sherd.
372	42KA5237	N/A
373	42KA5238	N/A
374	42KA5239	N/A
375	42KA5240	1 untyped eared point (P1).
376	42KA1373	1 Elko Side-notched point (P1).
377	42KA5241	1 Sudden Side-notched point (P1).
378	42KA5242	N/A
379	42KA5243	N/A
380	42KA5244	1 flake for material identification.
381	42KA5245	1 corner-notched hafted knife (P1).
382	42KA5246	N/A
383	42KA5247	1 Bull Creek point base.
384	42KA5248	1 Elko Side-notched point base.
385	42KA5249	N/A
386	42KA5250	3 dart points and 1 biface.
387	42KA5251	1 Pinto point (P3).
388	42KA5252	N/A
389	42KA5253	1 biface (B1).
390	42KA5254	1 Desert Side-notched point (P1), 1 obsidian flake (Of), 1 flake for material identification, and 1 Kanab Red sherd (S).
391	42KA5255	1 Gypsum point (P1).
392	42KA5256	N/A
393	42KA5257	N/A
394	42KA5258	1 small Cottonwood Triangular point (P1).
395	42KA5259	N/A
396	42KA5260	N/A
397	42KA5261	N/A
398	42KA5262	N/A
399	42KA5263	1 obsidian arrow (?) point (P2) and 1 Elko Corner-notched point (P4).
400	42KA5264	N/A

NNAD Site #	IMACS Site #	Collected items
401	42GA4774	N/A
402	42GA4775	N/A
403	42GA4776	N/A
404	42GA4777	N/A
405	42GA4778	N/A
406	42GA4779	1 Elko Corner-notched point base (P1).
407	42GA4780	N/A
408	42GA4781	1 Bull Creek point (P1).
409	42GA4782	1 short stemmed arrow point (P3) and 1 sherd nip of an Emery Gray jar sherd (S1).
410	42GA4783	N/A
411	42GA4784	N/A
412	42GA4785	1 Cottonwood Triangular point (P2).
413	42GA4786	1 small chert core (C1).
414	42GA4787	N/A
415	42GA4788	N/A
416	42GA4789	1 Pinto point (P1).
417	42GA4790	N/A
418	42GA4791	1 Elko Eared point base (P3).
419	42KA5265	1 untyped utility jar sherd and 1 nip of possible Shinarump White Ware bowl sherd.
420	42KA5266	N/A
421	42KA5267	N/A
422	42KA5268	1 possible Sudden Side-notched point (P1).
423	42KA5269	N/A
424	42KA5270	N/A
425	42KA5271	N/A
426	42KA5272	N/A
427	42KA5273	N/A
428	42KA5274	1 possible Elko Side-notched dart point (P1).
429	42KA5275	N/A
430	42KA5276	N/A
431	42KA5277	1 side-notched dart point (P1), and 1 Gypsum point (P2).
432	42KA5278	N/A
433	42KA5279	1 Rose Spring Corner-notched point (P2), 1 untyped utility sherd nip (S1), and 1 proximal flake (Ot3).
434	42KA5280	N/A
435	42KA5281	N/A
436	42KA5282	N/A
437	42KA5283	N/A
438	42KA5284	N/A
439	42KA5285	N/A
440	42KA5286	2 Rose Spring Corner-notched points (P1, P4), 1 Elko Corner-notched point (P2), and 1 Shinarump plain sherd nip (S1).
441	42KA5287	N/A
442	42KA5288	N/A
443	42KA5289	1 Elko Corner-notched point (P1).
444	42KA5290	N/A
445	42KA5291	N/A
446	42KA5292	N/A
447	42KA5293	1 Kanab B/R sherd (S1).
448	42KA5294	N/A

NNAD Site #	IMACS Site #	Collected items
449	42KA5295	N/A
450	42KA5296	N/A
452	42KA5297	N/A
453	42KA5298	N/A
454	42KA5299	N/A
455	42KA5300	1 Elko Corner-notched point (P1).
456	42KA5301	N/A
457	42KA5302	N/A
458	42KA5303	N/A
459	42KA5304	N/A
460	42KA5305	1 Elko Corner-notched point (P1).
461	42KA5306	N/A
462	42KA5307	N/A
463	42KA5308	N/A
464	42KA5309	N/A
465	42KA5310	N/A
466	42KA5311	1 sherd (S1).
467	42KA5312	N/A
468	42KA5313	N/A
469	42KA5314	N/A
470	42KA5315	N/A
471	42KA5316	N/A
472	42KA5317	1 square stemmed point (P2).
473	42KA5318	2 sherds (possible North Creek corrugated, North Creek B/g) for type examples.
474	42KA5319	N/A
475	42KA5320	1 Elko Side-notched point (P1).
476	42KA5321	N/A
477	42KA5322	N/A
478	42KA5323	1 Elko Corner-notched point (P1).
479	42KA5324	N/A
480	42KA5325	N/A
481	42KA1384	N/A
482	42KA5326	1 Sudden Side-notched point (P1).
483	42KA5327	N/A
484	42KA5328	2 Elko Side-notched point bases (P1, P2).
485	42KA5329	N/A
486	42KA5330	1 Elko Corner-notched point (P1) and 1 Shinarump rim sherd (S1).
487	42KA5331	N/A
488	42KA5332	N/A
489	42KA5333	N/A
490	42KA5334	N/A
491	42KA5335	1 Elko Corner-notched point (P1) and 1 cobble chopper (Ct1).
492	42KA5336	N/A
493	42KA5337	N/A
494	42KA5338	1 shell bead.
495	42KA5339	1 Elko Eared point (P3) and 1 Elko Corner-notched point (P4).
496	42KA5340	N/A
497	42KA5341	N/A
498	42KA5342	N/A
499	42KA5343	N/A

NNAD Site #	IMACS Site #	Collected items
500	42KA5344	N/A
501	42KA5345	1 cobble chopper (Ct1).
502	42KA5346	Juniper bark from a mortar chunk.
503	42KA5347	N/A
504	42KA5348	N/A
505	42KA5349	1 Gypsum point base (P1) and 1 whole Elko Corner-notched point (P2).
506	42KA5350	N/A
507	42KA5351	N/A
508	42KA5352	N/A
509	42KA5353	N/A
510	42KA5354	1 dart point tip/midsection (P1).
511	42KA5355	N/A
512	42KA5356	N/A
513	42KA5357	N/A
514	42KA5358	1 Northern Side-notched base/tip (P1).
515	42KA5359	N/A
516	42KA5360	1 resharpened Pinto point.
517	42KA5361	1 untyped basally notched point (P1) and 1 probable Elko Eared point (P2).
518	42KA5362	1 Bull Creek point (P1).
519	42KA5363	1 surface exposed basket and 1 Rose Spring Corner-notched point (P2).
520	42KA5364	1 probable Pinto point (P1).
521	42KA5365	1 possible Sand Dune Side-notched point (P1) and 1 Elko Side-notched point (P5).
522	42KA5366	1 untyped square stemmed dart point (P4).
523	42KA5367	N/A
524	42KA5368	1 cobble scraper plane (Ct1).
525	42KA5369	N/A
526	42KA5370	N/A
527	42KA5371	1 end-scraper for comparative purposes.
528	42KA5372	N/A
529	42KA5373	N/A
530	42KA5374	N/A
531	42KA5375	N/A
532	42KA5376	3 sherd nips for type examples.
533	42KA5377	2 sherd nips for type examples.
534	42KA5378	N/A
535	42KA5379	2 sherd nips from AC1 for analysis.
536	42KA5380	1 Gypsum point (P3) and 1 large notched point (P5).
537	42KA5381	N/A
538	42KA5382	N/A
539	42KA5383	N/A
540	42KA5384	N/A
541	42KA5385	N/A
542	42KA5386	N/A
543	42KA5387	N/A
544	42KA5388	1 untyped narrow side-notched dart point (P2).
545	42KA5389	1 biface tip for examination of use wear and resharpening patterns.
546	42KA5390	1 Elko Corner-notched point base (P1).
547	42KA5391	1 Elko Eared point (P2) and ceramic sherd nips.
548	42KA5392	Collected 6 sherd nips for lab analysis.
549	42KA5393	1 untyped dart point midsection (P1) and 1 Elko Corner-notched (P4).

NNAD Site #	IMACS Site #	Collected items
550	42KA5394	N/A
551	42KA5395	N/A
552	42KA5396	1 shaft abrader.
553	42KA5397	N/A
554	42KA5398	N/A
555	42KA5399	1 Pinto point base (P1).
556	42KA5400	1 Northern Side-notched point (P2).
557	42KA5401	N/A
558	42KA5402	1 T-shaped drill (D1).
559	42KA5403	1 reworked Pinto point (P1).
560	42KA5404	1 possible undiagnostic corner-notched dart point base (P2) and 1 stage 2 biface (B1).
561	42KA5405	1 undiagnostic notched dart point base (P1) and 1 Elko Eared point (P3).
562	42KA5406	N/A
563	42KA5407	N/A
564	42KA5408	N/A
565	42KA5409	1 possible Hawken Side-notched point (P4).
566	42KA5410	N/A
567	42KA5411	1 San Rafael Side-notched, 2 Rose Spring Corner-notched points (P2, P3), 2 Emery Gray sherds (S3, S4), and 1 Snake Valley Gray sherd (S2).
568	42KA5412	N/A
569	42KA5413	N/A
570	42KA5414	N/A
571	42KA5415	N/A
572	42KA5416	Mortar sample from F1 granary (the sample was a detached fragment of mortar on the west end of the granary near the packrat midden).
573	42KA5417	N/A
574	42KA5418	2 sherds (S1-possible North Creek Corrugated; S2-possible Virgin Series White Ware).
575	42KA5419	N/A
576	42KA5420	1 possible Cortaro point (P10), 1 Northern Side-notched (P11) and 1 scraper plane flake.
577	42KA5421	1 possible Sand Dune Side-notched point (P1).
578	42KA5422	N/A
579	42KA5423	1 short stemmed dart point (P1) and 1 possible Sand Dune Side-notched point (P3).
580	42KA5424	N/A
581	42KA5425	1 untyped square stemmed dart point (P1).
582	42KA5426	N/A
583	42KA5427	N/A
584	42KA5428	1 Elko Series point base (P3).
585	42KA5429	N/A
586	42KA5430	A small piece of bark from a chunk of cist mortar as a C14 sample.
587	42KA5431	N/A
588	42KA5432	N/A
589	42KA5433	1 corn cob from the surface.
590	42KA5434	12 sherds (S1-12).
591	42KA5435	11 sherds (S1-11).
592	42KA5436	8 sherds (S1-8).
593	42KA5437	12 sherds (S1-12) and 2 flakes (Fl 1, Fl 2).
594	42KA5438	1 Bull Creek point base (P1).
595	42KA5439	2 refurbishing flakes from cobble scraper planes.

NNAD Site #	IMACS Site #	Collected items
596	42KA5440	Daub from Feature 1.
597	42KA5441	N/A
598	42KA5442	N/A
599	42KA5443	N/A
600	42KA5444	1 corner-notched hafted knife (P1) and 1 denticulate end-scraper (Us1).
601	42KA5445	N/A
602	42KA5446	N/A
603	42KA5447	2 sherds (S2-Virgin Series WW; S3-Coombs variety WW).
604	42KA5448	2 sherds (S1-Virgin B/W; S5-North Creek Corrugated?).
605	42KA5449	2 Bull Creek points (P1, P2).
606	42KA5450	N/A
607	42KA5451	1 possible North Creek Corrugated sherd (S1) and 1 pigment sample.
608	42KA5452	2 sherd nips (S1, S2).
609	42KA5453	N/A
610	42KA5454	1 Rose Spring Corner-notched point (P3).
611	42KA5455	2 sherds (S1-North Creek Corrugated; S2-Virgin Series WW).
612	42KA5456	2 sherds (S2-Virgin B/W; S3-Shinarump Plain).
613	42KA5457	N/A
614	42KA5458	1 whole Bull Creek point (P3) and 1 Citadel Poly sherd (S1).
615	42KA5459	N/A
616	42KA5460	1 unfinished arrow point (P1) and 1 possible North Creek Corrugated (S1).
617	42KA5461	1 Elko Corner-notched base (P1).
618	42KA5462	N/A
619	42KA5463	1 Shinarump Corrugated sherd (S1).
620	42KA5464	N/A
621	42KA5465	N/A
622	42KA5466	N/A
623	42KA5467	N/A
624	42KA5468	1 cobble scraper plane (Ct1).
625	42KA5469	N/A
626	42KA5470	1 stage 5 biface (B1).
627	42KA5471	N/A
628	42KA5472	N/A
629	42KA5473	1 stage 5 biface (B1).
630	42KA5474	N/A
631	42KA5475	N/A
632	42KA5476	N/A
633	42KA5477	N/A
634	42KA5478	N/A
635	42KA5479	N/A
636	42KA5480	1 obsidian arrow point tip (P1), and 1 obsidian flake (Of).
637	42KA5481	N/A
638	42KA5482	N/A
639	42KA5483	N/A
640	42KA5484	1 untyped side-notched dart point (P1).
641	42KA5485	1 stage 4 biface (B1).
642	42KA5486	1 sherd (S1).
643	42KA5487	1 Elko Corner-notched base point (P1).
644	42KA5488	N/A
645	42KA5489	N/A

NNAD Site #	IMACS Site #	Collected items
646	42KA5490	1 square stem Gypsum (?) point (P1).
647	42KA5491	N/A
648	42KA5492	1 Sudden Side-notched point (P1).
649	42KA5493	1 whole willow leaf point (P4).
650	42KA5494	1 chert flake (Fl 1).
651	42KA5495	N/A
652	42KA5496	N/A
653	42KA5497	N/A
654	42KA5498	N/A
655	42KA5499	1 possible Elko Side-notched point (P1).
656	42KA5500	N/A
657	42KA5501	N/A
658	42KA5502	N/A
659	42KA5503	N/A
660	42KA5504	1 cobble flake scraper (Ct1).
661	42KA5505	N/A
662	42KA5506	N/A
663	42KA5507	N/A
664	42KA5508	N/A
665	42KA5509	N/A
666	42KA5510	N/A
667	42KA5511	N/A
668	42KA5512	N/A
669	42KA5513	N/A
670	42KA5514	N/A
671	42KA5515	N/A
672	42KA5516	N/A
673	42KA5517	1 whole Gypsum point (P1).
674	42KA5518	N/A
675	42KA5519	N/A
676	42KA5520	N/A
677	42KA5521	N/A
678	42KA5522	1 Sudden Side-notched point (P1).
679	42KA5523	1 Elko Corner-notched point (P1) and 1 thick bifacial tool (Ot1).
680	42KA5524	N/A
681	42KA5525	1 denticulate scraper (Us1).
682	42KA5526	1 biface (B1) and 1 Elko Corner-notched point (P2).
683	42KA5527	N/A
684	42KA5528	1 Elko Eared base (P1) and 1 quartzite cobble flake (Ct2).
685	42KA5529	1 quartzite cobble tool (Ct2).
686	42KA5530	N/A
687	42KA5531	N/A
688	42KA5532	N/A
689	42KA5533	1 unfinished arrow point preform (P1).
690	42KA5534	N/A
691	42KA5535	N/A
692	42KA5536	N/A
693	42KA5537	N/A
694	42KA5538	N/A
695	42KA5539	N/A

NNAD Site #	IMACS Site #	Collected items
696	42KA5540	N/A
697	42KA5541	1 Elko Corner-notched point (P1).
698	42KA5542	N/A
699	42KA5543	N/A
700	42KA5544	1 Elko Eared(?) point (PI).
701	42KA5545	1 Elko Corner-notched point (P1) and 1 biface base (B1).
702	42KA5546	N/A
703	42KA5547	N/A
704	42KA5548	2 Gypsum point bases (P1,P2).
705	42KA5549	N/A
706	42KA5550	N/A
707	42KA5551	1 Elko Corner-notched base.
726	42KA5552	N/A
727	42KA1440	N/A
728	42KA5553	N/A
729	42KA5554	N/A
751	42KA5555	N/A
752	42KA5556	N/A
753	42KA5557	N/A

Appendix B

Site Coding Form and Raw Data for Prehistoric Sites and Components Recorded by NNAD

Kaiparowits Plateau Survey

SITE CODING FORM

Navajo Nation Temporary Site Number (TempNo)
self explanatory; number prefixed by NN (this number is marked on site datum)

Sampling Stratum (Str)
1. East Clark Bench
2. Brigham Plains/Jack Riggs Bench
3. Horse Flat
4. Long Flat
5. Horse Mt./Paradise Bench
6. Nipple Bench
7. Smoky Mt.
8. Fourmile Bench
9. Collet Top

Sample Unit Number (Unit)
sequential number for each 160 acre observation unit that was surveyed; unit number specific to each stratum

Component Number (Comp)
1. Single Component
2. Multiple Component

Site Type (Primary component) (SiTy1)
1. Residential camp
2. Processing camp
3. Hunting camp
4. Reduction locus
5. Storage/cache
6. Unknown function
7. Other
8. Semi-permanent habitation

Site Type (Secondary component) (SiTy2)
same as above

Temporal Affiliation (Primary component) (TA1)
0. Unknown
1. Archaic
2. early Archaic
3. middle Archaic
4. late Archaic
5. Formative
6. Formative/Post-Formative
7. Post-Formative

Confidence in Temporal Assignment (Primary component) (Con1)
0. assignment based on alternative dating methods not temporal diagnostics
1. assignment based on temporal diagnostics often bolstered by alternative dating methods

Temporal Affiliation (Secondary component) (TA2)
same as above

Confidence in Temporal Assignment (Secondary component) (Con2)
same as above

Formative Cultural Affiliation (Cul)
1. Unassigned
2. Fremont
3. Anasazi
4. Both Fremont and Anasazi

Site Area (Area)
square meters

Count of Projectile Points (PjPt)
all points whole or fragmentary irrespective of arrow or dart

Count of Bifaces (Bif)
all bifaces whole or fragmentary irrespective of reduction stage

Count of Unifacial Tools (Unif)
all unifacially retouched tools of chert and other highly siliceous materials; excludes those made from coarse cobble materials (quartzite, metasediment, and igneous porphyry) which were classified as flaked cobble tools

Count of Other Flaked Tools (OFla)
all other facially flaked tools excluding flaked cobble tools; items such as drills, used flakes, gravers, and the like.

Count of Flaked Cobble Tools (FCobT)
all large cobble tools of course materials (quartzite, metasediment, and igneous porphyry) such as choppers, pounders, scraper-planes.

Count of Metates (Met)
all metate or grinding slabs.

Count of Manos (Man)
all manos irrespective of size class.

Debitage Abundance (Deb)
0. None
1. 1-9
2. 10-25
3. 26-100
4. 101-500
5. 501+

Relative Abundance of Debitage within Three Flaking Stages (Decortication [Décor], Secondary [Secon], and Tertiary [Tert])
0. None
1. Rare
2. Common
3. Abundant

Maximum Density of Lithic artifacts per Square Meter (MaxD)

Presence/Absence of Sherds (She)
0. Absent

1. Present

Presence/Absence of Hearths (PH)

0. Absent
1. Present

Presence/Absence of Rock Features (PFCR)

0. Absent
1. Present

Presence/Absence of Midden (PMid)

0. Absent
1. Present

Presence/Absence of Living Structures (LStr)

0. Absent
1. Present

Presence/Absence of Storage Structures (SStr)

0. Absent
1. Present

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
1	4	165	1	2	0	0	0	0	0	0	2600	0	2	0	0	1	0	0	3	1	2	3	2	0	1	1	0	0	0
2	4	165	1	2	0	0	0	0	0	0	770	0	2	1	0	0	0	0	2	1	1	2	2	0	0	1	0	0	0
3	4	165	1	1	0	1	1	0	0	0	28400	3	0	0	0	9	0	2	4	1	2	2	8	0	1	1	0	0	0
4	4	165	1	1	0	1	0	0	0	0	3498	0	0	0	0	5	1	1	4	1	2	3	4	0	1	1	1	0	0
5	4	165	1	2	0	1	1	0	0	0	884	1	2	0	0	1	0	1	3	0	1	3	4	0	0	1	0	0	0
6	4	165	1	1	0	1	0	0	0	0	1000	1	3	0	3	13	2	2	5	2	2	3	10	0	0	1	1	0	0
7	4	165	1	6	0	5	1	0	0	1	1200	1	1	0	0	4	0	1	3	2	2	1	1	0	0	0	0	0	0
8	4	164	1	7	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
9	4	164	1	1	0	1	1	0	0	0	1200	3	3	0	2	5	2	1	4	2	3	2	15	0	1	1	1	0	0
10	4	164	1	4	0	0	0	0	0	0	532	1	0	0	0	0	0	0	4	0	1	3	5	0	0	0	0	0	0
11	4	164	1	1	0	4	1	0	0	0	5152	4	8	4	0	23	0	3	5	2	2	3	15	0	0	1	0	0	0
12	4	164	1	4	0	3	1	0	0	0	2560	2	4	0	0	0	0	0	3	0	1	3	2	0	0	0	0	0	0
13	4	164	1	3	0	1	1	0	0	0	3910	2	6	3	1	0	0	0	4	0	2	3	10	0	1	1	0	0	0
14	4	164	1	2	0	0	0	0	0	0	96	0	0	0	1	0	1	0	1	0	1	1	1	0	1	0	0	0	0
15	4	164	1	1	0	1	1	0	0	0	5776	5	8	3	3	14	0	0	5	2	2	3	8	0	1	0	1	0	0
16	4	164	1	3	0	3	1	0	0	0	10000	1	16	2	2	3	0	0	5	1	2	3	6	0	0	0	0	0	0
18	4	155	1	3	0	4	1	0	0	0	1500	10	5	1	3	0	0	0	4	1	1	3	4	0	0	0	0	0	0
19	4	155	1	1	0	3	1	0	0	0	3432	3	3	2	1	2	2	0	4	1	2	3	5	0	1	1	0	0	0
20	4	155	1	2	0	7	1	0	0	0	2010	7	3	3	4	1	2	0	3	2	2	1	2	1	1	0	0	0	0
21	4	155	1	3	0	4	1	0	0	0	4015	11	7	1	1	0	0	0	4	1	2	3	2	0	0	0	0	0	0
22	4	155	1	2	0	0	0	0	0	0	2016	0	1	0	1	6	0	1	3	3	2	0	2	0	0	1	0	0	0
23	4	155	1	1	0	4	1	0	0	0	2150	5	9	1	3	19	3	4	4	2	2	2	8	0	0	1	1	0	0
24	3	40	3	3	3	2	1	3	1	0	279000	40	14	3	4	5	2	1	2	0	1	3	10	0	0	0	0	0	0
25	3	40	1	4	0	1	1	0	0	0	832	2	1	1	0	0	0	0	2	0	2	2	1	0	0	0	0	0	0
26	4	160	1	4	0	0	0	0	0	0	64	0	0	0	0	1	0	0	3	3	2	1	10	0	0	0	0	0	0
27	4	160	1	3	0	1	0	0	0	0	408	2	0	0	0	0	0	0	4	1	2	3	25	0	0	0	0	0	0
28	4	160	1	2	0	0	0	0	0	0	2925	0	0	0	0	4	0	1	4	3	2	2	10	0	0	0	0	0	0
29	4	149	2	1	3	0	0	7	1	0	89600	1	2	9	0	14	0	2	5	2	3	1	25	1	0	1	0	0	0
30	4	149	1	2	0	0	0	0	0	0	1900	0	1	0	0	5	0	1	4	3	2	2	25	0	0	0	0	0	0
31	4	149	1	2	0	6	0	0	0	0	459	1	1	0	0	1	0	0	3	3	2	1	10	0	0	1	0	0	0
32	4	149	1	2	0	7	0	0	0	0	1674	0	0	1	1	0	2	0	3	2	2	3	5	0	0	1	0	0	0
33	4	149	1	2	0	5	1	0	0	2	780	0	0	0	0	6	0	0	3	3	2	1	3	1	0	0	0	0	0
34	4	149	1	6	0	0	0	0	0	0	405	0	1	0	0	0	0	0	1	1	2	3	2	0	0	0	0	0	0
35	4	149	1	1	0	5	1	0	0	3	5780	1	0	1	2	2	0	0	5	2	2	3	50	1	1	0	0	0	0
36	4	149	1	3	0	1	1	0	0	0	2700	1	3	0	0	0	0	0	3	1	2	3	2	0	0	1	0	0	0
37	4	149	1	6	0	0	0	0	0	0	1080	0	0	0	1	1	0	0	3	3	2	2	5	0	0	1	0	0	0
38	4	149	1	3	0	0	0	0	0	0	810	1	2	0	2	0	0	0	4	2	2	3	10	0	0	0	0	0	0
40	4	149	1	2	0	0	0	0	0	0	1575	0	0	1	0	2	1	2	3	2	2	2	5	0	1	0	0	0	0
41	4	134	1	3	0	0	0	0	0	0	1800	0	1	0	0	0	0	0	3	2	2	3	5	0	1	0	0	0	0
42	4	134	1	2	0	7	1	0	0	0	21600	3	1	0	1	4	0	0	4	2	2	3	10	0	1	1	0	0	0
43	3	28	1	2	0	1	1	0	0	0	5625	4	1	0	1	0	0	1	4	2	2	3	10	0	1	0	0	0	0
44	3	15	1	6	0	1	1	0	0	0	4250	1	1	1	0	0	0	0	4	1	2	3	5	0	1	0	0	0	0
45	3	15	1	1	0	4	1	0	0	0	21000	3	3	0	0	2	2	1	4	2	2	3	5	0	1	0	0	0	0
46	3	15	1	2	0	1	0	0	0	0	4550	3	0	0	2	1	1	0	2	1	3	2	2	0	1	0	0	0	0
47	3	15	1	2	0	4	1	0	0	0	3000	1	0	1	4	1	1	0	4	2	2	3	3	0	0	0	0	0	0
48	3	15	1	2	0	1	1	0	0	0	1120	3	1	0	0	1	0	0	3	2	2	3	5	0	0	0	1	0	0
49	4	7	1	3	0	7	1	0	0	0	320	1	0	2	1	0	0	0	3	1	3	3	25	0	1	0	0	0	0
51	4	116	1	3	0	4	1	0	0	0	7000	1	4	0	0	4	0	1	3	1	1	3	3	0	0	0	0	0	0
52	4	116	1	4	0	0	0	0	0	0	1050	0	0	0	1	0	0	0	2	1	2	3	4	0	0	0	0	0	0
53	4	116	1	4	0	0	0	0	0	0	1140	0	0	0	0	0	0	0	2	0	1	3	1	0	0	0	0	0	0
54	4	116	1	3	0	1	1	0	0	0	2100	1	0	0	0	0	1	0	2	1	1	1	2	0	1	0	0	0	0
55	4	116	1	3	0	1	1	0	0	0	6400	1	0	0	0	2	0	0	4	1	1	3	6	0	0	0	0	0	0
56	4	160	1	2	0	0	0	0	0	0	7000	0	3	4	0	5	0	2	4	3	2	1	5	0	0	0	0	0	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
57	4	160	1	2	0	0	0	0	0	0	72	0	0	0	1	3	0	0	1	3	0	0	2	0	0	0	0	0	0
58	4	160	1	6	0	6	0	0	0	0	704	0	0	0	1	1	0	0	2	3	2	1	5	0	1	0	0	0	0
59	4	160	1	2	0	6	0	0	0	0	6	0	0	0	0	0	0	1	1	3	0	0	3	0	1	0	0	0	0
60	4	160	1	6	0	0	0	0	0	0	2000	1	1	0	1	2	0	0	3	1	2	3	3	0	0	0	0	0	0
61	4	116	1	1	0	3	1	0	0	0	14400	2	5	0	1	0	2	2	4	1	1	3	8	0	1	1	0	0	0
62	4	137	1	4	0	0	0	0	0	0	1200	0	0	0	0	0	0	0	2	0	1	3	1	0	0	0	0	0	0
63	4	116	1	2	0	0	0	0	0	0	2240	0	0	0	1	0	0	0	2	1	1	1	2	0	0	0	0	0	0
64	4	116	1	3	0	1	0	0	0	0	5600	1	4	0	0	0	0	0	4	0	1	3	4	0	1	0	0	0	0
65	4	116	1	1	0	0	0	0	0	0	7200	0	2	0	0	1	1	0	4	1	1	3	8	0	1	0	0	0	0
66	4	116	1	3	0	1	0	0	0	0	33750	5	9	0	0	0	2	1	5	1	1	3	8	0	1	0	0	0	0
67	4	122	1	4	0	0	0	0	0	0	5600	0	1	0	0	0	0	0	2	0	1	3	1	0	0	0	0	0	0
68	4	51	1	4	0	0	0	0	0	0	2940	0	0	0	1	0	0	0	4	1	1	3	12	0	0	0	0	0	0
69	4	51	1	2	0	7	1	0	0	0	968	1	0	0	0	0	4	1	1	1	1	1	1	0	1	1	0	0	0
70	4	51	1	2	0	0	0	0	0	0	450	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0
71	4	81	1	2	0	0	0	0	0	0	4200	2	2	0	2	2	3	1	4	0	2	3	10	1	1	0	0	0	0
72	4	51	1	1	0	7	0	0	0	0	6300	0	4	0	0	2	5	1	4	1	1	3	4	0	1	1	0	0	0
73	4	51	1	4	0	1	0	0	0	0	4560	1	4	0	0	1	0	1	4	2	2	2	5	0	0	1	0	0	0
74	4	51	1	4	0	5	1	0	0	1	2400	0	1	0	0	2	3	0	4	2	2	2	5	1	0	0	0	0	0
75	3	61	1	4	0	0	0	0	0	0	4675	0	4	0	1	0	0	0	3	1	1	3	2	0	0	0	0	0	0
76	4	7	1	1	0	1	1	0	0	0	21600	2	3	0	1	2	2	8	5	2	2	3	25	0	1	0	0	0	0
77	4	7	1	2	0	1	0	0	0	0	750	1	0	0	1	7	0	0	3	2	3	2	5	0	0	0	0	0	0
78	4	15	1	6	0	0	0	0	0	0	140	0	0	0	0	0	0	0	2	1	3	2	14	0	0	0	0	0	0
79	4	15	1	6	0	0	0	0	0	0	2000	0	0	0	0	0	0	0	2	0	2	3	3	0	0	0	0	0	0
80	4	15	1	2	0	0	0	0	0	0	6600	0	2	0	1	2	0	0	2	2	3	2	2	0	0	1	0	0	0
81	5	13	1	3	0	7	0	0	0	0	438	0	0	1	0	1	0	0	1	1	2	3	1	0	1	0	0	0	0
82	5	30	1	3	0	1	0	0	0	0	1200	0	2	0	0	0	0	0	3	2	2	3	10	0	1	0	0	0	0
83	5	30	1	4	0	1	0	0	0	0	1064	0	0	0	0	1	0	0	2	3	2	2	8	0	0	0	0	0	0
84	5	30	1	3	0	1	1	0	0	0	1800	2	3	1	0	0	0	0	3	2	3	2	5	0	0	0	0	0	0
85	5	30	1	3	0	1	0	0	0	0	1650	2	2	0	1	1	0	0	2	2	3	2	2	0	0	0	0	0	0
86	5	30	1	1	0	1	1	0	0	0	7200	5	1	0	2	3	0	0	4	2	3	2	15	0	1	0	0	0	0
87	5	30	1	4	0	0	0	0	0	0	1750	1	2	0	0	0	0	0	3	2	3	2	5	0	0	0	0	0	0
88	5	30	1	2	0	0	0	0	0	0	438	1	1	0	0	3	0	0	3	3	1	0	3	0	0	0	0	0	0
89	5	30	1	2	0	0	0	0	0	0	1800	0	2	0	2	1	1	0	4	1	2	3	20	0	0	0	0	0	0
90	5	30	1	3	0	1	1	0	0	0	1875	5	1	1	1	2	0	0	3	2	2	3	5	0	1	0	0	0	0
91	5	30	1	6	0	2	1	0	0	0	750	1	2	1	1	3	0	0	2	3	1	0	1	0	0	0	0	0	0
92	5	30	1	2	0	0	0	0	0	0	1500	2	0	1	0	0	1	1	3	2	3	2	5	0	0	0	0	0	0
93	5	30	1	6	0	0	0	0	0	0	1600	0	1	0	3	0	0	0	3	1	3	2	3	0	0	0	0	0	0
94	2	35	1	3	0	0	0	0	0	0	2800	0	0	0	0	0	0	0	2	0	1	3	3	0	0	0	0	0	0
95	5	35	1	2	0	6	0	0	0	0	2000	1	1	0	5	1	0	1	3	1	2	3	5	0	0	0	0	0	0
96	5	30	1	6	0	0	0	0	0	0	540	0	0	0	1	0	0	0	3	1	2	3	3	0	0	0	0	0	0
97	5	30	1	2	0	1	0	0	0	0	3200	1	1	0	0	1	1	1	4	2	3	2	5	0	1	0	0	0	0
98	5	30	1	3	0	1	0	0	0	0	2200	2	4	0	1	0	0	0	3	2	3	2	5	0	0	0	0	0	0
99	5	30	1	4	0	0	0	0	0	0	660	0	2	0	0	0	1	0	4	3	3	1	30	0	1	0	0	0	0
100	2	35	1	3	0	0	0	0	0	0	1600	0	0	0	1	0	0	0	3	1	1	3	3	0	0	0	0	0	0
101	3	40	1	3	0	1	1	0	0	0	3150	3	4	1	2	0	0	0	4	0	1	3	4	0	0	0	0	0	0
102	3	40	1	4	0	1	1	0	0	0	1785	2	2	0	0	0	0	0	2	0	1	3	1	0	0	0	0	0	0
103	3	40	1	6	0	4	1	0	0	0	2250	7	4	0	0	1	0	0	3	1	2	2	2	0	0	0	0	0	0
104	3	41	1	2	0	1	0	0	0	0	3600	0	2	2	0	5	1	1	3	1	3	2	2	0	0	0	0	0	0
105	3	41	1	4	0	0	0	0	0	0	4350	0	1	1	1	2	0	1	3	0	2	2	1	0	0	0	0	0	0
106	3	41	1	5	0	1	0	0	0	0	1058	0	0	0	0	3	0	2	1	1	2	0	1	0	0	0	0	0	0
107	3	41	1	4	0	0	0	0	0	0	750	0	0	0	0	0	0	0	2	0	1	3	2	0	0	0	0	0	0
108	3	41	1	4	0	0	0	0	0	0	3360	0	1	0	1	0	1	0	4	0	1	3	2	0	0	1	0	0	0
109	3	41	1	6	0	0	0	0	0	0	1088	1	0	0	1	0	0	0	1	0	2	2	1	0	0	0	0	0	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
110	3	5	1	6	0	0	0	0	0	0	2475	0	0	1	0	0	0	0	2	1	2	2	1	0	0	0	0	0	0
111	3	5	1	6	0	1	0	0	0	0	2025	1	2	0	0	0	0	0	2	1	2	1	2	0	0	0	0	0	0
112	3	5	2	4	3	1	0	7	0	0	1210	2	0	0	0	0	0	0	3	0	1	3	20	0	1	0	0	0	0
113	3	5	2	6	2	1	0	7	0	0	1350	0	0	1	2	0	2	0	3	0	3	0	2	0	0	1	0	0	0
114	3	5	1	2	0	1	1	0	0	0	2000	0	1	0	1	1	1	1	3	1	3	1	2	0	0	0	0	0	0
115	3	5	1	4	0	4	1	0	0	0	1050	2	0	0	0	0	0	0	2	0	2	1	1	0	0	0	0	0	0
116	3	5	1	6	0	0	0	0	0	0	572	1	0	0	0	0	0	0	2	0	1	3	1	0	0	0	0	0	0
117	3	5	1	6	0	0	0	0	0	0	1500	0	1	0	0	0	0	0	2	0	1	3	1	0	0	0	0	0	0
118	3	5	1	6	0	0	0	0	0	0	390	0	1	0	0	0	0	0	2	0	1	3	1	0	0	0	0	0	0
119	3	5	1	3	0	7	1	0	0	0	250	1	0	0	1	0	0	0	3	0	2	2	12	0	1	0	0	0	0
120	3	5	1	4	0	7	0	0	0	0	4085	1	2	0	2	0	0	0	3	0	2	2	2	0	1	0	0	0	0
121	3	5	1	6	0	0	0	0	0	0	8400	0	3	3	1	2	0	0	3	1	2	2	2	0	1	0	0	0	0
122	3	5	1	2	0	1	1	0	0	0	4500	2	1	0	1	4	4	1	2	1	3	2	1	0	0	0	0	0	0
123	4	178	1	2	0	1	0	0	0	0	2120	0	2	1	4	4	0	0	2	1	2	0	1	0	0	0	0	0	0
125	4	178	1	2	0	1	0	0	0	0	3010	0	1	0	0	0	1	1	2	0	2	2	1	0	1	0	0	0	0
126	3	61	1	3	0	1	0	0	0	0	1820	1	1	0	1	0	0	0	3	1	1	3	5	0	1	0	0	0	0
127	3	61	1	4	0	0	0	0	0	0	360	0	0	1	0	0	0	0	3	1	2	3	5	0	0	0	0	0	0
128	4	81	1	2	0	0	0	0	0	0	2400	0	0	0	1	0	2	1	3	0	2	2	4	0	0	0	0	0	0
129	4	81	1	2	0	0	0	0	0	0	1250	1	4	0	1	0	1	0	3	0	1	3	5	0	0	0	0	0	0
130	4	81	1	3	0	0	0	0	0	0	3250	0	5	1	0	0	0	0	4	0	1	3	6	0	0	0	0	0	0
131	4	81	1	2	0	7	1	0	0	0	1250	1	0	0	0	1	1	0	1	0	1	3	3	0	1	0	0	0	0
132	4	81	1	6	0	5	1	0	0	3	1005	1	1	0	0	1	0	0	3	1	1	3	3	1	0	0	0	0	0
133	4	81	1	6	0	5	1	0	0	3	1200	0	2	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0
134	4	81	1	3	0	0	0	0	0	0	28125	0	8	0	0	5	2	0	5	1	1	3	7	0	0	0	0	0	0
135	4	15	1	2	0	0	0	0	0	0	2450	0	0	0	1	0	0	1	3	2	2	2	6	0	0	0	0	0	0
136	4	178	1	2	0	1	1	0	0	0	12000	6	7	1	2	1	0	0	4	0	2	3	4	0	0	1	0	0	0
137	4	178	1	2	0	1	0	0	0	0	1000	1	0	0	0	6	0	0	3	2	3	1	1	0	0	0	0	0	0
138	4	178	1	2	0	1	1	0	0	0	4250	1	4	0	0	0	0	0	3	2	2	3	5	0	0	1	0	0	0
140	4	178	1	2	0	0	0	0	0	0	400	0	0	0	0	3	0	1	2	2	2	1	2	0	0	0	0	0	0
141	5	59	1	1	0	4	1	0	0	0	5600	3	8	0	0	0	1	4	4	1	1	3	3	0	1	0	0	0	0
142	5	59	1	3	0	4	1	0	0	0	6400	2	7	0	0	0	0	0	4	1	1	3	5	0	0	1	0	0	0
143	5	59	1	3	0	1	0	0	0	0	9600	1	6	0	0	0	1	0	4	1	1	3	3	0	0	0	0	0	0
144	5	59	1	2	0	0	0	0	0	0	2500	0	2	0	1	0	0	1	3	1	2	3	3	0	1	0	0	0	0
145	5	59	2	1	1	1	1	5	1	1	12800	5	11	1	0	0	0	2	4	1	1	3	10	0	1	0	0	0	0
146	5	59	3	1	1	2	1	4	0	0	20000	8	16	0	0	0	1	0	5	1	2	3	15	0	1	1	0	0	0
147	5	59	1	4	0	0	0	0	0	0	4500	0	5	0	0	0	0	0	4	1	1	3	10	0	0	0	0	0	0
148	5	59	2	1	1	1	1	7	0	0	7500	2	10	0	1	0	1	2	5	1	2	3	100	0	1	1	0	0	0
149	5	59	1	4	0	0	0	0	0	0	1125	0	4	0	0	0	1	0	3	1	2	3	1	0	0	0	0	0	0
150	5	59	1	4	0	0	0	0	0	0	3300	0	2	0	0	0	0	0	3	1	2	3	2	0	0	0	0	0	0
151	2	10	1	3	0	0	0	0	0	0	1200	0	1	0	0	0	0	0	3	1	1	3	3	0	0	0	0	0	0
153	2	10	1	3	0	0	0	0	0	0	3900	0	0	0	1	1	0	0	3	1	1	3	5	0	0	0	0	0	0
154	2	35	1	2	0	6	0	0	0	0	3380	0	1	0	1	2	1	2	3	2	3	1	5	0	1	0	0	0	0
155	2	35	1	3	0	0	0	0	0	0	1600	0	0	0	3	0	0	0	2	2	2	3	2	0	0	0	0	0	0
156	2	35	1	3	0	0	0	0	0	0	900	0	0	0	0	0	0	0	1	1	1	3	1	0	0	0	0	0	0
157	2	18	1	3	0	6	0	0	0	0	840	1	1	0	0	0	0	0	3	0	1	3	5	0	0	0	0	0	0
158	2	18	1	3	0	0	0	0	0	0	11200	4	4	0	7	1	0	0	4	1	2	3	5	0	0	0	0	0	0
159	2	18	1	3	0	0	0	0	0	0	2475	0	3	0	2	0	0	0	4	0	2	3	5	0	0	0	0	0	0
160	2	18	1	6	0	6	0	0	0	0	1600	0	0	0	1	0	0	0	1	1	2	3	1	0	1	0	0	0	0
162	2	10	1	2	0	2	0	0	0	0	2200	1	0	0	2	0	1	1	3	1	2	3	3	0	0	0	0	0	0
163	2	10	1	2	0	0	0	0	0	0	6400	0	0	0	0	0	1	1	4	1	1	3	4	0	1	0	0	0	0
165	5	45	1	1	0	0	0	0	0	0	9000	0	5	0	5	0	2	0	5	2	2	3	20	0	1	0	0	0	0
166	5	45	1	2	0	0	0	0	0	0	9900	1	3	0	4	5	0	1	5	2	2	3	10	0	0	0	0	0	0
167	5	45	1	2	0	0	0	0	0	0	4225	0	4	1	3	3	0	0	5	2	3	2	30	0	0	0	0	0	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
168	5	45	1	2	0	0	0	0	0	0	4750	1	4	1	3	1	1	0	4	2	3	2	5	0	0	0	0	0	0
169	5	45	1	6	0	0	0	0	0	0	6175	2	2	0	1	0	0	0	4	1	2	3	5	0	0	0	0	0	0
170	5	45	1	6	0	0	0	0	0	0	9000	0	2	1	0	2	0	0	5	2	3	2	25	0	0	0	0	0	0
171	5	45	1	4	0	7	1	0	0	0	540	1	1	0	0	0	0	0	2	3	2	1	8	0	0	0	0	0	0
173	5	45	1	3	0	0	0	0	0	0	16000	0	15	0	1	0	0	0	5	1	2	3	15	0	1	0	0	0	0
174	5	45	2	3	3	1	0	7	0	0	4355	1	4	0	0	0	0	0	4	2	2	3	5	0	0	0	0	0	0
175	5	45	1	6	0	0	0	0	0	0	4500	1	1	1	0	0	0	0	2	1	3	2	1	0	0	0	0	0	0
176	5	62	1	2	0	0	0	0	0	0	374	0	0	0	0	0	1	1	4	1	1	3	30	0	0	1	0	0	0
177	5	62	1	4	0	7	1	0	0	0	400	1	1	0	0	0	0	0	2	0	0	3	4	0	0	0	0	0	0
178	5	59	1	4	0	7	0	0	0	0	325	0	1	0	0	0	0	0	4	1	2	3	38	0	0	0	0	0	0
179	5	75	1	4	0	1	0	0	0	0	1800	2	1	0	0	0	0	1	3	0	1	3	3	0	0	0	0	0	0
180	5	75	1	4	0	0	0	0	0	0	6000	0	1	2	0	0	0	0	4	1	1	3	3	0	0	0	0	0	0
181	5	75	1	1	0	1	1	0	0	0	18080	1	7	1	6	0	1	2	4	0	2	3	6	0	0	0	0	0	0
182	5	75	1	4	0	4	1	0	0	0	4081	2	0	0	1	0	0	0	4	0	2	3	10	0	0	0	0	0	0
183	5	75	1	4	0	0	0	0	0	0	1330	0	3	0	0	0	0	0	3	0	2	2	2	0	0	0	0	0	0
184	2	107	1	6	0	0	0	0	0	0	304	0	5	0	1	1	0	1	1	0	1	2	1	0	0	0	0	0	0
185	2	103	1	2	0	7	0	0	0	0	800	0	0	0	0	0	2	0	1	0	1	0	1	0	0	1	0	0	0
186	2	103	1	6	0	0	0	0	0	0	468	1	0	1	0	0	0	0	2	1	2	2	1	0	0	0	0	0	0
187	2	103	1	2	0	0	0	0	0	0	704	0	0	1	0	1	0	0	1	2	2	0	1	0	1	0	0	0	0
188	2	103	1	2	0	0	0	0	0	0	8800	0	3	0	2	0	1	0	3	1	3	2	4	0	1	0	0	0	0
189	2	103	1	2	0	7	1	0	0	0	300	1	0	0	0	0	2	0	2	0	2	3	1	0	1	1	0	0	0
190	2	103	1	8	0	5	1	0	0	3	160	0	1	0	2	2	0	1	3	1	3	1	3	1	0	0	0	1	0
191	2	25	1	4	0	0	0	0	0	0	125	0	0	0	0	0	0	0	2	0	1	3	3	0	0	0	0	0	0
192	2	25	1	4	0	0	0	0	0	0	750	0	2	0	0	0	0	0	2	1	1	3	2	0	0	0	0	0	0
193	2	25	1	3	0	0	0	0	0	0	500	1	0	0	0	0	0	0	3	0	1	3	3	0	1	0	0	0	0
194	2	25	1	4	0	0	0	0	0	0	200	0	0	0	0	0	0	0	2	0	1	3	1	0	0	0	0	0	0
195	2	25	1	4	0	4	1	0	0	0	300	3	0	0	0	0	0	0	3	0	0	3	4	0	0	0	0	0	0
196	2	25	1	4	0	0	0	0	0	0	300	0	0	0	0	0	0	0	3	0	0	3	4	0	0	0	0	0	0
197	2	25	1	4	0	0	0	0	0	0	600	0	0	0	0	0	0	0	4	1	1	3	10	0	0	0	0	0	0
198	2	25	1	4	0	1	1	0	0	0	1800	1	1	0	0	1	0	0	4	1	1	3	5	0	0	0	0	0	0
199	2	25	1	3	0	0	0	0	0	0	96	0	1	0	1	0	0	0	1	0	1	1	1	0	1	0	0	0	0
200	2	25	1	4	0	0	0	0	0	0	500	0	1	0	0	0	0	0	3	1	1	3	3	0	0	0	0	0	0
201	5	73	1	3	0	1	1	0	0	0	3300	6	1	0	3	0	0	0	4	1	2	3	5	0	0	0	0	0	0
202	5	73	1	4	0	1	0	0	0	0	2475	1	0	0	0	0	0	0	3	0	3	1	1	0	0	0	0	0	0
203	5	73	1	3	0	4	1	0	0	0	1375	6	2	0	0	0	0	0	4	0	2	3	8	0	0	0	0	0	0
204	5	73	1	6	0	1	0	0	0	0	408	0	2	0	2	1	0	0	2	1	2	1	1	0	0	0	0	0	0
205	5	73	1	1	0	1	1	0	0	0	828	4	2	0	0	10	0	0	4	2	2	2	8	0	0	0	1	0	0
206	5	73	1	1	0	5	1	0	0	1	805	3	2	1	0	1	1	0	4	1	2	3	6	0	1	0	0	0	0
207	5	73	1	1	0	5	1	0	0	2	252	1	2	0	0	1	1	0	3	1	2	3	4	1	0	1	0	0	0
208	5	73	1	4	0	0	0	0	0	0	475	1	1	0	0	0	0	0	3	1	1	3	6	0	0	0	0	0	0
209	5	73	1	4	0	2	1	0	0	0	1728	1	1	0	1	0	0	0	4	0	2	3	8	0	0	0	0	0	0
210	5	73	1	4	0	1	1	0	0	0	1330	2	0	0	1	0	0	0	3	2	2	1	2	0	0	0	0	0	0
211	5	73	1	6	0	0	0	0	0	0	448	1	0	0	1	1	0	0	2	2	2	0	1	0	0	0	0	0	0
212	5	73	1	4	0	0	0	0	0	0	1066	2	1	0	0	1	0	0	3	1	3	2	2	0	0	0	0	0	0
213	5	68	2	1	3	1	1	5	1	3	3800	10	1	0	5	7	5	2	5	2	3	3	20	0	1	1	1	0	0
214	5	68	2	6	6	1	1	5	1	1	24750	4	11	2	11	3	6	2	5	1	2	3	15	1	0	0	0	0	0
215	5	75	1	2	0	1	0	0	0	0	200	0	2	0	0	0	1	1	4	1	2	3	14	0	0	0	0	0	0
216	5	75	1	4	0	1	0	0	0	0	216	4	2	0	1	0	0	0	3	1	2	2	12	0	0	0	0	0	0
217	5	75	2	3	3	1	0	6	0	0	378	2	2	0	1	0	0	0	4	0	2	3	12	0	0	0	0	0	0
218	5	75	1	4	0	1	1	0	0	0	2000	3	1	0	0	0	0	0	4	0	1	3	8	0	0	0	0	0	0
219	5	75	2	1	4	1	0	6	0	0	7280	1	1	1	0	6	0	3	4	1	2	3	18	0	0	0	0	0	0
220	5	68	1	4	0	1	0	0	0	0	2601	2	4	1	0	2	0	0	4	1	2	3	6	0	0	0	0	0	0
221	5	75	2	6	6	1	1	6	0	0	6380	3	7	2	3	0	0	0	4	2	2	3	2	0	0	0	0	0	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
222	5	75	1	4	0	0	0	0	0	0	1320	0	0	0	0	0	0	0	4	0	1	3	14	0	0	0	0	0	0
223	5	75	1	4	0	1	0	0	0	0	3825	2	3	0	1	0	0	0	4	0	2	3	10	0	0	0	0	0	0
224	5	75	1	3	0	4	1	0	0	0	3200	5	3	2	7	0	0	0	5	1	2	3	8	0	0	0	0	0	0
225	5	75	2	3	3	2	1	4	1	0	1880	7	0	1	1	0	0	0	4	0	1	3	8	0	0	0	0	0	0
226	2	25	2	3	3	1	1	5	1	3	300	1	2	0	0	0	0	0	4	1	1	3	8	1	0	1	0	0	0
227	4	70	1	4	0	1	0	0	0	0	7700	1	7	1	0	0	0	0	5	1	2	3	20	0	0	0	0	0	0
228	4	70	1	2	0	0	0	0	0	0	1720	0	3	0	1	0	1	1	3	1	1	3	4	0	0	0	0	0	0
229	4	70	1	4	0	0	0	0	0	0	1566	0	5	0	0	0	0	0	4	1	1	3	4	0	0	0	0	0	0
230	4	70	1	4	0	0	0	0	0	0	3150	0	3	0	0	0	0	0	3	1	2	3	5	0	0	0	0	0	0
231	4	70	1	3	0	1	1	0	0	0	18000	5	7	0	0	0	0	0	5	1	1	3	5	0	0	1	0	0	0
232	4	70	1	3	0	1	1	0	0	0	23000	3	5	0	0	0	0	0	5	1	2	3	15	0	1	0	0	0	0
234	4	70	1	3	0	1	1	0	0	0	4100	1	4	1	0	0	0	0	3	1	1	3	2	0	0	0	0	0	0
235	4	70	2	3	3	5	1	7	0	2	2064	0	1	0	0	1	0	0	3	1	1	3	3	1	0	1	0	0	0
236	4	70	2	1	1	1	0	7	0	0	2590	5	1	0	0	1	2	4	3	1	1	3	3	0	1	1	0	0	0
237	4	70	1	2	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
238	4	70	1	2	0	7	0	0	0	0	750	1	12	0	0	2	2	4	5	2	2	3	20	0	0	0	0	0	0
239	4	70	1	4	0	0	0	0	0	0	224	0	0	0	0	0	0	0	3	0	1	3	10	0	0	0	0	0	0
240	4	40	1	4	0	0	0	0	0	0	494	0	0	0	0	0	0	0	3	0	2	3	4	0	0	0	0	0	0
241	4	40	1	2	0	0	0	0	0	0	15	0	0	0	0	1	0	0	1	1	0	0	1	0	0	1	0	0	0
242	4	40	1	2	0	7	0	0	0	0	28	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
243	4	40	1	3	0	5	1	0	0	1	1829	1	1	0	0	0	1	0	4	0	1	3	20	0	0	1	0	0	0
244	4	40	2	3	3	4	1	7	1	0	2162	4	5	0	0	0	0	0	4	1	1	3	10	0	0	1	0	0	0
245	4	40	1	3	0	3	1	0	0	0	17200	4	7	1	0	0	4	2	4	1	1	3	6	0	1	0	0	0	0
246	4	40	1	4	0	7	1	0	0	0	195	3	1	0	0	0	0	0	3	0	1	3	5	0	0	0	0	0	0
247	4	40	1	2	0	6	0	0	0	0	874	2	3	0	0	0	3	1	3	1	1	3	5	0	0	1	0	0	0
248	4	40	1	3	0	0	0	0	0	0	2793	1	3	0	0	0	2	0	3	1	1	3	3	0	0	1	0	0	0
249	4	40	1	3	0	1	1	0	0	0	756	3	7	0	0	0	0	0	4	1	1	3	25	0	0	0	1	0	0
250	4	40	1	4	0	2	1	0	0	0	1537	1	0	0	0	0	0	0	4	1	1	3	15	0	0	0	0	0	0
251	2	103	1	1	0	5	1	0	0	1	36	1	0	0	1	1	1	0	1	0	2	2	1	0	1	0	0	0	0
252	2	103	2	4	2	5	1	7	0	2	10725	5	1	0	2	0	0	0	4	0	1	3	4	1	1	0	0	0	0
253	2	103	1	4	0	6	0	0	0	0	1250	0	0	0	1	0	0	0	3	0	3	2	3	0	0	0	0	0	0
254	2	103	3	4	2	1	0	5	1	3	15000	3	4	0	2	1	0	3	5	1	2	3	15	1	1	0	1	0	0
255	2	103	1	6	0	0	0	0	0	0	4200	2	1	0	2	1	0	0	3	1	2	3	2	0	1	0	0	0	0
256	2	46	1	4	0	6	0	0	0	0	1260	0	0	2	1	0	0	0	3	0	3	1	1	0	0	0	0	0	0
257	2	46	1	4	0	7	0	0	0	0	875	1	0	1	0	0	0	0	2	0	1	3	2	0	0	0	0	0	0
258	2	46	1	4	0	6	0	0	0	0	2150	3	2	1	1	0	0	0	3	0	3	1	1	0	1	0	0	0	0
259	2	46	1	6	0	0	0	0	0	0	2800	3	2	0	2	0	0	0	3	0	3	2	1	0	0	0	0	0	0
260	1	69	1	3	0	1	1	0	0	0	2035	1	3	1	1	0	0	0	3	1	1	3	1	0	0	0	0	0	0
261	1	69	1	4	0	1	0	0	0	0	156	0	1	0	1	0	0	0	3	1	2	2	4	0	0	0	0	0	0
262	1	69	1	4	0	0	0	0	0	0	759	0	1	1	0	0	0	0	2	1	3	1	1	0	0	0	0	0	0
263	1	69	1	4	0	0	0	0	0	0	2400	0	1	0	0	0	0	0	2	1	3	1	1	0	0	0	0	0	0
264	4	111	1	3	0	1	1	0	0	0	1188	2	1	0	0	0	0	0	4	1	2	3	12	0	0	0	0	0	0
265	4	111	1	4	0	0	0	0	0	0	10	0	0	0	0	0	0	0	2	1	3	0	6	0	0	0	0	0	0
266	4	111	1	2	0	0	0	0	0	0	441	0	1	1	0	3	0	0	3	1	3	2	2	0	0	1	0	0	0
267	4	111	1	4	0	1	0	0	0	0	64	0	0	0	0	0	0	0	3	2	3	1	3	0	0	0	0	0	0
268	5	75	1	3	0	4	1	0	0	0	2924	9	8	3	1	0	0	0	5	1	1	3	20	0	0	0	0	0	0
269	5	75	2	4	3	1	0	5	1	3	3600	7	3	0	3	2	0	0	4	1	2	3	10	1	0	0	0	0	0
270	5	75	1	3	0	5	1	0	0	1	3760	6	9	2	7	0	0	0	5	0	1	3	20	0	1	0	0	0	0
271	5	75	1	3	0	3	1	0	0	0	70000	6	8	3	4	2	2	1	5	1	2	3	8	0	0	0	0	0	0
272	5	75	2	6	6	3	1	6	0	0	2200	2	0	1	2	0	0	0	4	1	2	2	2	0	0	0	0	0	0
273	5	75	1	3	0	1	0	0	0	0	825	1	3	0	1	0	0	0	3	1	2	3	6	0	0	0	0	0	0
274	5	75	1	6	0	1	0	0	0	0	702	2	2	0	2	0	0	0	3	1	2	2	2	0	0	0	0	0	0
275	5	75	1	6	0	1	0	0	0	0	1462	0	4	2	2	0	0	0	4	1	2	3	2	0	0	0	0	0	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
276	5	45	1	2	0	7	1	0	0	0	875	1	0	0	2	0	0	1	3	2	3	2	25	0	1	0	0	0	0
277	5	45	1	6	0	6	0	0	0	0	5220	3	1	2	1	0	0	1	5	2	2	3	25	0	0	0	0	0	0
278	5	30	1	3	0	0	0	0	0	0	1650	0	3	0	3	0	0	0	4	2	2	3	10	0	0	0	0	0	0
279	5	30	1	6	0	0	0	0	0	0	1600	0	2	0	2	1	0	0	4	2	2	3	10	0	0	0	0	0	0
280	4	162	1	5	0	5	1	0	0	1	156	0	0	0	0	1	1	0	1	2	3	1	1	0	0	0	0	0	1
281	4	15	1	2	0	0	0	0	0	0	3825	0	3	0	3	1	0	0	4	2	2	3	30	0	1	0	0	0	0
282	4	15	1	2	0	0	0	0	0	0	1800	0	0	0	0	6	1	1	1	1	3	1	5	0	0	1	0	0	0
283	4	15	1	2	0	1	0	0	0	0	1600	0	1	0	0	2	1	0	4	1	2	3	25	0	0	0	0	0	0
284	4	15	2	2	2	5	1	7	1	3	11200	0	2	0	1	1	0	0	4	2	2	3	30	1	0	0	0	0	0
285	1	31	1	3	0	6	0	0	0	0	750	0	1	0	1	0	0	0	3	1	1	3	5	0	0	0	0	0	0
286	4	15	2	1	3	1	0	6	0	0	1591	0	2	3	1	7	1	2	4	1	3	3	8	0	1	1	0	0	0
287	4	15	1	4	0	6	0	0	0	0	2700	1	2	2	0	2	0	0	4	0	1	3	4	0	0	0	0	0	0
288	4	15	1	1	0	1	0	0	0	0	1598	1	2	0	8	9	3	2	4	1	3	3	15	0	1	0	0	0	0
289	4	15	1	2	0	1	0	0	0	0	540	0	2	4	0	5	1	0	3	1	3	2	4	0	0	0	0	0	0
290	4	15	1	4	0	0	0	0	0	0	1312	1	0	0	1	0	0	0	3	2	2	2	1	0	1	0	0	0	0
291	4	40	1	4	0	1	1	0	0	0	420	3	1	0	0	0	0	0	3	1	1	3	4	0	0	0	0	0	0
292	4	40	1	4	0	0	0	0	0	0	576	0	0	0	0	0	0	0	3	0	1	3	3	0	0	0	0	0	0
296	5	75	1	3	0	1	1	0	0	0	300	1	2	0	1	0	0	0	3	0	2	3	2	0	0	0	0	0	0
297	5	75	2	1	3	1	1	6	0	0	19425	6	8	4	4	2	3	2	5	1	2	3	50	0	1	0	0	0	0
298	5	68	1	4	0	6	0	0	0	0	500	0	1	1	0	0	0	0	2	1	2	2	2	0	0	0	0	0	0
299	5	75	1	6	0	1	0	0	0	0	1024	1	2	0	0	0	0	0	3	1	1	3	2	0	0	0	0	0	0
300	5	75	1	1	0	1	1	0	0	0	10800	4	15	0	1	15	5	5	4	1	3	3	10	0	1	0	0	0	0
301	5	75	1	3	0	4	1	0	0	0	1504	5	0	0	1	0	0	1	5	1	2	3	30	0	1	0	0	0	0
302	5	75	1	6	0	1	0	0	0	0	680	0	1	1	0	0	0	0	3	1	1	3	4	0	0	0	0	0	0
303	5	75	1	1	0	1	1	0	0	0	5035	2	2	0	0	1	2	0	4	1	2	3	10	0	0	0	0	0	0
304	5	75	1	4	0	1	0	0	0	0	1800	2	5	0	2	0	0	0	4	1	2	2	6	0	0	0	0	0	0
305	5	75	1	1	0	1	0	0	0	0	1820	0	5	1	1	2	2	3	4	1	3	2	4	0	0	0	0	0	0
306	5	75	1	6	0	3	1	0	0	0	1750	2	2	1	0	0	0	0	4	1	2	2	3	0	0	0	0	0	0
307	5	75	1	3	0	2	0	0	0	0	1935	2	2	0	2	0	0	0	4	1	1	3	30	0	0	0	0	0	0
308	5	75	1	3	0	1	1	0	0	0	11000	3	5	2	7	0	0	0	5	1	2	3	10	0	0	0	0	0	0
309	5	75	1	4	0	3	1	0	0	0	5358	4	4	2	0	0	0	1	4	1	2	3	2	0	0	0	0	0	0
316	1	2	1	4	0	0	0	0	0	0	680	0	0	0	0	0	0	2	3	1	1	3	8	0	0	0	0	0	0
310	9	59	1	5	0	4	0	0	0	0	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
311	9	59	1	3	0	0	0	0	0	0	88	0	3	0	3	0	0	0	2	0	2	2	2	0	0	0	0	0	0
312	9	59	1	1	0	1	0	0	0	0	6510	4	4	0	1	5	1	1	4	1	2	2	3	0	1	0	0	0	0
313	9	59	1	1	0	1	0	0	0	0	3854	5	3	1	2	2	3	0	4	1	2	3	5	0	0	0	0	0	0
314	9	59	1	1	0	1	0	0	0	0	1430	0	4	0	1	2	2	2	3	0	2	2	3	0	1	0	0	0	0
315	9	59	1	6	0	0	0	0	0	0	256	0	2	1	1	1	0	0	2	0	3	2	1	0	0	0	0	0	0
317	9	59	1	3	0	1	0	0	0	0	504	2	1	0	0	0	0	0	3	0	1	3	2	0	0	0	0	0	0
318	9	59	1	2	0	6	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
319	9	47	1	4	0	6	0	0	0	0	96	0	0	0	0	0	0	0	2	0	1	3	3	0	0	0	0	0	0
320	9	47	1	2	0	0	0	0	0	0	800	0	0	0	3	3	0	1	3	1	3	1	3	0	0	0	0	0	0
321	9	47	2	1	3	1	1	5	0	1	13386	15	10	0	5	2	1	1	5	1	2	3	15	0	0	0	0	0	0
322	9	47	1	3	0	5	0	0	0	1	1260	1	1	0	0	1	0	0	4	0	1	3	15	0	0	0	0	0	0
323	9	47	1	1	0	1	0	0	0	0	6370	0	3	0	0	5	0	2	4	2	3	2	2	0	0	0	0	0	0
324	9	47	1	3	0	1	1	0	0	0	1170	2	2	0	0	0	0	0	4	1	2	2	5	0	0	0	0	0	0
325	9	47	1	2	0	1	1	0	0	0	2236	0	2	0	0	5	0	3	2	1	2	1	1	0	0	0	0	0	0
326	9	47	1	1	0	1	1	0	0	0	1029	4	2	0	1	3	0	1	4	1	2	3	5	0	0	0	0	0	0
327	9	47	1	6	0	1	0	0	0	0	861	1	0	0	0	0	0	0	3	1	3	2	2	0	0	0	0	0	0
328	9	47	1	3	0	5	0	0	0	1	5504	0	4	1	1	0	0	0	4	0	1	3	6	0	0	0	0	0	0
329	9	47	1	2	0	1	0	0	0	0	1140	0	1	0	4	3	0	1	2	1	3	1	2	0	0	0	0	0	0
330	9	47	1	6	0	1	0	0	0	0	6177	1	0	0	1	0	1	1	3	1	3	1	2	0	0	0	0	0	0
331	9	47	1	2	0	1	1	0	0	0	252	0	0	0	4	1	0	1	2	1	2	1	1	0	0	0	0	0	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
332	9	47	1	6	0	0	0	0	0	0	1274	0	1	0	0	1	0	0	2	1	1	3	1	0	0	0	0	0	0
333	9	47	1	6	0	0	0	0	0	0	2133	1	3	0	0	0	0	0	3	0	1	3	2	0	0	0	0	0	0
334	9	47	1	2	0	1	1	0	0	0	364	0	0	0	0	1	0	2	2	1	2	2	1	0	0	0	0	0	0
335	9	35	1	3	0	2	1	0	0	0	1551	1	1	0	1	0	0	0	3	2	2	2	2	0	0	0	0	0	0
336	8	3	1	6	0	0	0	0	0	0	234	0	0	0	0	0	0	0	1	0	1	2	2	0	0	0	0	0	0
337	8	3	1	3	0	1	0	0	0	0	225	0	1	0	2	0	0	0	2	0	2	3	3	0	1	0	0	0	0
338	8	3	1	4	0	0	0	0	0	0	66	0	2	0	0	0	0	0	3	1	2	3	8	0	0	0	0	0	0
339	8	3	1	4	0	0	0	0	0	0	288	0	2	0	1	0	0	0	3	0	2	2	4	0	0	0	0	0	0
340	8	3	1	6	0	0	0	0	0	0	374	1	0	0	1	0	0	0	2	1	2	2	2	0	0	0	0	0	0
341	9	35	1	6	0	1	0	0	0	0	8284	1	2	0	0	0	0	0	2	2	3	1	1	0	0	0	0	0	0
342	9	35	1	1	0	1	1	0	0	0	2622	2	2	0	0	2	0	1	4	1	2	3	8	0	0	0	0	0	0
343	9	35	1	3	0	1	1	0	0	0	629	1	3	0	0	0	0	0	3	1	2	2	2	0	0	0	0	0	0
344	9	35	2	2	2	1	0	7	0	0	2255	0	0	0	2	4	3	2	3	1	3	1	2	1	1	0	0	0	0
345	8	3	1	3	0	0	0	0	0	0	3726	3	5	0	1	1	0	0	4	1	2	3	2	0	1	0	0	0	0
346	8	111	1	2	0	5	1	0	0	3	216	0	0	0	0	1	0	0	1	1	3	1	1	0	1	0	0	0	1
347	8	111	1	4	0	0	0	0	0	0	150	0	0	0	0	0	0	0	3	1	1	3	4	0	0	0	0	0	0
348	8	111	1	6	0	1	0	0	0	0	135	1	1	0	1	0	0	0	1	0	2	2	1	0	0	0	0	0	0
349	8	111	2	2	2	4	1	5	1	3	2625	3	3	0	1	1	2	1	3	1	3	2	2	1	0	0	0	0	0
350	8	111	1	8	0	5	1	0	0	3	2091	7	2	0	6	1	1	0	4	1	2	3	8	1	1	0	1	0	0
351	9	28	1	4	0	5	1	0	0	3	2888	0	0	0	0	0	0	0	4	1	1	3	40	0	0	0	0	0	0
352	9	28	1	3	0	0	0	0	0	0	2187	0	4	0	1	0	0	0	4	1	2	2	1	0	0	0	0	0	0
353	9	28	1	3	0	3	1	0	0	0	2666	1	8	0	0	0	0	0	4	0	2	2	4	0	0	0	0	0	0
354	9	28	1	2	0	0	0	0	0	0	48	0	0	0	0	0	1	1	1	0	3	0	1	0	0	0	0	0	0
355	9	28	1	3	0	0	0	0	0	0	1376	0	2	0	5	0	0	0	3	0	2	2	10	0	0	0	0	0	0
356	9	28	2	1	1	7	1	1	0	0	2905	3	6	1	0	1	2	0	4	1	1	3	10	0	1	0	0	0	0
357	9	28	1	6	0	0	0	0	0	0	3330	0	2	0	1	0	0	1	3	0	0	3	2	0	0	0	0	0	0
358	9	28	1	1	0	0	0	0	0	0	10790	2	9	0	3	1	0	0	5	0	1	3	8	0	0	0	0	0	0
359	9	28	1	1	0	2	1	0	0	0	6110	3	4	0	0	0	1	0	3	0	1	3	1	0	1	0	0	0	0
360	9	28	2	3	2	2	1	7	0	0	2772	2	2	0	1	0	0	0	3	0	1	3	3	0	1	0	0	0	0
361	9	28	1	6	0	1	0	0	0	0	5512	2	4	0	0	0	2	1	4	1	2	2	15	0	0	0	0	0	0
362	9	28	1	1	0	0	0	0	0	0	7250	1	1	0	2	0	0	2	4	1	1	3	20	0	0	0	0	0	0
363	9	28	1	6	0	0	0	0	0	0	2200	2	1	0	1	0	0	0	3	1	1	3	1	0	0	0	0	0	0
364	9	28	1	3	0	0	0	0	0	0	576	0	1	0	1	0	0	0	3	0	0	3	3	0	0	0	0	0	0
365	9	58	1	3	0	1	0	0	0	0	572	3	3	0	0	0	0	0	3	0	0	3	3	0	0	0	0	0	0
366	9	58	1	2	0	0	0	0	0	0	2356	0	1	0	1	0	1	0	3	1	1	1	2	0	0	0	0	0	0
368	9	35	1	1	0	1	0	0	0	0	620	3	0	0	1	0	0	0	4	1	2	2	10	0	1	0	1	0	0
369	9	35	2	3	3	1	1	7	1	0	14295	5	10	0	0	1	0	0	4	1	3	2	4	1	0	0	0	0	0
370	9	35	1	3	0	0	0	0	0	0	1344	1	1	0	0	0	0	0	2	1	2	1	2	0	0	0	0	0	0
371	9		1	2	0	5	1	0	0	2	775	1	2	0	0	1	0	0	2	0	2	2	1	1	0	1	0	1	1
372	8	51	1	3	0	0	0	0	0	0	6731	0	1	0	3	0	0	0	4	0	1	3	60	0	0	0	0	0	0
373	8	51	1	8	0	0	0	0	0	0	1134	0	1	1	0	0	0	0	2	1	3	1	2	0	0	0	0	0	0
374	8	51	1	4	0	1	0	0	0	0	670	1	0	0	0	0	0	0	3	0	0	3	2	0	0	0	0	0	0
375	8	51	1	3	0	1	1	0	0	0	6844	1	1	0	1	0	0	0	3	1	2	1	2	0	0	0	0	0	0
376	8	51	1	1	0	1	0	0	0	0	5720	1	3	0	0	0	0	1	4	1	1	2	3	0	1	0	0	0	0
377	8	51	1	3	0	3	1	0	0	0	6555	1	0	0	0	0	0	2	4	0	1	3	5	0	0	0	0	0	0
378	8	51	1	3	0	0	0	0	0	0	5712	0	4	0	1	0	0	1	3	1	1	3	1	0	0	0	0	0	0
379	8	51	1	4	0	0	0	0	0	0	609	0	1	0	0	0	0	0	2	2	2	0	1	0	0	0	0	0	0
380	8	51	1	3	0	1	1	0	0	0	1600	1	0	0	0	0	0	0	3	1	2	2	4	0	0	0	0	0	0
381	8	52	1	3	0	1	0	0	0	0	3445	1	5	0	0	0	0	0	4	1	1	2	2	0	0	0	0	0	0
382	8	52	1	2	0	0	0	0	0	0	4550	0	6	1	1	0	1	0	4	0	1	2	3	0	0	0	0	0	0
383	8	52	1	3	0	6	1	0	0	0	3080	1	2	0	0	0	0	0	3	0	1	3	4	0	0	0	0	0	0
384	8	52	1	1	0	1	1	0	0	0	2320	2	4	0	0	0	1	0	3	1	1	2	4	0	0	0	0	0	0
385	8	52	1	3	0	1	0	0	0	0	650	1	0	0	0	0	0	0	3	0	0	2	3	0	0	0	0	0	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
386	8	52	1	3	0	4	1	0	0	0	60515	17	20	0	0	0	0	2	5	1	3	2	5	0	0	0	0	0	0
387	8	52	1	3	0	2	1	0	0	0	4300	3	3	0	0	1	0	0	4	0	1	2	4	0	0	0	0	0	0
388	8	52	1	3	0	0	0	0	0	0	644	4	1	0	0	0	0	0	3	0	0	3	2	0	1	0	0	0	0
389	8	52	1	6	0	0	0	0	0	0	702	2	2	0	0	0	0	0	2	0	0	3	1	0	0	0	0	0	0
390	8	52	1	1	0	7	1	0	0	0	256	3	0	0	2	0	0	0	5	0	1	3	15	1	0	0	0	0	0
391	8	52	1	3	0	4	1	0	0	0	2250	5	0	1	1	0	0	0	3	0	3	2	1	0	0	0	0	0	0
392	8	52	1	6	0	1	0	0	0	0	1452	0	3	0	2	0	0	0	3	0	2	1	1	0	0	0	0	0	0
393	8	52	1	1	0	4	1	0	0	0	3640	1	1	0	1	0	0	0	4	0	1	2	4	0	1	0	0	0	0
394	8	52	1	6	0	7	0	0	0	0	1750	2	1	0	0	0	0	0	2	0	2	2	1	0	0	0	0	0	0
395	8	131	1	3	0	1	0	0	0	0	3124	2	2	0	1	0	0	0	4	1	1	2	5	0	0	0	0	0	0
398	8	131	1	6	0	1	0	0	0	0	950	1	1	0	0	0	0	0	3	0	2	2	2	0	0	0	0	0	0
397	8	131	1	3	0	4	1	0	0	0	2520	4	5	0	1	0	0	0	4	1	1	2	3	0	0	0	0	0	0
398	8	131	1	4	0	0	0	0	0	0	720	1	0	0	1	0	0	0	3	1	3	0	3	0	0	0	0	0	0
399	8	131	2	3	3	1	0	5	0	1	1980	6	3	0	2	0	0	0	4	0	2	2	4	0	0	0	0	0	0
400	8	131	1	3	0	1	0	0	0	0	39420	2	4	1	0	1	1	0	5	1	2	2	3	0	0	0	0	0	0
401	9	44	1	6	0	0	0	0	0	0	9030	0	1	0	0	0	1	0	4	2	1	3	3	0	0	0	0	0	0
402	9	44	1	3	0	0	0	0	0	0	2009	0	1	0	0	0	0	0	3	1	1	3	8	0	0	0	0	0	0
403	9	44	1	3	0	0	0	0	0	0	2850	2	0	0	0	0	0	0	3	1	1	3	5	0	0	0	0	0	0
404	9	44	1	2	0	1	0	0	0	0	4020	2	5	0	1	1	0	0	3	1	2	3	5	0	0	0	0	0	0
405	9	44	1	6	0	0	0	0	0	0	1134	1	0	0	1	0	0	0	3	1	2	3	5	0	0	0	0	0	0
406	9	44	1	3	0	1	0	0	0	0	768	2	2	0	1	0	0	0	3	1	2	3	5	0	0	0	0	0	0
408	9	30	1	3	0	5	0	0	0	1	396	1	1	1	0	1	0	0	3	1	2	3	5	0	0	0	0	0	0
409	9	30	1	3	0	5	1	0	0	2	324	8	6	0	0	0	0	0	3	1	2	3	7	1	0	0	0	0	0
410	9	30	2	3	6	1	1	5	0	2	3570	6	5	2	1	0	0	1	3	1	1	3	3	0	0	0	0	0	0
411	9	30	1	3	0	7	0	0	0	0	594	2	1	2	1	0	0	0	2	0	2	3	4	0	0	0	0	0	0
412	9	30	1	3	0	7	1	0	0	0	1536	2	0	0	1	0	0	0	4	0	1	3	15	0	0	0	0	0	0
413	9	30	1	2	0	1	0	0	0	0	1150	0	1	1	0	1	1	0	2	2	3	2	2	0	0	0	0	0	0
414	9	30	1	2	0	7	0	0	0	0	595	0	1	1	0	3	1	2	2	2	3	1	1	0	0	0	0	0	0
415	9	30	1	3	0	1	1	0	0	0	1152	6	11	1	0	1	0	0	4	1	2	3	5	0	0	0	0	0	0
416	9	30	1	3	0	2	1	0	0	0	4784	1	2	1	0	0	0	0	3	1	2	3	4	0	0	0	0	0	0
417	9	30	2	2	2	5	1	5	1	4	312	0	0	0	0	1	0	3	1	0	3	2	2	1	0	0	1	0	0
418	9	35	1	1	0	1	1	0	0	0	16700	4	7	1	1	6	0	2	4	2	2	3	5	0	0	0	0	0	0
419	9	35	1	2	0	5	1	0	0	3	875	3	2	0	2	1	0	0	3	1	2	3	3	1	0	0	0	0	0
420	9	35	1	2	0	1	0	0	0	0	3819	0	8	1	1	1	0	1	3	1	2	3	5	0	0	0	0	0	0
421	9	35	1	2	0	1	0	0	0	0	2622	3	8	0	3	3	0	0	3	2	2	3	5	0	0	0	0	0	0
422	8	66	1	3	0	3	0	0	0	0	255	1	0	0	0	0	0	0	2	0	0	3	2	0	0	0	0	0	0
423	8	141	1	3	0	1	0	0	0	0	4233	1	1	0	0	0	0	0	5	2	2	3	50	0	0	0	0	0	0
424	8	66	1	4	0	0	0	0	0	0	546	0	2	0	0	0	0	0	3	1	2	3	2	0	0	0	0	0	0
425	8	141	1	6	0	0	0	0	0	0	898	0	0	0	0	0	0	0	2	0	1	3	1	0	0	0	0	0	0
426	8	141	1	2	0	1	0	0	0	0	2880	0	0	0	2	0	0	1	2	0	2	3	2	0	0	0	0	0	0
427	8	141	1	2	0	1	0	0	0	0	11340	0	2	0	0	2	1	0	4	1	3	2	1	0	0	0	0	0	0
428	8	149	1	2	0	5	0	0	0	1	4698	1	0	1	0	2	1	0	4	2	2	3	50	0	1	0	0	0	0
429	8	149	1	6	0	5	0	0	0	1	1590	1	1	0	1	0	0	0	3	1	2	3	3	0	0	0	0	0	0
430	8	149	1	2	0	1	0	0	0	0	2679	1	2	0	0	1	2	1	3	1	2	3	5	0	0	0	0	0	0
431	8	149	1	2	0	4	1	0	0	0	2100	2	1	0	0	2	2	1	3	2	3	2	5	0	0	0	0	0	0
432	8	149	1	4	0	0	0	0	0	0	1064	0	1	0	0	0	0	0	2	0	1	3	2	0	0	0	0	0	0
433	8	149	1	1	0	5	1	0	0	2	29000	2	4	0	3	2	2	2	5	2	2	3	10	1	1	0	0	0	0
434	8	149	1	2	0	6	0	0	0	0	255	0	0	0	0	3	0	0	1	0	3	0	1	0	1	0	0	0	0
435	8	149	1	1	0	5	1	0	0	3	30000	7	6	1	2	2	2	0	5	2	2	3	10	1	1	0	0	0	0
436	8	149	1	6	0	0	0	0	0	0	3050	0	0	0	1	0	0	0	3	0	2	3	5	0	0	0	0	0	0
437	8	149	1	2	0	1	0	0	0	0	5124	1	6	0	0	1	1	0	3	2	2	3	5	0	0	0	0	0	0
438	8	118	1	6	0	1	0	0	0	0	2805	0	0	0	0	0	0	0	2	0	2	3	4	0	0	1	0	0	0
439	8	118	1	3	0	1	0	0	0	0	5874	0	2	0	0	1	0	0	3	0	2	3	3	0	0	0	0	0	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
440	8	118	2	3	3	5	1	1	0	3	3735	4	3	1	0	0	1	0	3	1	2	3	5	1	0	0	0	0	0
441	7	97	1	2	0	0	0	0	0	0	209	0	0	0	0	0	2	0	1	0	0	3	1	0	0	0	0	0	0
442	7	97	1	2	0	5	1	0	0	3	2592	0	2	0	0	0	1	0	3	0	2	3	3	1	1	0	0	0	0
443	7	97	1	3	0	6	1	0	0	0	2279	4	1	0	1	1	1	0	2	2	3	1	2	0	1	0	0	0	0
444	7	97	1	6	0	5	0	0	0	1	1064	1	0	2	0	0	1	0	2	1	2	3	2	0	0	0	0	0	0
445	7	97	1	2	0	7	0	0	0	0	1178	2	1	0	2	1	0	0	3	0	2	3	3	0	1	0	0	0	0
446	7	97	1	3	0	1	0	0	0	0	896	1	4	2	0	0	0	0	3	0	2	3	3	0	0	0	0	0	0
447	7	97	1	1	0	5	1	0	0	3	4732	6	4	0	0	2	2	0	3	0	2	3	3	1	1	0	0	0	0
448	7	97	1	6	0	1	0	0	0	0	682	1	0	1	1	0	0	0	1	0	2	3	2	0	0	0	0	0	0
449	7	97	1	6	0	0	0	0	0	0	1551	0	1	0	2	0	0	0	2	0	2	3	2	0	0	0	0	0	0
450	7	97	1	2	0	0	0	0	0	0	1584	0	1	0	2	1	0	0	2	0	2	3	2	0	0	0	0	0	0
452	7	65	1	6	0	1	0	0	0	0	3760	1	0	0	0	0	0	0	2	0	21	0	1	0	0	0	0	0	0
453	7	65	1	1	0	0	0	0	0	0	8160	1	0	0	2	1	1	0	4	1	1	3	3	0	0	0	0	0	0
454	7	65	1	3	0	1	0	0	0	0	2028	2	2	1	0	0	0	0	4	1	2	2	15	0	1	0	0	0	0
455	7	65	1	6	0	3	1	0	0	0	4816	3	1	0	0	0	0	0	3	0	1	2	3	0	0	0	0	0	0
456	7	65	1	6	0	0	0	0	0	0	2397	1	1	0	1	0	0	0	3	1	2	1	2	0	0	0	0	0	0
457	7	65	1	2	0	1	1	0	0	0	5002	1	1	0	0	0	1	0	3	1	2	1	2	0	0	0	0	0	0
458	7	65	2	3	3	2	1	3	1	0	4472	3	2	0	3	0	0	0	4	1	2	2	2	0	0	0	0	0	0
459	7	65	1	3	0	1	1	0	0	0	4816	3	1	0	2	0	0	0	4	1	1	3	2	0	0	0	0	0	0
460	7	66	1	1	0	1	0	0	0	0	713	1	1	0	0	0	0	1	1	1	1	2	1	0	1	0	0	0	0
462	7	66	1	3	0	1	1	0	0	0	6256	4	3	0	4	0	0	1	4	0	1	3	3	0	0	0	0	0	0
463	7	66	1	3	0	0	0	0	0	0	322	1	3	0	0	0	0	0	3	1	2	1	3	0	1	0	0	0	0
464	7	66	1	1	0	4	1	0	0	0	1880	2	4	0	1	1	1	0	4	0	1	2	3	0	0	0	0	0	0
468	7	68	1	6	0	5	1	0	0	3	2391	0	0	0	1	1	0	0	2	0	2	0	1	1	0	0	0	0	0
467	7	75	1	6	0	0	0	0	0	0	247	0	0	0	0	0	0	0	2	0	3	0	1	0	0	0	0	0	0
469	7	75	1	3	0	1	1	0	0	0	3332	1	2	0	1	0	0	0	3	1	2	1	2	0	0	0	0	0	0
470	7	75	1	3	0	1	1	0	0	0	3618	2	0	0	0	0	0	0	3	0	2	2	3	0	0	0	0	0	0
471	7	75	1	6	0	0	0	0	0	0	1482	0	1	0	0	0	1	0	2	0	1	3	1	0	1	0	0	0	0
472	7	75	1	3	0	2	1	0	0	0	1953	3	4	0	0	0	0	0	3	0	1	3	2	0	0	0	0	0	0
473	7	75	1	1	0	5	1	0	0	3	11473	2	1	0	0	0	0	1	4	1	2	2	5	1	0	0	1	0	0
474	7	75	1	6	0	0	0	0	0	0	3225	0	2	0	0	0	1	0	2	0	2	2	2	0	0	0	0	0	0
475	7	75	1	3	0	1	1	0	0	0	2553	3	1	0	0	0	0	0	4	0	1	3	4	0	0	0	0	0	0
476	8	3	1	6	0	0	0	0	0	0	900	0	2	0	0	0	0	0	2	0	1	2	1	0	0	0	0	0	0
477	8	3	1	4	0	0	0	0	0	0	510	1	0	0	0	0	0	0	2	1	2	3	2	0	0	0	0	0	0
478	8	3	1	1	0	1	1	0	0	0	3519	1	4	1	0	3	1	1	4	1	2	3	4	0	1	0	0	0	0
479	8	3	1	6	0	0	0	0	0	0	20	0	0	0	0	0	0	0	1	1	2	1	1	0	0	0	0	0	0
480	8	3	1	1	0	4	1	0	0	0	18669	1	5	0	2	3	3	2	4	1	2	3	5	0	1	0	0	0	0
481	8	111	1	3	0	1	1	0	0	0	3584	2	0	0	1	0	0	0	3	0	2	3	1	0	0	0	0	0	0
482	8	111	1	6	0	3	1	0	0	0	5390	1	3	0	0	0	1	0	2	0	3	1	1	0	0	0	0	0	0
483	8	111	1	2	0	1	0	0	0	0	2280	0	0	0	0	0	0	1	3	1	3	2	5	0	0	0	0	0	0
484	8	160	1	3	0	1	1	0	0	0	308	3	2	0	0	0	0	0	2	0	2	2	1	0	0	0	0	0	0
485	8	160	1	3	0	5	0	0	0	1	504	0	1	0	0	0	0	0	2	1	2	3	2	0	1	0	0	0	0
486	8	160	1	6	0	1	0	0	0	0	4230	1	1	0	2	1	0	0	3	1	2	3	4	1	0	0	0	0	0
487	8	160	1	6	0	0	0	0	0	0	1400	0	0	0	1	0	0	0	2	1	1	3	1	0	0	0	0	0	0
488	8	160	1	1	0	5	1	0	0	3	112	1	3	0	1	0	0	0	3	1	3	2	2	1	1	0	0	0	0
489	8	160	1	6	0	1	0	0	0	0	352	0	0	0	0	0	0	0	2	0	2	3	1	0	0	0	0	0	0
490	8	160	1	6	0	0	0	0	0	0	480	1	1	0	1	0	0	0	2	0	2	3	1	0	0	0	0	0	0
491	8	160	1	6	0	0	0	0	0	0	9900	1	4	0	1	1	0	0	4	1	2	3	4	0	0	0	0	0	0
492	8	160	2	2	3	3	1	5	0	1	16170	2	4	2	1	0	1	0	4	1	2	3	10	0	1	0	0	0	0
493	8	118	1	2	0	7	1	0	0	0	90	0	0	0	1	0	0	0	1	0	0	1	1	0	1	0	0	0	0
494	8	118	1	3	0	7	1	0	0	0	35	0	0	0	2	0	0	0	2	0	2	2	4	0	1	0	0	0	0
495	8	131	1	3	0	2	1	0	0	0	13416	7	3	0	1	0	0	0	4	1	2	3	8	0	0	0	0	0	0
496	8	131	1	3	0	1	0	0	0	0	1728	3	3	0	0	0	0	0	3	1	2	2	4	0	0	0	0	0	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
497	8	118	1	1	0	1	1	0	0	0	1479	0	1	0	0	0	0	0	4	1	2	2	8	0	0	0	1	0	0
498	7	94	1	3	0	3	0	0	0	0	475	1	0	0	1	0	0	0	3	0	1	3	1	0	0	0	0	0	0
499	7	94	1	2	0	5	0	0	0	1	1534	1	1	0	0	0	1	0	2	0	3	1	1	0	1	0	0	0	0
500	7	94	1	2	0	5	1	0	0	3	70	0	1	0	1	1	0	0	1	1	1	1	1	1	0	0	0	0	0
501	7	94	1	6	0	0	0	0	0	0	50	0	0	0	0	1	0	0	1	2	3	0	1	0	0	0	0	0	0
502	7	94	1	5	0	5	1	0	0	3	819	0	1	0	0	0	0	2	1	0	1	0	1	0	0	0	0	0	1
503·	7	94	1	6	0	0	0	0	0	0	759	1	1	0	1	1	0	0	1	1	2	0	1	0	0	0	0	0	0
504	7	94	1	2	0	0	0	0	0	0	264	0	1	0	0	1	0	1	1	1	2	1	1	0	0	0	0	0	0
505	7	94	1	3	0	4	1	0	0	0	1260	5	1	0	0	0	0	0	3	1	3	2	1	0	0	0	0	0	0
506	7	94	1	2	0	1	1	0	0	0	325	0	0	0	1	0	0	0	1	1	1	0	2	0	1	0	0	0	0
507	7	94	1	4	0	5	0	0	0	1	1400	0	0	0	0	0	0	0	3	2	2	3	3	1	0	0	0	0	0
508	7	80	1	6	0	0	0	0	0	0	56	0	2	0	0	1	0	0	1	0	2	0	1	0	0	0	0	0	0
510	7	80	1	1	0	5	0	0	0	1	198	1	4	1	1	1	0	0	3	1	3	2	3	0	1	0	0	0	0
511	7	80	1	6	0	0	0	0	0	0	77	0	0	0	1	1	0	0	1	2	2	2	1	0	1	0	0	0	0
512	7	80	1	4	0	0	0	0	0	0	891	0	0	0	3	0	0	0	3	2	2	2	2	0	0	0	0	0	0
513	7	80	1	2	0	0	0	0	0	0	253	0	0	0	2	0	0	0	1	1	2	0	1	0	0	0	0	0	0
514	7	114	1	3	0	2	1	0	0	0	986	4	0	0	0	0	0	0	3	1	2	2	2	0	1	0	0	0	0
517	7	114	1	3	0	3	1	0	0	0	2400	4	1	1	1	0	0	1	1	1	3	2	1	0	0	0	0	0	0
518	7	114	1	3	0	5	1	0	0	3	40	2	1	0	1	1	0	0	3	1	2	3	6	1	1	0	1	0	0
519	7	114	2	2	2	5	1	7	1	1	114	1	1	0	1	1	0	0	2	1	2	2	1	0	1	0	0	0	0
520	7	114	2	6	6	1	1	5	1	1	6726	3	4	0	1	0	0	0	3	1	2	2	1	0	0	0	0	0	0
521	7	114	1	3	0	2	1	0	0	0	3944	6	4	0	0	1	1	0	4	1	2	3	5	0	0	0	0	0	0
522	7	114	1	3	0	2	1	0	0	0	1998	4	3	0	1	0	0	0	3	1	2	2	2	0	0	0	0	0	0
523	7	114	1	2	0	6	1	0	0	0	60	1	1	0	0	0	1	1	2	1	2	1	2	0	1	0	1	0	0
524	7	114	1	6	0	0	0	0	0	0	430	0	1	0	0	4	0	0	3	2	2	1	1	0	0	0	0	0	0
525	7	114	1	4	0	1	0	0	0	0	1140	0	2	0	0	0	0	0	3	1	2	2	4	0	0	0	0	0	0
526	6	46	1	6	0	1	0	0	0	0	540	1	0	0	0	0	0	0	2	0	2	1	2	0	0	0	0	0	0
527	6	46	1	6	0	1	0	0	0	0	532	0	0	1	0	0	0	0	2	0	0	3	1	0	0	0	0	0	0
528	7	1	1	2	0	0	0	0	0	0	224	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
529	8	35	1	2	0	1	1	0	0	0	648	1	1	0	5	1	1	0	3	0	1	0	3	0	0	0	0	0	0
530	8	35	1	3	0	1	0	0	0	0	3312	1	5	0	1	0	0	1	5	1	2	2	3	0	0	0	0	0	0
531	7	75	1	6	0	0	0	0	0	0	3071	0	0	0	0	0	0	0	3	0	1	3	3	0	0	0	0	0	0
532	9	190	1	5	0	5	1	0	0	3	180	0	0	0	0	0	0	1	1	0	2	0	2	1	0	0	0	0	1
533	9	190	1	1	0	5	1	0	0	3	3224	1	1	0	3	2	0	0	4	0	1	3	7	1	0	0	0	0	0
534	9	190	1	1	0	5	1	0	0	3	2295	4	3	0	1	0	0	1	4	0	2	3	4	1	0	0	0	0	0
535	9	190	1	1	0	5	1	0	0	3	1632	0	4	0	1	1	0	0	3	0	2	2	3	1	0	0	1	1	0
536	9	81	2	3	3	3	1	4	1	0	2870	6	3	0	2	0	0	0	4	0	1	3	3	0	0	0	0	0	0
537	9	81	1	3	0	1	1	0	0	0	2650	4	4	0	1	0	0	0	3	0	3	2	2	0	0	0	0	0	0
538	9	81	1	4	0	0	0	0	0	0	832	0	0	0	1	0	0	0	3	0	0	3	4	0	0	0	0	0	0
539	9	81	1	6	0	0	0	0	0	0	2650	0	4	0	1	0	0	0	3	0	2	1	3	0	0	0	0	0	0
540	9	154	1	6	0	0	0	0	0	0	374	0	0	0	2	0	0	0	3	0	1	2	4	0	0	0	0	0	0
541	9	154	1	5	0	5	1	0	0	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
542	9	154	1	6	0	0	0	0	0	0	1760	2	3	0	5	0	0	0	3	0	1	0	4	0	0	0	0	0	0
543	9	154	1	3	0	0	0	0	0	0	2025	0	2	0	1	0	0	0	3	0	2	1	2	0	0	0	0	0	0
544	9	154	2	3	3	1	0	5	0	1	8517	2	1	0	2	0	0	0	5	0	1	3	50	0	0	0	0	0	0
545	9	154	1	3	0	1	0	0	0	0	3626	0	4	0	1	0	0	0	3	0	2	2	2	0	1	0	0	0	0
546	9	154	2	3	3	5	0	1	0	1	4988	2	2	0	0	0	0	0	5	1	1	3	30	0	1	0	0	0	0
547	9	154	2	3	1	1	1	5	1	3	55180	5	10	0	1	0	2	0	5	1	2	3	100	1	1	0	0	0	0
548	9	154	1	1	0	5	1	0	0	3	1824	1	10	0	3	1	0	0	3	0	2	1	3	1	0	1	0	0	0
549	9	154	2	1	1	5	1	1	0	3	20352	5	1	0	0	1	1	0	5	1	2	2	30	1	1	0	0	0	0
550	9	156	1	4	0	0	0	0	0	0	270	0	1	0	0	0	0	0	3	1	3	1	12	0	0	0	0	0	0
551	7	97	1	6	0	0	0	0	0	0	2793	1	2	0	0	0	0	0	3	0	2	3	3	0	0	0	0	0	0
552	7	97	1	6	0	0	0	0	0	0	880	1	0	0	1	1	0	0	1	0	0	3	2	0	0	0	0	0	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
553	7	97	1	6	0	6	0	0	0	0	2580	1	0	1	1	0	0	0	2	0	1	3	2	0	0	0	0	0	0
555	7	97	1	3	0	2	1	0	0	0	2436	2	0	0	0	0	0	0	3	0	2	3	4	0	0	0	0	0	0
556	7	97	1	3	0	2	1	0	0	0	14352	3	3	0	0	1	0	0	4	1	2	3	5	0	0	0	0	0	0
557	7	93	1	3	0	1	0	0	0	0	4536	1	1	0	0	0	0	0	3	0	2	3	3	0	0	0	0	0	0
558	7	93	1	6	0	0	0	0	0	0	2852	0	0	0	2	0	0	0	2	0	2	3	1	0	0	0	0	0	0
559	7	93	1	3	0	2	1	0	0	0	2451	1	1	0	1	0	0	0	2	0	2	3	1	0	0	0	0	0	0
560	7	114	1	3	0	2	1	0	0	0	1395	4	2	0	0	0	0	0	2	0	1	3	3	0	0	0	0	0	0
561	7	114	1	3	0	1	1	0	0	0	4752	3	1	0	1	0	0	0	3	0	1	3	2	0	0	0	0	0	0
562	7	114	2	3	3	1	1	7	1	0	3168	6	2	0	1	1	0	0	3	1	2	3	3	0	0	0	0	0	0
563	7	114	1	3	0	1	1	0	0	0	2610	1	1	1	1	1	0	0	2	1	2	3	3	0	0	0	0	0	0
564	7	114	1	2	0	0	0	0	0	0	1798	0	0	0	0	3	1	0	2	1	3	2	2	0	0	0	0	0	0
565	7	114	1	3	0	3	0	0	0	0	8829	6	4	0	0	0	0	0	3	1	2	3	2	0	0	0	0	0	0
566	6	108	1	2	0	1	0	0	0	0	5760	4	2	0	1	1	1	1	3	1	2	3	5	0	0	0	0	0	0
567	6	108	1	1	0	5	1	0	0	2	5180	3	4	1	0	0	6	3	3	1	2	3	5	1	0	1	0	0	0
568	6	108	1	2	0	1	1	0	0	0	6097	0	3	1	1	1	3	2	4	1	2	3	3	0	0	0	0	0	0
569	6	108	1	2	0	0	0	0	0	0	1632	0	2	0	0	2	9	1	2	0	2	3	1	0	1	0	0	0	0
570	6	108	1	3	0	1	0	0	0	0	972	0	2	0	0	0	0	0	2	0	2	3	4	0	0	1	0	0	0
571	6	108	1	6	0	1	0	0	0	0	1248	0	0	0	0	0	0	0	2	0	0	3	1	0	0	0	0	0	0
572	9	169	1	5	0	5	1	0	0	1	567	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
573	9	189	1	3	0	1	0	0	0	0	546	0	4	0	0	1	0	0	3	1	2	3	3	0	0	0	0	0	0
574	9	189	1	1	0	5	0	0	0	3	2805	0	3	0	0	0	0	0	3	1	2	3	5	1	0	0	0	0	0
575	9	189	1	8	0	5	1	0	0	3	2793	0	5	1	1	0	0	0	4	1	2	3	30	1	1	1	0	1	0
576	7	114	2	3	3	2	1	4	1	0	20336	11	5	0	0	1	1	0	4	1	2	3	6	0	0	0	0	0	0
577	7	114	1	3	0	2	1	0	0	0	2052	2	0	0	0	0	0	0	3	1	2	2	2	0	0	0	0	0	0
578	7	114	1	2	0	2	1	0	0	0	380	2	0	0	3	0	0	0	3	2	3	1	4	0	0	0	0	0	0
579	7	114	1	3	0	2	1	0	0	0	1025	4	1	0	0	0	0	0	3	1	2	2	2	0	0	0	0	0	0
580	6	128	1	4	0	5	0	0	0	1	380	0	0	0	0	0	0	0	2	0	2	3	1	0	0	0	0	0	0
581	6	128	2	4	4	1	0	5	0	1	3738	2	1	0	0	0	0	1	3	0	1	3	4	0	0	0	0	0	0
582	6	108	1	4	0	1	0	0	0	0	378	1	0	0	1	0	0	0	2	0	2	2	1	0	0	0	0	0	0
583	6	108	2	6	6	5	0	1	0	1	4260	2	1	1	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0
584	6	108	1	3	0	1	0	0	0	0	2950	3	0	1	0	0	0	0	2	0	1	2	2	0	0	0	0	0	0
585	9	200	1	2	0	0	0	0	0	0	700	0	0	0	1	0	1	0	1	0	1	2	1	0	0	0	0	0	0
586	9	70	1	5	0	5	0	0	0	1	68	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
587	9	70	1	2	0	5	0	0	0	1	448	0	0	0	0	1	2	0	2	0	1	3	4	0	1	0	0	0	0
588	9	132	1	2	0	0	0	0	0	0	2652	0	1	0	2	0	1	1	3	1	3	2	1	0	0	0	0	0	0
589	9	132	1	5	0	5	1	0	0	1	99	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
590	9	132	1	8	0	5	1	0	0	3	578	4	5	0	0	1	1	0	4	1	1	3	100	1	0	0	1	1	0
591	9	132	1	8	0	5	1	0	0	3	5304	1	4	0	2	0	1	2	5	1	1	3	200	1	0	0	1	1	0
592	9	132	1	8	0	5	1	0	0	3	2703	0	3	0	3	0	0	1	4	1	2	3	8	1	0	0	1	1	0
593	9	132	1	6	0	5	1	0	0	3	575	1	3	0	3	3	0	1	5	1	1	3	30	1	0	0	1	1	0
594	9	132	1	1	0	5	1	0	0	3	350	1	2	0	3	0	0	0	3	0	1	3	4	1	0	0	0	1	0
595	9	132	2	1	2	1	1	5	1	3	8632	3	6	1	2	0	1	1	4	0	2	3	6	1	0	0	0	0	0
596	9	132	2	1	6	5	1	1	0	3	3355	0	3	0	2	0	1	0	3	1	2	3	16	1	0	0	0	1	0
597	9	132	1	2	0	1	0	0	0	0	5551	0	0	0	4	1	1	2	2	2	2	1	1	0	0	0	0	0	0
598	9	132	1	2	0	5	1	0	0	3	1620	0	0	0	0	2	1	0	3	1	2	3	6	1	0	0	0	0	0
599	9	132	1	2	0	5	1	0	0	3	1012	0	1	0	1	0	0	2	2	1	2	3	2	1	0	0	0	0	0
600	9	149	1	6	0	0	0	0	0	0	880	1	1	1	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0
601	9	189	1	1	0	5	1	0	0	3	418	0	0	0	0	0	0	0	1	0	2	3	1	1	0	0	0	1	0
602	9	189	1	6	0	5	1	0	0	3	396	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
603	9	189	1	8	0	5	1	0	0	3	930	1	0	0	0	0	0	0	3	1	2	3	5	1	0	0	1	1	0
604	9	189	1	8	0	5	1	0	0	3	1650	0	2	3	0	0	0	0	4	0	1	3	100	1	0	1	0	1	0
605	9	189	1	8	0	5	1	0	0	3	2585	2	6	0	0	1	1	0	5	1	1	3	10	1	1	0	1	1	0
606	9	189	1	8	0	5	1	0	0	3	2863	2	9	0	0	0	1	1	5	1	1	3	100	1	0	0	1	1	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
607	9	189	1	2	0	5	1	0	0	3	2726	0	0	0	0	1	0	0	2	1	2	3	2	0	1	0	0	1	0
608	9	189	1	1	0	5	1	0	0	3	327	0	0	0	0	3	0	0	3	0	1	3	3	1	0	0	0	1	0
609	9	189	1	2	0	5	1	0	0	3	812	0	2	0	0	2	1	0	3	0	1	3	3	1	1	0	0	0	0
610	9	189	1	3	0	5	1	0	0	3	112	3	0	0	0	0	0	0	3	0	1	3	10	1	0	0	0	0	0
611	9	189	1	8	0	5	1	0	0	3	3328	0	2	0	0	1	2	0	3	0	1	3	5	1	0	0	0	1	0
612	9	189	1	1	0	5	1	0	0	3	5580	0	1	2	0	1	0	0	3	1	2	3	3	1	0	1	0	0	0
613	9	189	1	1	0	5	1	0	0	3	690	0	6	0	0	0	1	0	3	1	2	3	3	1	0	0	0	0	0
614	9	189	1	8	0	5	1	0	0	3	3300	5	5	0	0	2	1	0	4	0	2	3	5	1	0	0	1	1	0
615	9	189	1	6	0	5	1	0	0	3	972	2	2	0	0	0	0	0	2	0	2	3	2	1	0	0	0	0	0
616	9	189	1	2	0	5	1	0	0	3	1353	1	0	0	0	1	0	1	2	0	1	3	3	1	0	0	0	0	0
617	9	132	1	3	0	1	0	0	0	0	61605	2	2	0	1	0	2	0	5	1	2	3	10	0	0	0	0	1	0
618	9	132	1	6	0	5	1	0	0	3	156	0	2	0	1	0	0	0	1	0	0	3	2	1	0	1	0	0	0
619	8	118	2	3	3	5	1	1	0	3	3784	1	5	1	2	1	0	0	4	1	2	3	10	1	0	0	0	0	0
620	8	118	1	3	0	1	0	0	0	0	5040	2	11	1	4	1	0	0	4	0	2	3	5	0	0	0	0	0	0
621	8	118	2	1	1	7	0	5	0	3	1353	3	0	0	3	0	0	1	3	2	2	3	10	1	0	0	0	0	0
622	8	118	2	1	1	5	1	1	0	1	37400	9	7	0	0	0	3	1	5	1	2	3	25	0	1	0	0	0	0
623	8	145	1	3	0	1	0	0	0	0	1610	1	3	0	0	0	0	0	2	0	2	3	2	0	0	0	0	0	0
624	8	145	1	2	0	1	0	0	0	0	12408	0	3	1	0	1	1	2	4	1	2	3	5	0	1	0	0	0	0
625	8	145	1	6	0	0	0	0	0	0	1700	0	0	0	0	0	0	0	3	1	2	3	3	0	0	0	0	0	0
626	9	156	1	6	0	0	0	0	0	0	1250	1	1	1	0	0	0	0	2	0	2	0	2	0	0	0	0	0	0
627	9	156	1	4	0	1	0	0	0	0	504	0	1	1	0	0	0	0	3	0	3	0	3	0	0	0	0	0	0
628	9	156	1	1	0	1	1	0	0	0	3723	6	11	0	2	1	1	0	4	0	2	1	4	0	1	0	0	0	0
629	9	156	1	4	0	6	0	0	0	0	153	0	2	0	0	0	0	0	3	0	3	0	8	0	0	0	0	0	0
630	9	156	1	3	0	1	1	0	0	0	2665	1	1	0	0	0	0	0	3	0	1	3	3	0	1	0	0	0	0
631	9	138	1	3	0	1	0	0	0	0	810	0	3	0	0	1	0	0	3	0	2	2	2	0	0	0	0	0	0
632	9	138	1	6	0	1	0	0	0	0	1558	1	3	0	0	0	0	0	2	0	3	0	2	0	0	0	0	0	0
633	9	136	1	6	0	1	0	0	0	0	2784	0	5	0	3	0	0	0	3	0	2	1	3	0	0	0	0	0	0
634	9	138	1	2	0	4	0	0	0	0	1836	1	1	0	0	0	0	2	3	0	2	0	3	0	0	0	0	0	0
635	9	138	1	1	0	1	0	0	0	0	3080	1	2	0	2	2	0	0	4	0	2	1	3	0	1	0	0	0	0
636	8	31	1	2	0	7	0	0	0	0	4914	1	1	0	0	1	2	2	3	0	1	0	8	0	0	0	0	0	0
637	8	31	1	2	0	1	0	0	0	0	8938	0	3	0	1	2	0	0	3	1	2	0	2	0	0	0	0	0	0
839	8	31	1	4	0	8	0	0	0	0	448	0	0	0	0	0	0	0	3	0	0	3	12	0	0	0	0	0	0
640	8	31	1	2	0	1	1	0	0	0	3773	1	3	0	0	1	0	2	3	0	3	1	3	0	0	0	0	0	0
641	8	8	1	6	0	0	0	0	0	0	1974	0	1	0	0	1	0	0	2	0	1	0	2	0	0	0	0	0	0
642	8	8	2	4	6	5	1	1	0	1	720	2	0	0	0	0	0	0	2	1	3	0	3	1	0	0	0	0	0
643	8	8	1	7	0	1	0	0	0	0	1638	1	0	0	0	0	0	0	2	3	1	0	1	0	0	0	0	0	0
644	8	31	1	2	0	0	0	0	0	0	4368	0	3	0	0	0	1	0	3	0	1	3	6	0	0	0	0	0	0
846	8	31	1	3	0	4	1	0	0	0	6050	1	2	0	2	1	0	0	3	1	3	2	2	0	0	0	0	0	0
647	6	50	1	6	0	0	0	0	0	0	119	0	0	0	2	0	0	0	1	0	3	0	1	0	1	0	0	0	0
648	6	50	1	3	0	3	1	0	0	0	7098	1	0	0	2	0	0	0	4	0	1	3	4	0	0	0	0	0	0
649	6	65	1	6	0	0	0	0	0	0	546	4	1	0	0	0	1	0	1	0	2	0	1	0	0	0	0	0	0
650	8	65	1	6	0	0	0	0	0	0	1026	0	1	0	0	0	0	0	2	0	3	0	2	0	0	0	0	0	0
651	8	145	1	2	0	1	0	0	0	0	3000	1	1	0	0	0	0	0	3	2	2	3	3	0	1	0	0	0	0
652	8	145	1	2	0	1	0	0	0	0	6000	0	3	1	2	0	1	1	3	1	2	3	3	0	0	0	0	0	0
653	8	145	1	3	0	1	0	0	0	0	2624	1	0	1	0	0	0	0	3	1	2	3	5	0	0	0	0	0	0
654	8	145	1	6	0	0	0	0	0	0	2000	0	0	0	1	0	0	0	2	1	3	2	2	0	0	0	0	0	0
655	8	145	1	3	0	0	0	0	0	0	2200	1	0	1	0	0	0	0	2	0	2	3	3	0	0	0	0	0	0
856	8	145	1	3	0	0	0	0	0	0	2193	0	2	1	0	1	0	0	3	1	2	3	7	0	0	0	0	0	0
857	8	145	1	2	0	8	1	0	0	0	3036	1	8	1	0	1	0	4	3	1	2	3	3	0	0	0	0	0	0
658	8	145	1	2	0	0	0	0	0	0	2912	0	3	0	3	2	0	0	3	1	2	3	5	0	0	0	0	0	0
659	8	145	1	6	0	0	0	0	0	0	3906	0	0	0	1	1	0	0	3	1	2	3	3	0	0	0	0	0	0
660	8	145	1	4	0	0	0	0	0	0	483	0	1	0	0	1	0	0	3	1	2	3	5	0	0	0	0	0	0
661	8	145	1	2	0	0	0	0	0	0	9378	0	9	1	1	1	0	0	4	1	2	3	7	0	0	0	0	0	0

TempNo	Str	Unit	Comp	SiTy1	SiTy2	TA1	Con1	TA2	Con2	Cul	Area	PjPt	Bif	Unif	OFla	FCobT	Met	Man	Deb	Décor	Secon	Tert	MaxD	She	PH	PFCR	Pmid	LStr	SStr
662	8	145	1	2	0	6	0	0	0	0	4143	0	6	0	0	0	2	0	3	1	2	3	5	0	1	0	0	0	0
663	8	145	1	2	0	6	0	0	0	0	1920	0	0	0	0	0	1	1	3	2	3	2	5	0	0	0	0	0	0
664	8	145	1	4	0	0	0	0	0	0	1170	0	1	0	0	0	0	1	3	1	3	2	5	0	0	0	0	0	0
665	8	145	1	6	0	0	0	0	0	0	3358	0	1	0	0	0	0	0	3	1	2	3	2	0	0	0	0	0	0
666	8	145	1	6	0	0	0	0	0	0	2494	0	4	0	1	0	0	0	3	1	2	3	8	0	0	0	0	0	0
667	8	145	1	3	0	1	0	0	0	0	690	1	6	0	0	1	1	0	3	1	2	3	5	0	0	1	0	0	0
668	8	145	1	2	0	0	0	0	0	0	1560	0	0	0	1	1	0	3	3	1	2	3	3	0	0	0	0	0	0
669	8	145	1	6	0	0	0	0	0	0	432	0	0	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	0
670	8	145	1	2	0	0	0	0	0	0	2226	0	4	0	1	0	0	0	3	1	2	3	5	0	0	0	0	0	0
671	8	145	1	2	0	6	0	0	0	0	2268	0	1	0	0	1	0	0	3	2	3	2	3	0	1	0	0	0	0
672	6	118	1	2	0	1	0	0	0	0	6732	0	2	0	0	0	4	0	3	1	2	3	3	0	0	0	0	0	0
673	6	118	1	2	0	5	0	0	0	1	1023	1	1	0	0	0	1	0	2	0	1	3	2	0	0	1	0	0	0
674	6	118	1	3	0	0	0	0	0	0	1184	0	3	1	1	0	0	0	3	0	2	3	4	0	0	0	0	0	0
675	6	126	1	2	0	5	0	0	0	1	3139	0	4	0	0	1	2	1	3	0	2	3	5	0	0	0	0	0	0
676	9	149	1	1	0	5	0	0	0	1	1056	1	1	0	1	0	1	0	3	0	2	3	2	0	0	0	0	0	0
677	9	149	1	6	0	5	0	0	0	1	374	0	0	1	1	0	0	0	2	0	2	2	1	0	0	0	0	0	0
678	9	149	1	3	0	3	1	0	0	0	943	1	2	0	1	0	0	0	2	0	2	2	2	0	0	0	0	0	0
679	9	149	1	3	0	1	1	0	0	0	680	1	0	1	5	0	0	0	2	1	3	2	1	0	0	0	0	0	0
680	9	149	1	1	0	1	0	0	0	0	570	0	4	1	4	1	2	3	3	1	3	1	4	0	0	0	1	0	0
681	9	149	1	2	0	4	0	0	0	0	1125	0	1	1	0	0	0	0	1	0	1	2	1	0	1	0	0	0	0
682	9	149	1	6	0	0	0	0	0	0	4186	2	3	1	0	2	0	0	2	1	1	3	1	0	0	0	0	0	0
683	9	136	1	2	0	1	0	0	0	0	570	1	2	0	2	0	1	0	1	0	2	2	1	0	1	0	0	0	0
684	9	138	1	3	0	1	1	0	0	0	4365	2	5	0	1	5	0	0	3	1	3	2	4	0	0	0	0	0	0
685	9	138	1	1	0	4	0	0	0	0	552	2	4	0	0	4	2	0	3	1	2	2	8	0	1	0	0	0	0
686	8	115	1	6	0	1	0	0	0	0	1375	0	1	1	0	0	0	0	2	2	2	1	2	0	0	0	0	0	0
687	6	115	1	4	0	0	0	0	0	0	336	0	1	0	0	0	0	0	3	0	1	2	5	0	0	0	0	0	0
688	8	115	1	4	0	1	0	0	0	0	3477	1	2	0	1	1	0	0	3	2	2	2	2	0	0	0	0	0	0
689	8	115	1	4	0	6	1	0	0	0	775	1	4	0	0	0	0	0	4	1	1	3	50	0	1	0	0	0	0
690	8	115	1	6	0	1	0	0	0	0	700	2	0	0	0	0	0	0	3	2	3	2	3	0	0	0	0	0	0
691	8	115	1	4	0	5	0	0	0	1	1800	1	1	0	2	1	0	0	3	0	2	3	2	0	0	0	0	0	0
692	8	115	1	3	0	1	0	0	0	0	1584	1	5	1	2	0	0	0	4	1	2	2	2	0	0	0	0	0	0
693	8	115	1	3	0	3	1	0	0	0	29455	3	11	0	0	0	0	0	5	1	2	3	6	0	0	0	0	0	0
694	8	115	1	3	0	3	1	0	0	0	2184	4	3	0	0	0	0	0	3	1	2	3	2	0	0	0	0	0	0
695	8	115	2	3	3	1	0	6	0	0	3248	1	2	1	2	0	0	0	3	1	2	3	3	0	1	0	0	0	0
696	8	115	1	4	0	5	0	0	0	1	660	0	1	0	0	0	0	0	3	1	2	3	4	0	0	0	0	0	0
697	8	115	1	6	0	0	0	0	0	0	806	1	0	0	0	0	0	0	2	1	2	2	1	0	0	0	0	0	0
698	8	115	1	4	0	1	0	0	0	0	1920	0	5	0	0	0	0	0	3	1	2	3	5	0	0	0	0	0	0
699	8	115	1	3	0	5	1	0	0	1	36	0	0	0	0	0	1	0	2	1	1	2	2	1	1	0	0	0	0
700	8	72	1	7	0	1	1	0	0	0	288750	1	7	0	0	0	0	1	5	3	3	1	4	0	0	0	0	0	0
701	6	65	1	6	0	1	0	0	0	0	1891	1	2	0	0	0	0	0	2	0	2	0	2	0	0	0	0	0	0
702	6	65	1	6	0	0	0	0	0	0	812	0	1	1	1	0	0	0	2	0	2	0	1	0	0	0	0	0	0
703	6	50	1	4	0	0	0	0	0	0	187	0	0	0	0	0	0	0	1	0	3	0	1	0	0	0	0	0	0
704	6	122	1	3	0	4	1	0	0	0	4059	2	1	0	1	0	0	0	3	1	2	2	3	0	0	0	0	0	0
705	6	122	1	6	0	0	0	0	0	0	551	0	1	0	0	0	0	0	2	0	1	2	1	0	0	0	0	0	0
706	6	122	1	4	0	0	0	0	0	0	468	0	0	0	0	0	0	0	3	0	0	3	3	0	0	0	0	0	0
707	6	122	1	1	0	1	0	0	0	0	1430	1	0	0	1	0	0	0	3	0	2	1	2	0	0	0	0	0	0
726	6	126	1	2	0	6	0	0	0	0	1176	0	1	0	0	0	2	0	2	0	3	2	1	0	0	0	0	0	0
727	6	126	1	2	0	6	1	0	0	0	1200	0	0	0	0	0	2	0	3	0	1	3	5	0	0	0	0	0	0
728	6	126	1	6	0	0	0	0	0	0	1161	0	1	0	0	0	0	0	2	0	1	3	2	0	0	0	0	0	0
729	6	126	1	2	0	5	0	0	0	1	375	0	0	0	0	0	6	1	2	1	3	2	3	0	0	0	0	0	0
751	6	16	1	2	0	5	1	0	0	1	336	0	4	0	1	0	0	0	2	1	2	2	1	1	1	0	0	0	0
752	6	16	1	3	0	0	0	0	0	0	36	0	0	0	1	0	0	0	2	0	2	3	2	0	1	0	0	0	0
753	6	98	1	6	0	0	0	0	0	0	232	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0

Appendix C

Projectile Point Analysis Coding Form and Raw Data

Site or IO Number – Site/IO#
Point Number – Pt#

Condition – Cond

1 Whole
2 Base snapped above notches or stem
3 Base snapped across notches or stem
4 Almost whole, small part of tip missing
5 Small Portion of base missing
6 Base remnant with part of haft and midsection (snapped and longitudinally split)
7 Ear/Tang missing
8 Base missing, snapped across notches
9 Base portion no notches

Point Type-- Type

1 Untyped dart point--NFS
2 Untyped dart point low side-notched
3 Untyped dart point high side-notched
4 Untyped dart point corner-notched
5 Untyped dart point stemmed (Archaic)
6 Untyped dart point stemmed (Paleoindian)
7 Untyped willow leaf
8 Untyped basally notched
9 Untyped concave base (Paleoindian?)
10 Elko Series—(corner/side-notched)
11 Elko Corner-notched
12 Elko Side-notched
13 Elko Eared
14 Basketmaker II Corner/Side-Notched
15 Northern Side-Notched
16 Hawken Side-notched
17 San Rafael Side-Notched
18 Sudden Side-notched
19 Untyped square stem
20 Gypsum (Gatecliff)
21 Pinto Series
22 McKean Lanceolate
23 San Rafael Stemmed (?)
24 Cortaro
25 Sand Dune Side-notched
30 Untyped Arrow Point—NFS
31 Rose Spring Corner-notched
32 Bull Creek
33 Cottonwood Triangular
34 Desert Side-notched
35 Virgin Anasazi short stemmed
36 Parowan Basal-notched
37 Untyped small side-notched
50 Hafted knife (corner-notched)
98 Unfinished arrow pt.
99 Unfinished dart pt. (Stage 5 biface)

Production Technology - ProTech

0 None
1 Pressure alone
2 Pressure and perhaps percussion but not necessarily (only pressure flakes obvious)
3 Pressure and definite percussion
9 Indeterminate

Blank Morphology - BlMor

1 flake (obvious ventral/dorsal attributes)
2 flake possibly (plano-convex cross-section / longitudinal curvature)
3 No flake attributes evident (perhaps a nodule)
9 Indeterminate

Raw Material Type - RM

1 Chert - NFS
2 Paradise chert
3 Paradise chalcedony
4 Canaan Peak cobble chert (tan/yellow to red)
5 Agatized wood
6 other petrified wood
7 Kaibab chert
8 Glen Canyon chert
9 Other chalcedony
10 Local fossiliferous chert
11 Boulder jasper
12 mudstone/siltstone
13 Honaker Trail
14 Owl Rock chert
20 Obsidian
21 Rhyolite
22 Metasediment
30 Quartzite
99 Indeterminate

Thermal Alteration - TAlt
0 Absent
1 Heat Treated (overall high luster with small nip to test material for gloss patina)
2 Heat Treated (differential luster)
3 Heat Treated (heat affected fracture)
4 Heat Treated (differential coloration)
5 Burned (crazed, potlids, etc.) so can't evaluate (burning also precludes accurate patina evaluation)
9 Indeterminate

White Patina (Face 1) – Pat (Face 1)
0 Absent
1 Light
2 Moderate
3 Heavy
9 Burned

White Patina (Face 2) – Pat (Face 2)
0 Absent
1 Light
2 Moderate
3 Heavy
9 Burned

Cortex – Cor
0 Absent
1 Present

Use Traces - UsTr
0 Absent (no obvious use-wear associated with original tool form)
1 Impact
2 Edge polish
3 Tip polish/rounding (drill)
4 Tip and edge damage (step fracture, rounding—cutting use)

Fragment Reuse - FrgReu
0 No evidence of reuse
1 Evidence for reuse of point fragment as a tool
9 Indeterminate

Function of Reused Fragment - ReuFun
0 None
1 Cutting
2 Scraping
3 Drilling
4 Engraving (projection/beak)
5 Continued proj. pt. use
9 Indeterminate

Resharpening - Reshr
0 Absent
1 Present
2 Burin spall
8 Not Applicable
9 Indeterminate

Blank Patina – BlPat
0 Absent
1 Present

Maximum Complete Dimension Length - Len

Maximum Complete Dimension Width - Wid

Maximum Complete Dimension Thickness - Thi

Weight - Wt

Site#	IO#	Pt#	Cond	Type	ProTec	BlMor	RM	TAlt	PatF1	PatF2	Cor	UsTr	FrgReu	ReuFun	Reshr	BlPat	Len	Wid	Thi	Wt
0	028	0	3	15	2	2	2	1	1	0	0	1	0	0	0	0	0	2.8	0.6	3
0	031	0	2	11	2	2	5	1	3	0	0	1	0	0	0	0	0	2.3	0.4	2.6
0	039	0	2	11	3	3	1	5	0	0	0	1	0	0	0	0	0	0	0.5	3.9
0	040	0	4	3	1	3	7	0	0	0	0	2	0	0	1	0	0	0	0.6	4.7
0	044	0	4	32	1	2	8	1	0	0	0	1	0	0	0	0	0	1.5	0.3	1.2
0	056	0	6	17	1	2	9	2	0	0	0	1	0	0	1	0	0	0	0.3	1.7
0	059	0	8	1	2	2	1	1	3	3	0	1	0	0	1	0	0	2.3	0.4	4.3
0	064	0	4	12	2	2	2	1	0	0	0	1	0	0	1	0	0	1.7	0.5	1.7
0	117	0	7	13	3	2	2	1	1	1	0	2	0	0	1	0	3.7	2.3	0.6	4.9
0	119	0	2	11	3	1	2	0	0	0	1	1	1	99	0	0	0	2.6	0.4	3.2
0	122	0	2	12	1	3	4	1	0	0	0	1	0	0	0	0	0	1.6	0.4	0.7
0	123	0	4	31	1	3	3	1	1	0	0	1	0	0	1	0	0	1.5	0.3	1.6
0	135	0	2	12	2	3	2	0	2	2	0	1	0	0	0	0	0	0	0.4	1.5
0	146	0	4	11	2	3	5	1	0	0	0	1	0	0	0	0	0	1.8	0.4	4.1
0	173	0	2	20	2	3	3	1	0	0	0	1	0	0	0	0	0	1.9	0.6	3.6
0	177	0	2	11	3	3	3	1	0	0	0	1	0	0	0	0	0	2.7	0.5	3
0	178	0	2	12	2	3	7	1	0	0	0	1	0	0	0	0	0	0	0.5	1.8
0	183	0	2	3	2	3	3	1	0	0	0	1	0	0	0	0	0	1.7	0.5	1.3
0	196	0	2	12	1	1	20	0	0	0	0	1	0	0	0	0	0	1.9	0.4	1.8
0	215	0	4	1	2	2	2	5	2	0	0	1	0	0	1	0	0	2.6	0.5	3.7
0	221	0	2	20	1	1	5	1	2	1	0	1	0	0	0	0	0	2.7	0.6	5.7
0	225	0	4	11	2	2	7	1	0	0	0	1	0	0	0	0	0	2.1	0.3	3.3
0	227	0	2	21	2	3	3	1	1	0	0	1	0	0	0	0	0	0	0.5	2.5
0	232	0	1	7	2	3	2	1	2	1	0	2	0	0	1	0	4.4	1.8	0.7	5.5
0	242	0	2	12	2	3	2	1	0	0	0	2	0	0	0	0	0	1.7	0.5	1.9
0	269	0	2	13	2	3	2	1	3	1	0	1	0	0	1	0	0	1.7	0.5	2.4
0	272	0	4	2	2	3	7	1	0	0	0	1	0	0	1	0	0	1.4	0.6	3
0	284	0	4	13	2	2	22	0	0	0	0	1	0	0	0	0	0	2.1	0.6	4.6
0	293	0	2	13	3	2	5	1	0	0	0	1	0	0	1	0	0	2.6	0.4	3.1
0	306	0	2	18	3	2	2	1	3	2	0	1	0	0	1	0	0	2.2	0.5	4.4
0	311	0	4	11	2	1	1	0	1	1	0	1	0	0	0	0	0	2.1	0.5	2.9

0	313	0	1	20	2	2	30	5	0	0	0	0	0	0	1	0	2.7	2.3	0.5	2.7
0	314	0	4	11	2	3	2	1	0	0	0	1	0	0	1	0	0	1.7	0.5	2.4
0	317	0	2	11	3	2	2	1	2	1	0	1	0	0	0	0	0	2.5	0.5	3.2
0	320	0	4	34	1	2	2	1	0	0	0	1	0	0	0	0	0	0	0.3	0.8
0	329	0	2	11	2	2	5	1	1	0	0	1	0	0	0	0	0	0	0.5	2.7
0	404	0	2	11	1	1	2	2	2	1	0	1	0	0	1	0	0	1.8	0.5	2.6
0	407	0	4	16	2	2	2	1	3	2	0	1	0	0	0	1	0	2	0.6	5.1
0	449	0	2	11	3	3	5	1	0	0	0	4	0	0	0	0	0	0	0.4	2.6
0	456	0	2	2	2	2	3	1	1	1	0	4	0	0	0	0	0	1.6	0.5	2.9
0	473	0	2	12	1	1	3	2	0	0	0	1	0	0	0	0	0	2.2	0.6	3.1
0	501	0	4	11	3	3	13	0	0	0	0	4	0	0	0	1	4.4	2.3	0.4	3.8
0	513	0	4	32	1	3	2	1	0	0	0	1	0	0	0	0	3.5	1.3	0.4	1.2
0	522	0	3	21	2	3	20	0	0	0	0	1	1	2	9	0	0	0	0.5	2.4
0	523	0	1	2	1	3	2	2	0	0	0	0	0	0	0	1	3.8	1.8	0.6	3.6
0	533	0	2	11	2	1	5	1	1	0	0	0	0	0	0	0	0	0	0.4	1.3
0	544	0	2	2	2	2	1	1	0	0	0	0	0	0	1	0	0	1.9	0.5	2.3
0	565	0	2	21	1	3	5	0	2	1	0	0	0	0	1	0	0	1.6	0.4	1.9
0	573	0	1	11	1	1	3	0	3	2	0	0	1	5	1	0	2.8	2.1	0.4	2.3
0	576	0	4	12	2	2	2	0	0	0	0	1	0	0	1	1	3.6	1.7	0.5	2.6
0	593	0	2	17	2	3	3	1	1	0	0	9	0	0	9	0	0	2	0.5	1.7
0	600	0	1	11	3	3	4	1	1	1	0	4	1	5	1	0	3	1.7	0.5	2.5
0	608	0	2	12	3	2	2	2	1	0	0	1	1	9	0	0	0	0	0.7	3.4
0	624	0	1	13	2	3	2	0	3	1	0	0	0	0	1	0	2.7	1.8	0.5	2
0	626	0	2	17	3	3	2	2	0	0	0	0	0	0	0	0	0	2.7	0.4	4.5
0	628	0	2	12	2	2	3	1	0	0	0	0	0	0	0	0	0	1.6	0.5	1.8
0	637	0	4	13	3	2	1	1	0	0	0	4	0	0	0	0	5.5	2.1	0.5	6.1
0	642	0	4	13	2	3	3	1	0	0	0	1	0	0	0	0	3.5	1.5	0.5	1.9
0	646	0	3	13	2	3	5	1	0	0	0	9	0	0	9	0	0	0	0.3	0.7
0	700	0	4	35	1	2	6	2	0	0	0	0	0	0	0	0	3	1.1	0.3	0.9
0	716	0	1	20	1	2	6	1	0	0	0	0	0	0	0	0	3.6	1.7	0.5	2.8
0	724	0	5	1	3	3	4	1	0	0	0	4	0	0	1	0	6.5	2.1	0.5	6.6
0	727	0	4	31	1	1	3	1	0	0	0	1	0	0	0	0	1.9	0.7	0.3	0.3

0	728	0	5	11	3	2	1	0	0	0	0	4	0	0	1	0	3.2	2.3	0.5	3.1
0	729	0	9	32	1	2	3	1	0	0	0	1	0	0	0	0	0	1.7	0.3	0.9
0	758	0	2	10	3	3	5	1	0	0	1	1	1	9	0	0	0	0	0.5	2.4
0	762	0	2	11	3	3	5	2	0	0	0	0	0	0	0	0	0	2.3	0.5	2.5
0	778	0	2	20	2	3	3	1	2	1	0	0	0	0	0	0	0	1.9	0.5	2.2
0	781	0	2	11	3	3	9	1	1	0	0	1	1	9	0	0	0	0	0.5	2.9
0	790	0	9	32	1	2	3	1	1	0	0	0	0	0	0	0	0	1.3	0.4	1.5
0	792	0	2	11	3	2	5	2	0	0	0	4	1	2	0	0	0	2.6	0.5	4
0	799	0	4	20	3	1	3	0	2	2	0	0	0	0	0	0	5	2.2	0.9	8.2
0	804	0	2	11	3	3	3	1	0	0	0	4	0	0	0	0	0	2.4	0.5	1.9
0	814	0	5	10	2	3	2	1	2	1	0	0	0	0	1	0	2.9	2.9	0.5	2.2
0	815	0	4	34	1	1	1	0	0	0	0	0	0	0	0	0	3.7	2.6	0.3	1.4
0	822	0	2	11	1	1	1	1	2	0	0	1	0	0	0	0	0	2.1	0.5	3.8
0	850	0	8	30	1	1	3	1	1	1	0	1	0	0	0	0	0	1.6	0.4	1.4
0	861	0	9	9	3	3	1	1	3	2	0	0	0	0	0	0	0	2.2	0.6	3.1
0	899	0	4	20	1	2	2	2	1	1	0	1	0	0	0	0	5	2.1	0.6	5.2
0	904	0	2	11	3	3	9	1	0	0	0	4	0	0	0	0	0	2.8	0.5	2.9
0	926	0	4	34	1	1	3	0	0	0	0	0	0	0	0	0	1.8	0.9	0.2	0.3
0	941	0	4	25	2	2	2	5	9	9	0	0	0	0	0	0	4	1.6	0.5	2.4
0	949	0	1	11	1	1	3	2	0	0	0	4	0	0	0	0	2.4	1.8	0.4	1.5
42GA4746	0	5	2	13	1	1	2	5	9	9	0	2	0	0	0	0	0	2.9	0.6	2.4
42GA4747	0	1	1	11	3	2	5	1	0	0	0	3	0	0	1	0	4.4	2.2	0.5	4.7
42GA4765	0	3	2	34	1	1	2	0	0	0	0	0	0	0	0	0	0	1.4	0.3	0.8
42GA4768	0	2	3	15	3	3	2	2	0	0	0	0	0	0	0	0	0	2.3	0.4	1.5
42GA4768	0	1	1	21	3	3	2	9	2	2	0	0	0	0	1	0	2.4	1.8	0.6	1.7
42GA4769	0	1	2	5	3	3	5	1	3	3	0	1	0	0	0	0	0	2	0.6	2.8
42GA4779	0	1	2	11	3	3	9	1	1	0	0	4	0	0	0	0	0	2	0.5	4.3
42GA4781	0	1	1	32	1	1	5	1	0	0	0	0	0	0	0	0	2.7	1.4	0.2	0.6
42GA4782	0	3	2	35	1	3	8	3	0	0	0	1	0	0	0	0	0	1.1	0.4	1
42GA4785	0	2	7	33	1	1	9	2	0	0	0	0	0	0	0	1	1.7	0	0.2	0.5
42GA4789	0	1	4	21	1	1	5	5	9	9	0	4	0	0	1	0	2.2	1.5	0.4	1.5
42GA4791	0	3	2	13	3	3	8	5	9	9	0	4	0	0	0	0	0	1.9	0.6	2.2

42KA1373	0	1	2	12	3	1	2	2	0	0	0	4	0	0	0	1	0	2.3	0.5	3.3
42KA4546	0	1	2	12	1	2	2	5	3	2	0	0	0	0	0	0	0	0	0	2
42KA4548	0	1	2	11	3	2	5	2	0	0	0	0	0	0	0	0	0	2.2	0.3	2.1
42KA4552	0	1	8	1	3	3	4	1	0	0	0	1	0	0	0	0	0	2.6	0.4	6
42KA4554	0	1	1	24	2	2	2	0	1	1	0	0	0	0	0	0	3.2	1.9	0.4	2.8
42KA4555	0	1	2	16	1	2	6	1	0	0	0	1	99	99	0	0	0	0	0.6	3.2
42KA4556	0	1	2	11	3	1	9	1	0	0	0	1	0	0	0	0	0	2.7	0.4	2.1
42KA4558	0	1	1	19	1	2	2	1	1	1	0	0	0	0	0	0	3.9	1.7	0.5	2.7
42KA4561	0	3	1	7	2	3	8	0	0	0	0	0	0	0	0	0	5.6	2	0.8	8.5
42KA4561	0	4	9	99	1	2	3	1	0	0	0	1	99	99	0	0	0	2	0.5	2.9
42KA4561	0	2	2	13	2	1	2	5	2	1	0	1	0	0	0	0	0	1.9	0.5	1.6
42KA4561	0	1	2	20	1	1	2	1	2	1	0	1	0	0	0	0	0	1.9	0.6	2.9
42KA4562	0	1	1	17	2	2	1	2	1	1	0	1	1	1	1	0	3.9	2.1	0.5	4.4
42KA4563	0	2	1	4	2	2	5	1	0	0	0	4	0	0	1	0	2.5	1.9	0.5	2.2
42KA4563	0	6	3	18	2	3	8	1	0	0	0	1	0	0	0	0	0	0	0.5	3
42KA4563	0	5	1	2	1	2	4	1	0	0	0	4	0	0	1	0	3.2	2.1	0.6	3.9
42KA4563	0	1	1	34	1	2	2	1	0	0	0	0	0	0	0	0	2.1	1.4	0.3	0.7
42KA4563	0	4	2	2	2	2	2	1	3	3	0	1	0	0	0	0	0	1.8	0.6	2.8
42KA4563	0	3	2	18	3	3	2	1	3	3	0	1	0	0	0	0	0	2.4	0.7	6.5
42KA4564	0	1	2	20	2	1	2	2	0	0	0	1	0	0	0	0	0	0	0.5	2.4
42KA4564	0	2	2	1	2	2	9	1	1	0	0	1	0	0	0	0	0	0	0.4	2.1
42KA4566	0	1	2	20	3	2	2	1	0	0	0	1	0	0	0	0	0	2.5	0.5	3.1
42KA4567	0	1	2	12	1	1	5	5	1	0	0	1	0	0	1	0	0	0	0.5	1.6
42KA4567	0	2	2	12	2	2	2	5	1	0	0	1	0	0	0	0	0	0	0.5	2.8
42KA4567	0	10	2	15	2	3	2	1	1	0	0	1	1	99	0	0	0	1.8	0.6	2.4
42KA4567	0	4	1	13	3	1	7	2	1	1	0	1	0	0	1	0	3.1	1.6	0.4	1.8
42KA4567	0	5	2	2	2	1	3	1	0	0	0	1	0	0	0	0	0	2	0.5	2.4
42KA4567	0	6	2	18	2	3	1	1	1	0	0	1	1	3	2	0	0	0	0.5	2.2
42KA4567	0	7	4	11	3	2	2	1	1	0	0	1	1	99	2	0	0	0	0.5	3.2
42KA4567	0	8	2	11	2	3	2	1	1	0	0	1	1	99	2	0	0	0	0.6	1.9
42KA4567	0	9	2	20	1	1	2	0	2	1	0	1	0	0	0	0	0	1.6	0.4	2
42KA4567	0	3	2	12	2	3	9	1	0	0	0	1	0	0	0	0	0	1.8	0.4	1.5

42KA4567	0	11	4	12	3	1	6	0	0	0	0	1	0	0	0	0	0	2	0.5	3.1
42KA4574	0	1	1	11	1	1	8	1	0	0	0	2	0	0	0	0	3.2	1.7	0.3	2.1
42KA4578	0	1	1	31	1	1	5	1	0	0	0	0	0	0	0	1	1.9	0.9	0.2	0.4
42KA4585	0	2	7	34	1	1	2	0	0	0	0	1	0	0	0	0	2.6	1.2	0.3	0.8
42KA4585	0	1	4	34	1	1	2	0	0	0	0	1	0	0	0	0	0	1.2	0.3	0.4
42KA4586	0	1	2	11	3	2	1	2	0	0	0	1	0	0	0	0	0	2.8	0.5	4
42KA4586	0	2	3	1	3	1	20	0	0	0	0	1	0	0	0	0	0	2.7	0.6	3.3
42KA4587	0	1	2	12	1	3	20	0	0	0	0	1	1	99	1	0	0	1.8	0.5	2.5
42KA4588	0	1	2	20	2	2	7	0	0	0	0	1	0	0	1	0	0	2	0.4	1.6
42KA4589	0	1	2	10	3	3	2	1	0	0	0	1	0	0	2	0	0	0	0.5	2
42KA4590	0	1	2	20	3	2	7	1	0	0	0	1	0	0	0	0	0	2.2	0.5	2.7
42KA4591	0	3	1	12	2	1	1	0	0	0	0	2	0	0	1	0	3	1.9	0.5	2.6
42KA4591	0	2	1	12	1	1	4	1	0	0	0	0	0	0	0	0	4	2.2	0.5	3.7
42KA4591	0	1	4	23	2	3	5	1	1	0	0	1	99	99	0	0	0	1.6	0.5	2.4
42KA4592	0	1	4	34	1	1	3	1	0	0	0	1	0	0	0	0	0	1.6	0.3	0.6
42KA4594	0	1	2	20	1	3	8	1	0	0	0	1	1	2	0	0	0	1.5	0.5	1.2
42KA4597	0	1	5	13	2	3	3	1	1	0	0	4	0	0	1	0	0	0	0.5	2.9
42KA4598	0	1	2	13	2	2	2	0	2	2	0	1	0	0	0	0	0	2.1	0.5	3.5
42KA4607	0	1	2	10	3	2	5	1	0	0	0	1	1	99	0	0	0	2.6	0.5	3.8
42KA4609	0	4	2	3	2	3	5	5	0	0	0	1	1	2	0	0	0	1.5	0.7	3.1
42KA4609	0	3	9	99	2	3	2	0	2	2	0	1	0	0	0	0	0	0	0.5	2.8
42KA4609	0	2	2	12	2	3	6	1	0	0	0	1	0	0	0	0	0	2	0.5	2.5
42KA4609	0	1	2	2	3	3	3	1	0	0	0	1	0	0	0	0	0	1.9	0.4	2.1
42KA4616	0	1	2	10	2	3	9	1	2	0	0	1	1	99	0	0	0	0	0	1
42KA4619	0	1	6	1	3	3	5	5	2	0	0	0	0	0	0	0	0	0	0.6	4.4
42KA4619	0	2	2	11	3	3	4	2	0	0	0	1	0	0	0	0	0	0	0.5	2.7
42KA4620	0	1	8	1	3	1	2	1	1	0	0	1	0	0	0	0	0	0	0.4	3.9
42KA4627	0	1	2	12	2	3	1	1	0	0	0	1	0	0	0	0	0	2.4	0.4	2.3
42KA4629	0	3	1	11	2	3	8	2	0	0	0	0	0	0	1	0	2.7	1.7	0.5	1.7
42KA4629	0	2	1	7	3	1	20	0	0	0	0	0	0	0	0	0	3.9	1.9	0.4	3.5
42KA4629	0	1	1	2	2	3	3	1	1	1	0	1	1	99	2	0	2.1	1.8	0.5	1.9
42KA4633	0	1	4	11	2	1	3	0	3	1	0	1	0	0	1	0	0	1.9	0.6	3.4

42KA4633	0	2	2	50	3	3	2	1	2	1	0	1	0	0	99	0	0	3.6	0.8	14
42KA4634	0	1	2	15	2	1	2	1	3	0	0	1	0	0	0	0	0	0	0.5	2.5
42KA4638	0	1	1	13	2	3	3	2	2	0	0	0	0	0	1	0	2.5	1.9	0.5	1.6
42KA4641	0	1	2	12	2	3	2	1	0	0	0	1	0	0	0	0	0	1.6	0.5	1.8
42KA4644	0	1	4	11	3	3	2	0	3	2	0	1	0	0	0	0	0	2.2	0.5	3.9
42KA4644	0	2	2	4	2	3	2	1	3	2	0	1	0	0	0	0	0	1.7	0.5	2.1
42KA4645	0	1	1	11	3	2	2	1	1	0	0	1	1	1	1	0	0	0	0.4	2.2
42KA4646	0	3	5	11	2	2	5	1	2	2	0	1	0	0	0	0	0	0	0.5	2.2
42KA4646	0	2	2	20	2	3	2	0	2	1	0	1	0	0	0	0	0	2	0.5	2.3
42KA4646	0	1	9	24	2	3	8	1	2	2	0	1	0	0	0	0	0	2.3	0.5	2.8
42KA4658	0	1	2	20	2	3	5	1	0	0	0	1	0	0	0	0	0	0	0.4	1.8
42KA4665	0	1	2	12	2	1	3	1	0	0	0	1	0	0	0	0	0	1.9	0.5	2.3
42KA4669	0	1	5	13	2	3	1	1	0	0	0	1	1	99	1	0	0	0	0.4	1.9
42KA4674	0	1	4	34	1	1	3	2	0	0	0	1	0	0	0	0	0	1.4	0.3	0.6
42KA4676	0	1	9	98	1	1	20	0	0	0	0	0	0	0	0	0	0	1.9	0.4	1.4
42KA4679	0	1	2	11	2	3	2	2	1	1	0	1	0	0	0	0	0	2	0.5	2.9
42KA4681	0	1	4	13	3	2	3	2	2	1	0	1	0	0	0	0	0	2.3	0.5	4.5
42KA4684	0	2	2	20	3	3	2	2	0	0	0	2	1	1	0	0	0	0	0.6	4.3
42KA4684	0	1	2	20	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0.5	0.9
42KA4685	0	2	2	11	3	3	30	0	0	0	0	1	1	2	0	0	0	0	0.6	5.8
42KA4685	0	1	2	20	3	2	2	2	2	1	0	0	0	0	0	0	0	2.1	0.7	5.7
42KA4686	0	1	1	13	2	3	2	0	2	2	0	4	1	2	1	0	1.9	1.8	0.5	1.9
42KA4688	0	1	5	31	1	1	3	2	0	0	0	1	0	0	0	0	0	1.1	0.3	0.5
42KA4688	0	4	2	13	2	2	3	1	1	0	0	1	0	0	0	0	0	0	0.5	2.4
42KA4688	0	3	6	1	2	3	3	1	0	0	0	0	0	0	0	0	0	0	0	1.1
42KA4688	0	2	1	11	3	1	3	2	0	0	0	4	1	2	1	0	2.7	1.9	0.5	2.3
42KA4689	0	4	4	12	1	2	4	0	0	0	0	1	0	0	0	0	0	2.1	0.6	3.1
42KA4689	0	2	2	15	2	2	3	2	0	0	0	2	0	0	0	0	0	2.1	0.4	2.4
42KA4689	0	7	1	1	1	1	4	0	0	0	0	3	0	0	0	0	2.4	1.6	0.3	1.2
42KA4689	0	1	7	13	1	2	4	1	0	0	0	1	0	0	0	0	4.3	0	0.7	4.8
42KA4689	0	6	2	11	3	3	4	2	0	0	0	1	0	0	0	0	0	2.9	0.5	6.1
42KA4689	0	5	3	10	2	3	10	0	0	0	0	1	0	0	0	0	0	0	0.4	1.8

42KA4689	0	3	2	20	1	1	3	2	0	0	0	1	0	0	0	0	0	0	0.5	2.3
42KA4691	0	2	2	12	2	3	2	0	2	2	0	1	0	0	0	0	0	1.9	0.5	1.4
42KA4691	0	1	1	11	2	1	7	0	0	0	0	0	0	0	1	0	3.5	2.2	0.5	4
42KA4700	0	1	2	3	2	2	2	1	1	0	0	1	0	0	0	0	0	0	0.5	3.1
42KA4701	0	1	2	10	2	1	5	5	0	0	0	1	0	0	0	0	0	0	0.4	1.9
42KA4701	0	2	2	2	2	2	10	1	0	0	0	1	0	0	0	0	0	2.1	0.6	1.9
42KA4701	0	3	1	98	1	1	5	1	0	0	0	0	0	0	0	1	3.2	1.7	0.3	1.7
42KA4705	0	1	2	15	2	3	5	1	0	0	0	1	0	0	0	0	0	0	0.5	2.2
42KA4709	0	1	2	50	3	3	2	0	3	3	0	2	0	0	0	0	0	3.1	0.6	9.4
42KA4714	0	1	4	34	1	1	1	1	0	0	0	1	0	0	1	0	0	1.6	0.3	1.1
42KA4717	0	1	2	13	1	1	2	2	0	0	0	1	0	0	0	0	0	1.9	0.5	2.3
42KA4720	0	1	5	34	1	1	3	1	0	0	0	0	0	0	0	0	2.3	0	0.4	1
42KA4722	0	1	3	10	2	3	5	5	0	0	0	0	0	0	1	0	0	0	0	1.1
42KA4722	0	2	2	2	2	3	5	1	0	0	0	0	0	0	0	0	0	0	0.4	1.7
42KA4724	0	1	2	12	2	2	2	1	2	1	0	1	0	0	0	0	0	0	0.5	2.2
42KA4725	0	1	1	20	3	3	8	1	0	0	0	2	0	0	1	0	3.4	2.3	0.5	3.7
42KA4738	0	2	2	13	1	3	3	5	1	1	0	1	0	0	0	0	0	0	0.5	1.5
42KA4738	0	1	2	22	2	3	2	1	0	0	0	1	0	0	0	0	0	0	0.5	1.9
42KA4741	0	1	2	12	3	2	2	1	2	2	0	1	0	0	0	0	0	0	0.6	3.2
42KA4744	0	2	1	2	3	3	8	1	2	0	0	0	0	0	1	0	2.8	1.9	0.4	2.5
42KA4746	0	1	2	20	3	2	10	5	0	0	0	1	0	0	0	0	0	0	0.5	3.8
42KA4748	0	1	1	7	3	1	5	1	0	0	0	4	0	0	0	1	4.3	2	0.8	6.1
42KA4749	0	1	4	31	1	1	5	1	0	0	0	1	0	0	0	0	0	1.2	0.3	0.5
42KA4750	0	1	4	31	1	1	6	0	0	0	0	1	0	0	0	1	0	1.3	0.3	0.9
42KA4753	0	2	2	18	3	3	2	0	1	1	0	1	0	0	0	0	0	2	0.6	4.2
42KA4753	0	1	2	2	1	1	6	5	2	2	0	0	0	0	0	0	0	0	0.4	1
42KA4755	0	1	2	12	2	3	5	1	0	0	0	1	0	0	0	0	0	1.9	0.5	2.2
42KA4756	0	1	2	36	1	2	5	2	0	0	0	1	0	0	0	0	0	1.6	0.3	1
42KA4756	0	2	2	35	1	1	5	2	0	0	0	1	0	0	0	0	0	0	0.2	0.4
42KA4756	0	3	4	12	3	3	1	0	0	0	0	1	0	0	0	0	0	1.8	0.6	3.8
42KA4767	0	1	2	11	2	3	5	1	0	0	0	1	0	0	0	0	0	2.2	0.5	4
42KA4768	0	2	2	20	1	3	3	1	2	0	0	2	0	0	0	0	0	1.6	0.6	1.9

42KA4768	0	1	2	20	1	1	5	2	0	0	0	3	0	0	0	0	0	1.4	0.5	1.4
42KA4768	0	3	2	12	2	3	2	2	1	0	0	1	0	0	0	0	0	2.1	0.5	2.3
42KA4769	0	1	4	13	1	1	5	2	0	0	0	1	0	0	0	0	0	3	0.7	8.6
42KA4770	0	1	6	10	2	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0.8
42KA4774	0	5	6	50	3	3	3	5	0	0	0	1	0	0	0	0	0	0	0.7	8
42KA4774	0	4	2	24	2	1	8	1	0	0	0	1	0	0	0	0	0	2	0.6	3.6
42KA4774	0	3	2	9	2	3	5	1	3	0	0	1	0	0	0	0	0	2.7	0.4	2.9
42KA4774	0	1	2	8	2	3	12	0	0	0	0	1	0	0	0	0	0	0	0.4	1.7
42KA4774	0	2	2	12	2	3	3	0	0	0	0	1	0	0	0	0	0	1.6	0.5	2.3
42KA4775	0	1	2	13	2	3	5	1	1	0	0	1	0	0	0	0	0	2.3	0.5	3.3
42KA4775	0	2	2	24	1	3	4	1	0	0	0	1	1	99	1	0	0	2.2	0.5	3.7
42KA4775	0	3	6	11	3	2	3	1	3	2	0	1	1	2	2	0	0	0	0.6	3.2
42KA4777	0	1	2	1	2	3	1	5	0	0	0	1	1	1	0	0	0	0	0.5	2
42KA4779	0	2	4	98	1	1	2	2	0	0	0	0	0	0	0	1	0	1.6	0.4	1.1
42KA4779	0	4	2	11	2	3	8	1	0	0	0	1	0	0	0	0	0	1.9	0.5	2.5
42KA4779	0	3	2	11	1	1	4	1	0	0	0	1	1	99	1	0	0	1.6	0.4	1.5
42KA4779	0	1	7	98	1	2	5	1	0	0	0	0	0	0	0	0	2.4	0	0.3	1
42KA4781	0	1	6	1	1	3	1	5	0	0	0	0	0	0	0	0	0	0	0	1.5
42KA4785	0	1	9	98	1	2	5	1	0	0	0	0	0	0	0	0	0	1.9	0.4	1.2
42KA4786	0	1	1	37	1	1	5	1	2	0	0	3	0	0	0	0	3.2	1.3	0.4	1.7
42KA4787	0	1	2	34	1	1	2	1	0	0	0	1	0	0	0	0	0	0	0.2	0.3
42KA4787	0	2	2	34	1	1	3	1	0	0	0	1	0	0	0	0	0	1.3	0.2	0.3
42KA4787	0	3	2	20	1	3	6	5	0	0	0	0	0	0	0	0	0	1.6	0.5	1.5
42KA4787	0	4	2	20	1	2	2	0	0	0	0	1	0	0	0	0	0	1.6	0.4	1.2
42KA4788	0	2	6	11	2	3	4	1	0	0	0	0	0	0	1	0	0	0	0	2.3
42KA4788	0	3	2	11	3	3	4	1	0	0	0	1	0	0	0	0	0	2.9	0.5	4.9
42KA4788	0	1	2	18	2	3	2	1	0	0	0	1	0	0	1	0	0	2.1	0.5	2.6
42KA4790	0	2	1	2	1	1	2	1	0	0	0	0	0	0	1	0	2.1	1.2	0.4	0.9
42KA4790	0	1	2	1	2	3	6	5	0	0	0	1	0	0	1	0	0	1.3	0.4	1.3
42KA4792	0	3	1	3	2	3	2	1	0	0	0	4	0	0	1	0	3.1	1.9	0.5	3.3
42KA4792	0	2	2	11	3	3	2	5	0	0	0	0	0	0	2	0	0	2.7	0.5	3.8
42KA4792	0	1	2	12	2	3	5	1	2	1	0	0	0	0	0	0	0	2.7	0.5	2.5

42KA4793	0	1	4	15	2	3	2	5	1	0	0	1	0	0	1	0	0	1.7	0.5	1.8
42KA4794	0	1	2	31	1	3	8	1	0	0	0	1	0	0	0	0	0	1.2	0.2	0.2
42KA4795	0	1	3	21	2	3	7	1	0	0	0	2	0	0	0	0	0	0	0.6	1.6
42KA4797	0	3	4	20	1	1	2	0	2	2	0	1	0	0	1	0	0	2	0.5	3.9
42KA4797	0	2	3	34	1	1	2	2	0	0	0	1	0	0	0	0	0	0	0.2	0.2
42KA4797	0	1	2	34	1	2	2	1	0	0	0	1	0	0	0	0	0	0	0.2	0.3
42KA4802	0	1	6	6	2	2	5	1	0	0	0	1	0	0	0	0	0	0	0.5	3
42KA4803	0	1	4	2	2	3	3	1	0	0	0	0	0	0	1	0	2.7	1.8	0.5	1.9
42KA4807	0	1	2	11	3	2	10	0	0	0	0	1	0	0	0	0	0	0	0.5	3.6
42KA4811	0	2	1	99	1	1	3	2	2	2	0	0	0	0	1	0	4.3	2.2	0.7	6
42KA4811	0	1	2	20	2	2	3	1	1	0	0	1	0	0	0	0	0	2.4	0.7	3.7
42KA4813	0	1	4	31	1	1	2	1	0	0	0	1	0	0	0	0	0	1	0.3	0.3
42KA4814	0	1	2	2	2	3	3	1	2	0	0	1	1	99	0	0	1.5	2.2	0.4	1.7
42KA4814	0	2	2	18	2	3	7	1	1	0	0	2	0	0	0	0	0	2.7	0.5	4.2
42KA4817	0	1	4	11	1	1	10	1	0	0	0	1	0	0	0	0	0	1.9	0.5	3.9
42KA4819	0	1	6	34	1	1	3	5	0	0	0	1	0	0	0	0	0	0	0.2	0.2
42KA4820	0	1	4	98	1	1	3	1	0	0	0	1	0	0	0	0	0	1.5	0.2	1
42KA4834	0	1	1	2	1	2	8	1	0	0	0	0	0	0	0	0	2.6	2.2	0.5	2.1
42KA4836	0	1	2	11	2	3	10	1	0	0	0	1	0	0	0	0	0	2.3	0.5	2.7
42KA4837	0	1	1	11	1	2	6	1	0	0	0	3	0	0	1	0	3.4	1.7	0.5	2.5
42KA4840	0	2	2	11	3	3	8	2	0	0	0	1	0	0	0	0	0	0	0.5	3.5
42KA4840	0	1	2	7	1	1	8	1	3	2	0	1	0	0	0	0	0	2	0.6	4.3
42KA4841	0	2	2	11	2	2	1	5	0	0	0	1	1	99	0	0	0	0	0.5	2.1
42KA4841	0	1	2	20	1	2	2	1	1	0	0	1	0	0	0	0	0	1.7	0.4	1.7
42KA4843	0	1	1	11	3	3	4	1	0	0	0	0	0	0	0	0	6.7	2.2	0.5	7.8
42KA4847	0	1	2	15	1	1	2	2	2	1	0	1	0	0	0	0	0	0	0.4	3.7
42KA4848	0	2	2	10	2	1	6	2	0	0	0	1	0	0	0	0	0	0	0.4	1.9
42KA4848	0	1	2	12	2	3	3	1	1	0	0	1	0	0	0	0	0	1.9	0.5	3.3
42KA4849	0	2	2	18	3	3	10	1	0	0	0	2	0	0	1	0	3	2.4	0.6	4.3
42KA4849	0	1	1	35	1	1	8	1	0	0	0	0	0	0	0	0	2.6	1.2	0.4	0.9
42KA5214	0	1	3	15	2	1	8	1	0	0	0	0	0	0	0	0	0	2.8	0.5	2.1
42KA5222	0	1	2	12	2	3	4	3	0	0	0	4	0	0	0	0	0	2.1	0.5	1.9

42KA5228	0	2	2	33	1	1	6	1	0	0	0	1	0	0	0	0	0	1.4	0.3	0.7
42KA5228	0	1	2	12	2	3	4	1	0	0	0	1	0	0	0	0	0	2	0.4	1.6
42KA5228	0	3	2	20	3	3	3	1	0	0	0	0	0	0	0	0	0	2.4	0.5	2.4
42KA5229	0	3	4	32	1	1	9	1	0	0	0	0	0	0	0	0	2.5	1.2	0.4	1
42KA5229	0	4	4	32	1	2	7	1	0	0	0	0	0	0	0	0	2.9	1	0.3	0.7
42KA5229	0	2	9	32	1	3	4	1	0	0	0	0	0	0	0	0	2.4	1.7	0.3	0.9
42KA5229	0	1	9	33	1	1	1	1	0	0	0	0	0	0	0	0	0	1.3	0.3	0.7
42KA5230	0	1	2	11	3	3	5	1	0	0	0	4	0	0	0	0	0	2.2	0.5	1.9
42KA5234	0	2	4	2	1	3	6	1	1	1	0	1	0	0	1	0	3.1	1.5	0.4	1.7
42KA5234	0	3	2	12	3	3	4	1	0	0	0	4	0	0	1	0	0	2	0.6	4.6
42KA5234	0	4	8	2	3	3	3	1	2	0	0	4	0	0	0	0	0	2	0.5	3.9
42KA5234	0	1	4	34	1	1	3	0	0	0	0	0	0	0	0	0	3.1	1.5	0.3	0.9
42KA5236	0	1	6	50	3	3	8	0	0	0	0	0	1	9	0	0	0	0	0.7	4.3
42KA5240	0	1	4	1	2	3	1	5	9	9	0	0	0	0	1	0	2.9	1.5	0.5	2.1
42KA5241	0	1	2	18	2	3	1	1	0	0	0	1	1	4	0	0	0	2.1	0.5	2.9
42KA5245	0	1	1	50	3	3	2	1	0	0	0	4	0	0	1	0	2.8	2.5	0.5	4
42KA5247	0	1	9	32	1	3	4	1	0	0	0	0	0	0	0	0	0	1.6	0.3	0.8
42KA5248	0	2	2	12	2	3	4	4	0	0	0	0	0	0	0	0	0	1.7	0.5	2
42KA5250	0	17	2	8	3	3	4	4	0	0	0	0	0	0	0	0	0	2.4	0.6	4.5
42KA5250	0	12	5	12	2	3	4	1	0	0	0	3	0	0	0	0	3.3	1.8	0.4	1.9
42KA5250	0	1	2	13	3	3	13	1	0	0	0	1	1	2	0	0	0	2.1	0.5	4.5
42KA5251	0	3	4	21	2	3	11	1	0	0	0	1	0	0	1	0	3.4	1.8	0.5	2.4
42KA5254	0	1	1	34	1	1	5	1	0	0	0	0	0	0	0	0	1.4	1	0.2	0.2
42KA5255	0	1	1	20	2	1	5	1	2	0	0	0	0	0	0	0	4.2	1.9	0.6	3.6
42KA5258	0	1	4	33	1	3	2	1	0	0	0	0	0	0	0	0	1.9	1.8	0.3	0.7
42KA5263	0	4	4	11	3	3	2	2	0	0	0	4	0	0	1	1	4	2.4	0.5	3.9
42KA5263	0	2	1	37	2	3	20	0	0	0	0	0	0	0	1	1	2.3	1.3	0.4	1.1
42KA5268	0	1	2	18	3	3	2	1	3	2	0	0	0	0	0	0	0	3.1	0.7	7.5
42KA5274	0	1	5	12	2	3	5	2	0	0	0	0	0	0	1	0	4.2	2	0.4	3.3
42KA5277	0	2	2	20	3	3	9	1	0	0	0	0	0	0	0	0	0	2.3	0.5	2.4
42KA5277	0	1	1	12	2	1	2	2	0	0	0	4	0	0	1	0	2.2	2	0.5	2
42KA5279	0	2	1	31	1	2	8	1	0	0	0	0	0	0	0	0	2.3	1.3	0.3	0.7

42KA5286	0	2	2	11	2	1	2	1	0	0	0	1	0	0	0	0	0	2.5	0.5	2.1
42KA5286	0	1	8	31	1	1	2	0	0	0	0	0	0	0	1	0	0	1.3	0.2	0.4
42KA5286	0	4	4	31	1	2	6	1	2	0	0	1	0	0	0	0	1.9	0.9	0.3	0.5
42KA5289	0	1	2	11	2	3	7	1	0	0	0	0	0	0	0	0	0	1.9	0.4	1.7
42KA5300	0	2	3	17	3	3	7	1	0	0	0	0	1	4	0	0	0	2.9	0.5	2.1
42KA5305	0	1	2	11	3	3	1	3	0	0	0	4	0	0	0	0	0	2.6	0.5	3.9
42KA5317	0	2	2	1	3	1	5	1	0	0	0	4	0	0	0	0	0	2.3	0.7	5.7
42KA5320	0	1	1	12	3	1	6	1	0	0	0	4	0	0	1	0	2.9	2.1	0.5	2.7
42KA5323	0	1	4	11	3	3	11	4	0	0	0	1	0	0	1	0	7.5	2.1	0.6	8.3
42KA5326	0	1	2	18	3	1	3	2	0	0	0	0	0	0	0	0	0	2.2	0.7	4
42KA5328	0	1	2	12	2	3	3	1	1	0	0	1	0	0	0	0	0	2	0.5	2.5
42KA5328	0	2	2	12	2	3	2	5	9	9	0	1	0	0	1	0	0	1.8	0.4	1.6
42KA5330	0	1	2	11	3	3	6	0	0	0	0	4	1	5	0	0	0	2.3	0.4	3.5
42KA5335	0	1	2	11	2	2	5	1	0	0	0	4	1	5	0	0	0	1.8	0.5	2.2
42KA5339	0	3	2	13	3	3	6	1	0	0	0	4	0	0	1	0	0	2	0.5	3.8
42KA5339	0	4	2	11	2	3	4	1	0	0	0	1	1	4	0	0	0	2	0.5	2.7
42KA5349	0	1	2	20	1	2	9	5	9	9	0	0	0	0	0	0	0	1.9	0.5	2
42KA5349	0	2	1	11	3	3	5	1	0	0	0	4	0	0	0	0	4.4	2.3	0.7	5.9
42KA5354	0	1	8	1	3	3	5	2	0	0	0	4	1	2	0	0	5.1	2.2	0.5	5.9
42KA5358	0	1	1	15	1	1	9	1	0	0	0	0	0	0	1	0	3.7	2.5	0.4	3.8
42KA5360	0	1	2	21	3	2	3	5	9	9	0	4	0	0	1	0	0	1.5	0.4	2
42KA5361	0	1	2	8	3	3	3	1	0	0	0	4	0	0	0	0	0	2.8	0.5	4.2
42KA5361	0	2	5	13	1	1	2	0	3	2	0	1	0	0	1	0	3.5	1.7	0.5	2.8
42KA5362	0	1	9	32	1	3	1	1	0	0	0	0	0	0	0	0	0	1.6	0.3	0.8
42KA5363	0	2	4	31	1	1	6	5	9	9	0	0	0	0	0	0	2.8	1.1	0.3	0.8
42KA5364	0	1	2	21	1	1	5	0	3	3	0	0	1	2	0	0	0	2.5	0.5	4.3
42KA5365	0	1	4	25	1	1	2	5	9	9	0	0	0	0	0	0	3.9	1.6	0.7	3.6
42KA5365	0	5	2	12	1	3	1	1	0	0	0	4	0	0	0	0	0	1.8	0.4	1.4
42KA5366	0	4	2	5	1	1	1	1	0	0	0	1	0	0	1	0	0	2.2	0.5	2.7
42KA5380	0	3	2	20	1	1	2	2	3	1	0	0	0	0	0	0	0	1.7	0.5	2.3
42KA5380	0	5	3	1	3	3	5	0	2	1	0	9	1	4	0	0	0	0	0.5	2
42KA5388	0	2	2	2	1	1	6	2	0	0	0	0	0	0	0	0	0	1.6	0.4	1.6

42KA5390	0	1	2	11	1	1	3	2	0	0	0	0	0	0	0	0	0	2.3	0.4	1.2
42KA5391	0	2	2	13	3	1	2	2	0	0	0	0	0	0	0	0	0	0	0.5	2.1
42KA5393	0	4	4	11	2	3	5	1	1	1	0	0	0	0	0	0	4.5	2	0.6	4.4
42KA5393	0	1	8	1	2	3	20	0	0	0	0	0	0	0	1	0	0	1.4	0.5	1.1
42KA5399	0	1	2	21	2	3	5	1	0	0	0	1	0	0	1	0	0	1.8	0.6	2.4
42KA5400	0	2	2	15	2	3	4	0	0	0	0	1	1	2	0	0	0	1.8	0.6	2.6
42KA5403	0	1	2	21	1	3	3	1	1	1	0	1	0	0	1	0	0	1.3	0.4	1
42KA5404	0	2	6	4	3	3	2	1	0	0	0	4	0	0	0	0	0	0	0.5	1.3
42KA5405	0	1	6	4	3	3	5	1	0	0	0	4	0	0	0	0	0	0	0.6	3.1
42KA5405	0	3	1	13	3	2	6	0	0	0	0	4	0	0	1	0	3.2	1.8	0.5	2.8
42KA5409	0	4	2	16	2	3	2	5	9	9	0	4	0	0	0	0	0	1.7	0.4	2.2
42KA5411	0	1	2	17	3	2	3	2	1	0	0	4	0	0	0	0	0	2.1	0.4	2.7
42KA5411	0	3	4	31	1	1	6	1	0	0	0	1	0	0	0	0	1.7	1	0.2	0.2
42KA5411	0	2	1	31	1	1	1	0	0	0	1	3	0	0	0	1	2.1	1.3	0.4	0.8
42KA5420	0	11	2	15	3	3	4	1	0	0	0	0	0	0	0	0	0	2.1	0.5	3.2
42KA5420	0	10	9	24	2	2	6	1	1	0	0	0	0	0	0	0	0	1.8	0.5	2
42KA5421	0	1	1	25	1	1	3	1	1	0	1	1	0	0	0	0	3.7	1.4	0.6	3.3
42KA5423	0	1	1	5	1	1	3	0	1	0	0	0	0	0	1	0	2.5	1.8	0.6	2.5
42KA5423	0	3	2	25	1	1	3	2	2	0	0	0	0	0	0	0	0	1.6	0.5	1.6
42KA5425	0	1	1	5	1	1	14	2	0	0	0	4	0	0	0	0	3	2	0.5	2.6
42KA5428	0	3	1	10	3	3	2	2	0	0	0	0	1	2	1	0	1.9	1.7	0.4	1.6
42KA5438	0	1	9	32	1	2	1	1	0	0	0	0	0	0	0	0	0	1.5	0.3	0.6
42KA5444	0	1	1	50	3	3	2	0	3	2	0	0	0	0	1	0	4.4	2.9	0.7	7.6
42KA5449	0	2	9	32	1	3	2	3	0	0	0	0	0	0	0	0	0	1.8	0.4	1
42KA5449	0	1	9	32	1	3	1	1	0	0	0	0	0	0	0	0	0	1.9	0.4	1.3
42KA5454	0	3	4	31	1	1	4	2	0	0	0	1	0	0	0	0	2.8	1.4	0.3	1.2
42KA5458	0	3	1	32	1	2	5	1	0	0	0	0	0	0	0	0	2.9	1.3	0.3	0.9
42KA5460	0	1	7	33	1	1	1	2	0	0	0	0	1	1	0	0	1.8	1.8	0.3	0.7
42KA5480	0	1	8	30	1	2	20	0	0	0	0	0	0	0	0	0	0	0	0.2	0.3
42KA5484	0	1	1	2	2	2	5	1	2	1	0	0	0	0	1	0	3.2	1.6	0.5	2.2
42KA5487	0	1	2	11	3	2	5	2	0	0	0	0	0	0	0	0	0	2.3	0.5	2.3
42KA5490	0	1	2	20	2	1	2	0	3	3	0	0	1	3	1	0	0	2	0.4	3.1

42KA5492	0	1	2	18	3	3	2	1	0	0	0	1	1	2	0	0	0	2	0.5	3.4
42KA5493	0	4	1	7	1	1	1	1	0	0	0	4	0	0	0	0	4.9	1.7	0.6	4.5
42KA5499	0	1	2	12	1	1	5	5	9	9	0	0	0	0	0	0	0	1.6	0.4	1.3
42KA5517	0	1	4	20	1	1	5	1	0	0	0	0	0	0	0	0	3.8	2	0.6	3.2
42KA5522	0	1	2	18	2	3	2	0	2	2	0	1	0	0	9	0	0	2.3	0.5	2.6
42KA5523	0	1	2	11	2	3	3	0	3	2	0	0	0	0	0	0	0	2.4	0.5	1.6
42KA5526	0	2	2	11	3	2	4	1	0	0	0	0	0	0	0	0	0	2.3	0.4	2.4
42KA5528	0	1	2	13	1	1	3	2	1	0	0	1	0	0	0	0	0	0	0.5	1.8
42KA5533	0	1	4	33	1	1	2	2	0	0	0	0	0	0	0	0	3.1	1.9	0.3	1.7
42KA5541	0	1	2	11	2	3	11	1	0	0	0	0	0	0	1	0	0	2.2	0.3	1.3
42KA5544	0	1	2	13	3	3	9	2	0	0	0	1	0	0	0	0	0	2.9	0.6	5.6
42KA5545	0	1	1	11	1	1	4	1	0	0	0	4	0	0	0	1	4.1	2.1	0.6	5.1
42KA5548	0	1	2	20	1	1	1	2	0	0	0	0	0	0	0	0	0	1.8	0.5	1.8
42KA5548	0	2	2	20	3	2	1	1	0	0	0	4	0	0	0	0	0	2.5	0.5	2.1
42KA5551	0	1	2	11	3	1	3	2	1	0	0	4	0	0	0	0	0	2.5	0.5	3

Appendix D

Simple Random Sample Draws for the Nine Sampling Strata of the Kaiparowits Plateau Survey

Simple Random Sample of the First 62 Units out of 200 for the Collet Top Stratum.

Sequence #	Unit #	Sampling Fraction	Sequence #	Unit #	Sampling Fraction
1	138		32	153	
2	058		33	126	
3	149		34	177	
4	030		35	108	17.5
5	044	2.5	36	093	
6	154		37	141	
7	156		38	024	
8	200		39	026	
9	070		40	055	20.0
10	190	5.0	41	019	
11	035		42	032	
12	189		43	083	
13	059		44	017	
14	028		45	022	22.5
15	047	7.5	46	114	
16	066		47	180	
17	081		48	061	
18	132		49	086	
19	163		50	007	25.0
20	039	10.0	51	012	
21	040		52	147	
22	096		52	104	
23	111		54	088	
24	139		55	150	27.5
25	155	12.5	56	054	
26	014		57	130	
27	045		58	136	
28	194		59	158	
29	064		60	003	
30	037	15.0	61	092	
31	077		62	143	31.0

Simple Random Sample of the First 26 Units out of 83 for the Horse Mountain Stratum.

Sequence #	Unit #	Sampling Fraction	Sequence #	Unit #	Sampling Fraction
1	59		14	46	
2	13		15	18	18.1
3	62		16	72	
4	68		17	61	
5	75	6.0	18	83	
6	45		19	40	
7	30		20	33	24.1
8	73		21	16	
9	66		22	09	
10	21	12.0	23	43	
11	39		24	50	
12	27		25	51	
13	03		26	04	31.3

Simple Random Sample of the First 56 Units out of 182 for the Long Flat Stratum.

Sequence #	Unit #	Sampling Fraction	Sequence #	Unit #	Sampling Fraction
1	149		29	085	
2	111		30	154	16.5
3	165		31	054	
4	007		32	046	
5	051	2.7	33	030	
6	155		34	019	
7	070		35	169	19.2
8	015		36	031	
9	040		37	166	
10	116	5.5	38	145	
11	122		39	175	
12	081		40	124	22.0
13	160		41	095	
14	162		42	002	
15	137	8.2	43	058	
16	178		44	141	
17	164		45	158	24.7
18	134		46	017	
19	109		47	168	
20	079	10.9	48	025	
21	091		49	053	
22	180		50	049	27.5
23	105		51	112	
24	028		52	011	
25	108	13.7	53	177	
26	039		54	144	
27	038		55	042	
28	089		56	159	30.8

Simple Random Sample of the First 20 Units out of 65 for the Horse Flat Stratum.

Sequence #	Unit #	Sampling Fraction	Sequence #	Unit #	Sampling Fraction
1	54		11	24	
2	15		12	55	
3	61		13	16	
4	05		14	46	
5	41	7.7	15	42	23.1
6	28		16	20	
7	40		17	08	
8	34		18	45	
9	06		19	31	
10	47	15.4	20	22	30.1

Simple Random Sample of the First 54 Units out of 174 for the Fourmile Bench Stratum.

Sequence #	Unit #	Sampling Fraction	Sequence #	Unit #	Sampling Fraction
1	052		28	099	
2	051		29	135	
3	131		30	025	17.2
4	031		31	081	
5	066	2.9	32	027	
6	008		33	041	
7	118		34	101	
8	145		35	053	20.1
9	160		36	140	
10	003	5.7	37	073	
11	072		38	074	
12	115		39	050	
13	111		40	163	23.0
14	141		41	100	
15	149	8.6	42	087	
16	088		43	148	
17	028		44	038	
18	122		45	091	25.9
19	034		46	035	
20	107	11.5	47	116	
21	048		48	154	
22	061		49	064	
23	060		50	062	28.7
24	078		51	165	
25	168	14.4	52	130	
26	109		52	121	
27	161		54	095	31.0

Simple Random Sample of the First 40 Units out of 119 for the Smoky Mt. Stratum.

Sequence #	Unit #	Sampling Fraction	Sequence #	Unit #	Sampling Fraction
1	063		21	054	
2	066		22	105	
3	093		23	036	
4	075		24	062	
5	114	4.2	25	026	21.0
6	094		26	021	
7	097		27	106	
8	065		28	117	
9	001		29	020	
10	080	8.4	30	013	25.2
11	095		31	100	
12	032		32	015	
13	027		33	112	
14	118		34	041	
15	008	12.6	35	057	29.4
16	033		36	029	
17	060		37	079	
18	111		38	044	
19	042		39	074	
20	018	16.8	40	005	33.6

Simple Random Sample of the First 36 Units out of 110 for the Brigham Plains Stratum.

Sequence #	Unit #	Sampling Fraction	Sequence #	Unit #	Sampling Fraction
1	041		19	104	
2	046		20	005	17.5
3	018		21	061	
4	103		22	039	
5	062	4.4	23	105	
6	025		24	094	
7	081		25	059	21.9
8	035		26	019	
9	010		27	048	
10	098	8.8	28	079	
11	107		29	042	
12	033		30	060	26.3
13	074		31	084	
14	053		32	004	
15	021	13.2	33	030	
16	026		34	073	
17	092		35	007	
18	055		36	045	31.6

Simple Random Sample of the First 44 Units out of 139 for the Nipple Bench Stratum.

Sequence #	Unit #	Sampling Fraction	Sequence #	Unit #	Sampling Fraction
1	016		23	102	
2	003		24	116	
3	126		25	084	18.0
4	118		26	117	
5	065	3.6	27	072	
6	128		28	048	
7	108		29	119	
8	050		30	131	21.6
9	017		31	109	
10	046	7.2	32	056	
11	098		33	082	
12	122		34	036	
13	040		35	073	25.2
14	014		36	105	
15	132	10.8	37	130	
16	106		38	063	
17	026		39	002	
18	025		40	059	28.8
19	033		41	019	
20	028	14.4	42	071	
21	068		43	029	
22	077		44	099	31.7

Simple Random Sample of the First 30 Units out of 92 for the East Clark Bench Stratum.

Sequence #	Unit #	Sampling Fraction	Sequence #	Unit #	Sampling Fraction
1	06		16	03	
2	10		17	44	
3	59		18	08	
4	33		19	38	
5	31	5.4	20	25	21.7
6	76		21	15	
7	83		22	21	
8	02		23	75	
9	69		24	53	
10	30	9.8	25	48	27.2
11	79		26	51	
12	09		27	65	
13	72		28	39	
14	32		29	88	
15	35	16.3	30	13	32.6


U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Utah State Office
SALT LAKE
Salt Lake Field Office
VERNAL
Vernal Field Office
PRICE
Price
Field Office
Fillmore Field Office
FILLMORE
RICHFIELD
Richfield
Field Office
Moab Field
Offcie
MOAB
HANKSVILLE
Henry Mtn. Field Station
MONTICELLO
Monticello Field Office
Cedar City Field Office
CEDAR CITY
ESCALANTE
GRAND STAIRCASE-ESCALANTE
NATIONAL MONUMENT
St. George
Field Office
ST GEORGE
Kanab
Field
Office
KANAB