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Deceptive Desolation: Prehistory of the Sonoran Desert in West Central Arizona

Connie L. Stone

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Deceptive Desolation: Prehistory of the Sonoran Desert in West Central Arizona

by

Connie L. Stone

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CHAPTER 1
INTRODUCTION

This document is a "Class I overview" of prehistoric cultural resources within the Lower Gila North planning area defined by the Bureau of Land Management (BLM), an agency of the U.S. Department of the Interior. Regional Class I overview preparation is an important phase of the cultural resource inventory process outlined in BLM Manual 8111, Release 8-3 (1978). All lands within the boundaries of a study area, not just federally administered lands, are taken into consideration. Based on a compilation and assessment of existing data, the overview provides guidance for future planning and management decisions regarding cultural resources. It incorporates background information on the natural environment, ethnographic occupation, and history of archaeological research; a review of culture history and anthropological research issues; a discussion of site types; and a comprehensive bibliography. The synthesis of this information is used to generate recommendations for inventory, research, and management priorities. As stated in Manual 8111, Class I overviews provide "the basis and foundation for all future management actions in the area" as well as "critical evaluations oriented towards the unique problems and concerns encountered in an active management program". This information can also provide the basis for incorporating cultural resources into multiple use planning.

Beginning in the late 1970s, regional Class I overviews were completed or initiated in most western regions managed by federal agencies, primarily by the Bureau of Land Management and the U.S. Forest Service. In 1978, the Arizona State Office of the BLM and Region 3 of the Forest Service established an *"Interagency Cultural Resource Inventory Agreement"* (BLM AZ-950-IA8-001) for the coordination of Class I overview efforts. This agreement partitioned Arizona into nine geographic areas, known as "joint cultural resource overview units" (Map 1-1). A "lead agency" was designated to assume the completion of overviews for each unit. The BLM was held responsible for prehistoric and historic overviews of three units: West Central, Southwest, and Southeast Arizona. The first overview, covering the prehistory of the Southwest study unit, was completed by McGuire and Schiffer (1982). Draft reports for most other areas are in progress or have been completed.

By consensus of the author and other BLM archaeologists, the West Central overview unit has been divided into separate overview zones corresponding to two administrative areas: the Lower Gila North planning area and to its north, the Kingman Resource Area. This division correlates with major ethnographic and environmental boundaries, a situation favoring separate treatment for greater clarity and better planning. This document is an overview of the Lower Gila North planning area, the southern portion of the West Central Arizona overview unit.

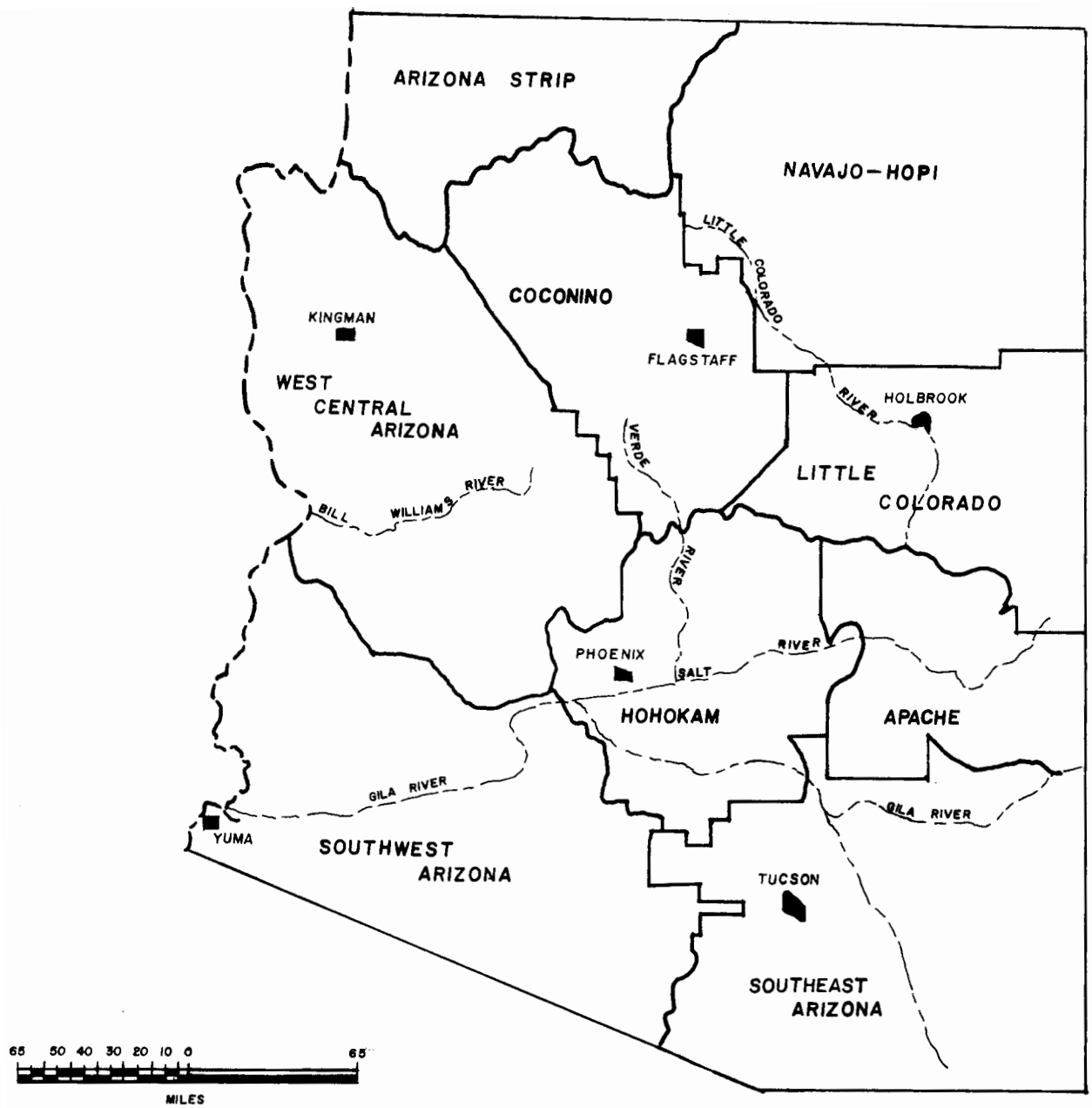
Public lands administered by the BLM are encompassed within a geographic hierarchy of districts, resource areas, and planning units. The boundaries of the Phoenix District, one of the largest in the entire Bureau, incorporate a total area of 57 million acres located primarily in western Arizona. Within districts, activities and personnel are organized by resource areas. The Lower Gila Resource Area of the Phoenix District encompasses much of southwestern Arizona (Map 1-2). The Lower Gila North planning area is part of the Lower Gila Resource Area containing portions of La Paz, Maricopa, and Yavapai counties. Its eastern border extends roughly due north from the outskirts of Buckeye to Iron Springs just west of Prescott. Following the Southern Pacific railroad line west from Buckeye, the southern border meets Centennial Wash and follows it northward to its intersection with Interstate Highway 10. The border follows the highway, then shifts northward along Bouse Wash to the town of Bouse. After an abrupt eastward jog, it extends north to the Bill Williams River. The northern border consists roughly of the Bill Williams and Santa Maria rivers and the Prescott National Forest border. Within Lower Gila North, there are three planning units bounded partially by major highways: the Vulture unit in the southeast, the Harcuvar unit in the northwest, and the Skull Valley unit in the northeast. In 1982, when a draft environmental impact statement for a grazing management program was completed, Lower Gila North encompassed 1,393,000 acres of public (BLM) land, 847,000 acres of state land, and 442,000 acres of private land (Bureau of Land Management 1982:1). Federal lands were blocked in large, contiguous portions of the Harcuvar and Vulture units, while the Skull Valley unit incorporated predominantly state and private lands. Since 1982, land exchanges have slightly modified the above figures.

DECEPTIVE DESOLATION

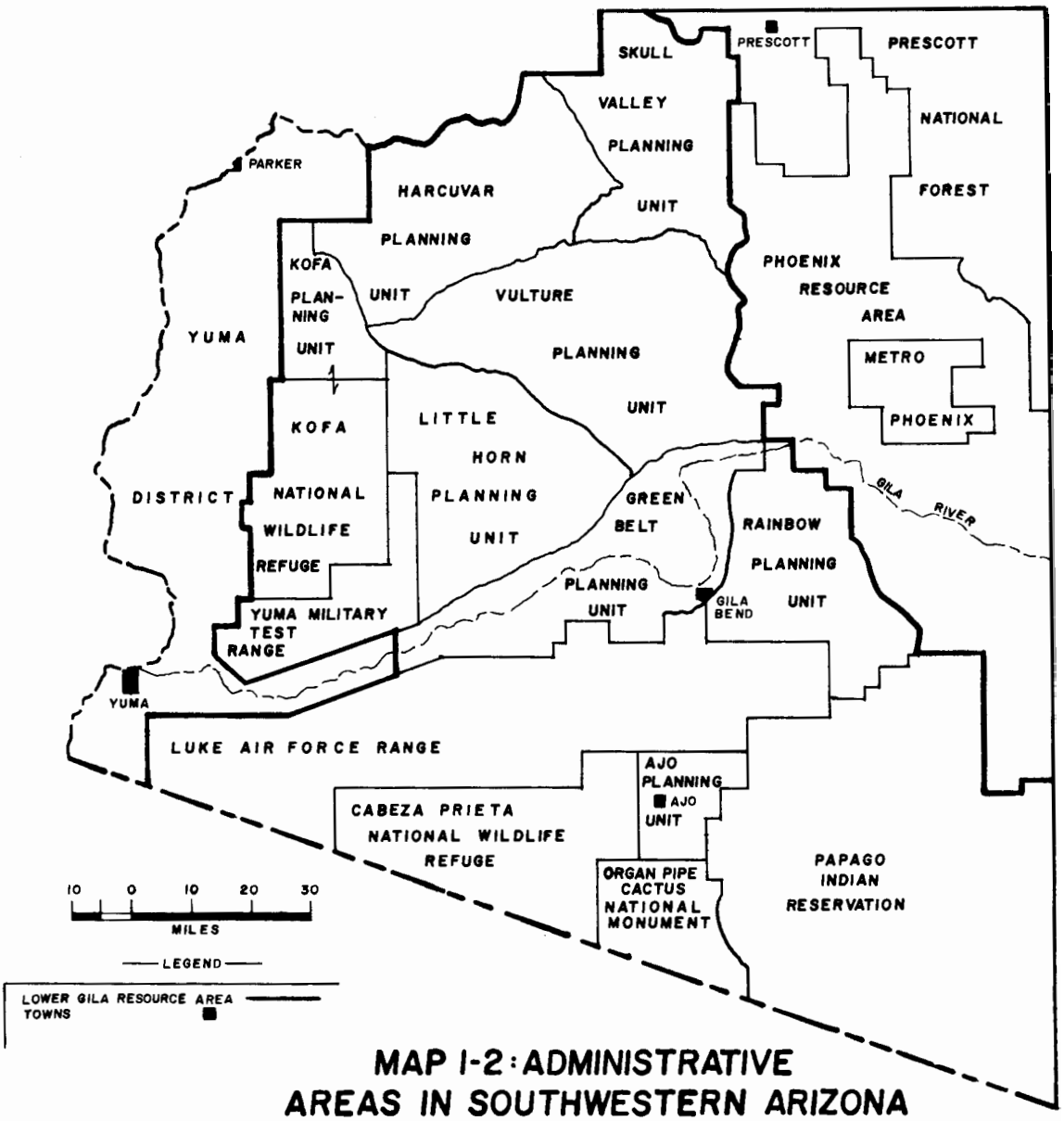
The hot, arid creosote flats and rugged mountains of the northern Sonoran Desert suggest an unproductive and hostile landscape. This is exemplified by the mythological mascot of the region, the Salome Frog created by humorist Dick Wick Hall, who carried a canteen and never learned to swim (Myers 1970). Unlike the Papagueria to the south of the Gila River, the region was only recently graced with its own name. Until the publication of a recent issue of *Arizona Highways* (November 1985), the author usually referred to the region as "out there" or the "western desert". The latter term evoked images of the Australian interior, which has its own "Western Desert". It thus came as no surprise when *Arizona Highways* christened the region as the "great western outback" of Arizona, recognizing it as a country of "awe-inspiring" beauty.

One cannot deny that the Arizona outback is a challenging and often treacherous environment for humans. Yet its beauty exists not only in striking desert landscapes but also in its surprising diversity of natural resources; in its intellectual challenge to those who study strategies of human survival in arid lands; and in the reverence accorded to the land by contemporary Native Americans (Bean et al. 1978).

Prehistoric and historic Indian groups occupied the region despite its apparent desolation. At least 450 archaeological



MAP I-1: CULTURAL RESOURCE OVERVIEW UNITS IN ARIZONA



MAP 1-2: ADMINISTRATIVE AREAS IN SOUTHWESTERN ARIZONA

sites, as well as numerous isolated artifacts and features, have been documented in the Lower Gila North planning area (BLM files; Giorgi and Bayer 1981; Stone and Quinn 1983). Using an average estimate of one site per 180 acres as indicated by previous archaeological surveys, Giorgi and Bayer (1981) suggested that the region might contain 10,000 sites. Since site densities appear to vary over the region and because site boundaries can be difficult to define, this figure should be regarded only as a very general estimate. Archaeological evidence indicates that aboriginal patterns of land use, spanning thousands of years, were based on the exploitation of wild plant foods, game, and raw materials, and on periodic travel between the Colorado River, Gila River, and upland areas to the north. At the northeastern edge of the region, in the higher alluvial valleys west of Prescott, relatively large and more permanent occupations may have been supported by a combination of farming and wild resource use. However, the desert region appears to have been characterized by low population densities, a lack of "permanent" villages, a high degree of mobility, and short term but repeated use of more productive areas, over a long period of time.

The cultural resources of the Arizona outback possess value to archaeologists, Native Americans, and the public. They offer significant insights into the history and dynamics of human use of arid environments. Their research values extend beyond administrative boundaries. For scientists, these prehistoric resources represent an archaeological bridge between the Southwest, the Great Basin, and the California desert. In a more general sense, these archaeological remnants represent a monument to human versatility and stamina.

A BRIEF REVIEW OF OVERVIEWS

A review of unpublished and published Class I overviews revealed variability in quality and usefulness to researchers, cultural resource managers, and land managers. Although management recommendations should have been an important aspect of these studies, they frequently devoted only a few pages to the discussion of management issues. The poor quality of some overviews has promoted negative attitudes among some archaeologists, characterized by such published comments as "above average given the normal level of expectations for such overviews" (Doyel 1983:472). Although warranted in some cases, such attitudes threaten to undermine the potential usefulness of these regional syntheses.

In a review of such problems, McGuire and Schiffer (1982:5-9) discussed the nature of overviews and their target audiences. They defined two basic approaches to overview preparation. "Bibliographic" overviews, written primarily for nonarchaeologists, were characterized as uncritical summaries of regional prehistory, with little attention paid to research issues. Such documents were seen to be of limited use to either agency or nonagency archaeologists. Many early overviews fit this definition.

In their alternative approach, McGuire and Schiffer (1982:6) asserted that archaeologists should be the main audience, although overviews should also contain basic information accessible to land managers and the public. They stressed the importance of critical evaluations of past research, followed by a discussion of future research directions. As to the role of overviews in the conduct of research:

> Overviews straddle the abyss between areal syntheses and regional research designs. Like syntheses, overviews must strive to isolate cogent research problems, suggest hypotheses, and outline productive lines of investigation, while avoiding the overly narrow problem focus of a regional research design . . . The key emphasis should be on a plurality of problems, ranging widely over method, theory, technique, and substantive issues [McGuire and Schiffer 1982:8].

Overviews can thus make important contributions to archaeological research. Indeed, some documents have been recognized as "truly original contributions" whose value "extends beyond their strictly management objectives" (Dancey 1983:168). As syntheses, they can serve as valuable resources in reducing tedious background research. They can also enable the archaeologist to monitor the vast amount of information generated by numerous contract projects. Archaeologists should support the writing and periodic updating of such documents, since "only the agencies which administer public lands have the financial, personnel, and technical resources to pursue holistic, integrated, and long-term research designs" (Cordell 1979:1).

McGuire and Schiffer (1982) successfully integrated basic information and research issues in their overview of southwestern Arizona. Yet their frame of reference drew criticism. A focus on the Papagueria necessitated a broad frame of reference incorporating the Hohokam core area of central Arizona. But according to Doyel (1983:472), "preoccupation with the problems of the core Hohokam area detracts from the opportunity to approach the study area on its own terms". Doyel advocated greater attention to "more relevant research problems" in the study area: the nature of hunting and gathering adaptations, culture contact situations, and unusual settlement patterns.

This overview of the west central desert incorporates an integrated approach to research and management. In addition to a focus on research issues, it incorporates more attention to management than is characteristic of most overviews. Finally, although an expanded regional context is employed for interpretive purposes, the frame of reference focuses squarely on this portion of west central Arizona, incorporating information from both published and unpublished sources. The overview can be useful in the preparation of specific research designs for this region. It can be used in conjunction with AZSITE, the new statewide computer data base of archaeological sites developed through a cooperative effort between the Arizona State Museum and the Bureau of Land Management. The overview can also serve as a resource for developing research and management strategies in other arid regions of the West.

ORGANIZATION OF THE OVERVIEW

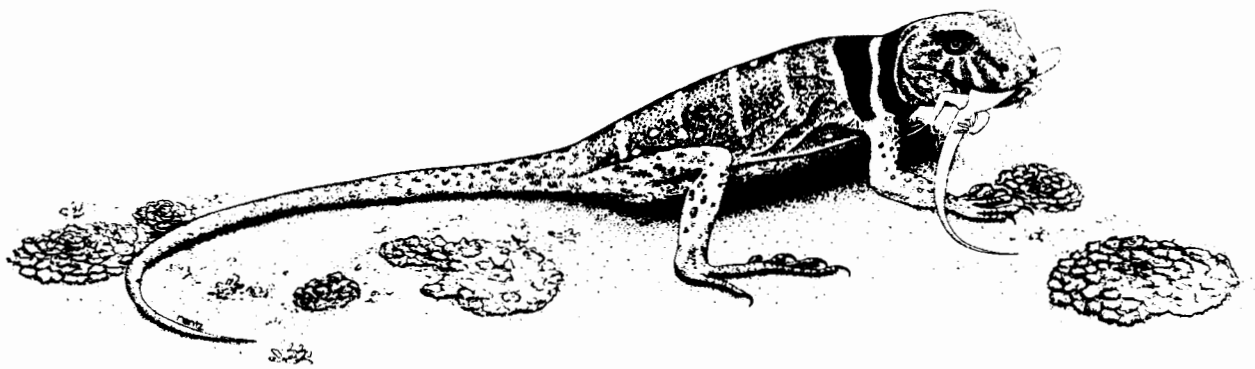
The overview is organized in terms of two areas: the desert zone and the Skull Valley zone. The desert zone incorporates the Harcuvar and Vulture planning units and encompasses most of the federally administered lands in the overview area. For interpretive purposes, the overview will also consider the cultural resources of the southern Harquahala Valley and Eagletail Mountains, areas located just south of the administrative boundary of the Vulture planning unit.

The Skull Valley zone consists of the Skull Valley planning unit. Its culture history is tied to that of the Prescott region, and its upland environment is different in many respects from that of the desert zone. The desert and Skull Valley zones offer somewhat different sets of problems for research, management, and inventory.

Chapters 2 through 4 provide environmental and ethnographic background information for the overview area. Separate chapters address the environments and natural resources of the desert and Skull Valley zones, with a common focus on the use of resources by the aboriginal inhabitants. Chapter 4 is an ethnographic summary of the entire overview area, including a discussion of groups that resided along the Colorado River. The chapter focuses on the economics of life in the desert and its bordering uplands.

Chapters 5 through 7 concern the prehistory of the desert zone. A history of archaeological research is followed by a summary prehistory of the northern Sonoran Desert. These set the stage for a discussion of research problems.

Chapters 8 and 9 address the prehistory of the Skull Valley zone, involving a consideration of the greater Prescott region. The discussion of research issues is incorporated into Chapter 9, the summary prehistory. The final section of the overview, Chapters 10 through 14, concerns management issues. Chapter 10 is a detailed presentation of desert site types with attention devoted to the nature, research values and investigative problems of particular site types. Chapter 11 discusses the values associated with cultural resources and their relationship to the "use categories" defined for BLM cultural resource managers. Chapter 12 describes the modern activities and natural processes affecting sites, concluding with a consideration of strategies for protection and preservation. Chapter 13 is a brief consideration of additional site types and management problems specific to the Skull Valley zone. Finally, Chapter 14 discusses survey techniques and inventory priorities for both the desert and Skull Valley zones.



CHAPTER 2

THE ENVIRONMENT AND NATURAL RESOURCES OF THE DESERT ZONE

The natural environmental context is a crucial consideration in any study of human behavior. As expressed by McGuire and Schiffer (1982:9), "human societies and their changes must be understood as resulting from the interaction of the material conditions of existence: demography, subsistence, environment, and other human groups". Decisions regarding settlement, subsistence, and travel are influenced by the properties and distribution of important natural resources (Binford 1964; Flannery 1968; Jochim 1981). Major studies of Sonoran Desert prehistory have employed this cultural ecological approach (Doelle 1980; Goodyear 1975).

The Sonoran Desert is one of the four subdivisions of the North American Desert, the others being the Mohave, Great Basin, and Chihuahan deserts. Symbolized by the saguaro cactus, the Sonoran Desert incorporates much of southeastern California and the Mexican states of Sonora and Baja California. In Arizona, it covers the southwestern quadrant, the Colorado River Valley, and elevations under 3000 feet (909 m) in southeastern Arizona (Map 2-1). Although it is the hottest of the four deserts, its plant life is the most varied and lush. The other deserts, generally cooler and higher in elevation, are dominated by a flora of shrubs, grasses, and yucca. None match the diversity of cacti and arboreal species in the Sonoran Desert (Lowe 1964:30-35). Yet its extensive creosote flats and rugged mountains can appear quite barren.

In the northern Sonoran Desert, the sparsely settled region bounded by the Hassayampa, Gila, Colorado and Bill Williams rivers has been labeled as an exceedingly desolate area by explorers and travelers, "as nearly a no man's land as can be found in the United States" (Ross 1923:xiv). Yet humans have ranged over this area and exploited its natural resources for perhaps thousands of years (Brown and Stone 1982). The challenge for anthropologists lies in the determination of patterns of settlement, resource use, and social interaction which enabled humans to occupy this rugged and forbidding area. An inevitable outcome of such study is an appreciation for human adaptability.

This descriptive review of the regional environment will address the character and distribution of natural resources available for sustenance, raw materials, shelter, and travel. Basic descriptions of physiography and geology, hydrology, climate, vegetation, and wildlife will include discussions of environmental features as exploitable resources. The final portion of the chapter will review issues concerning paleoenvironmental reconstruction and historic environmental changes.

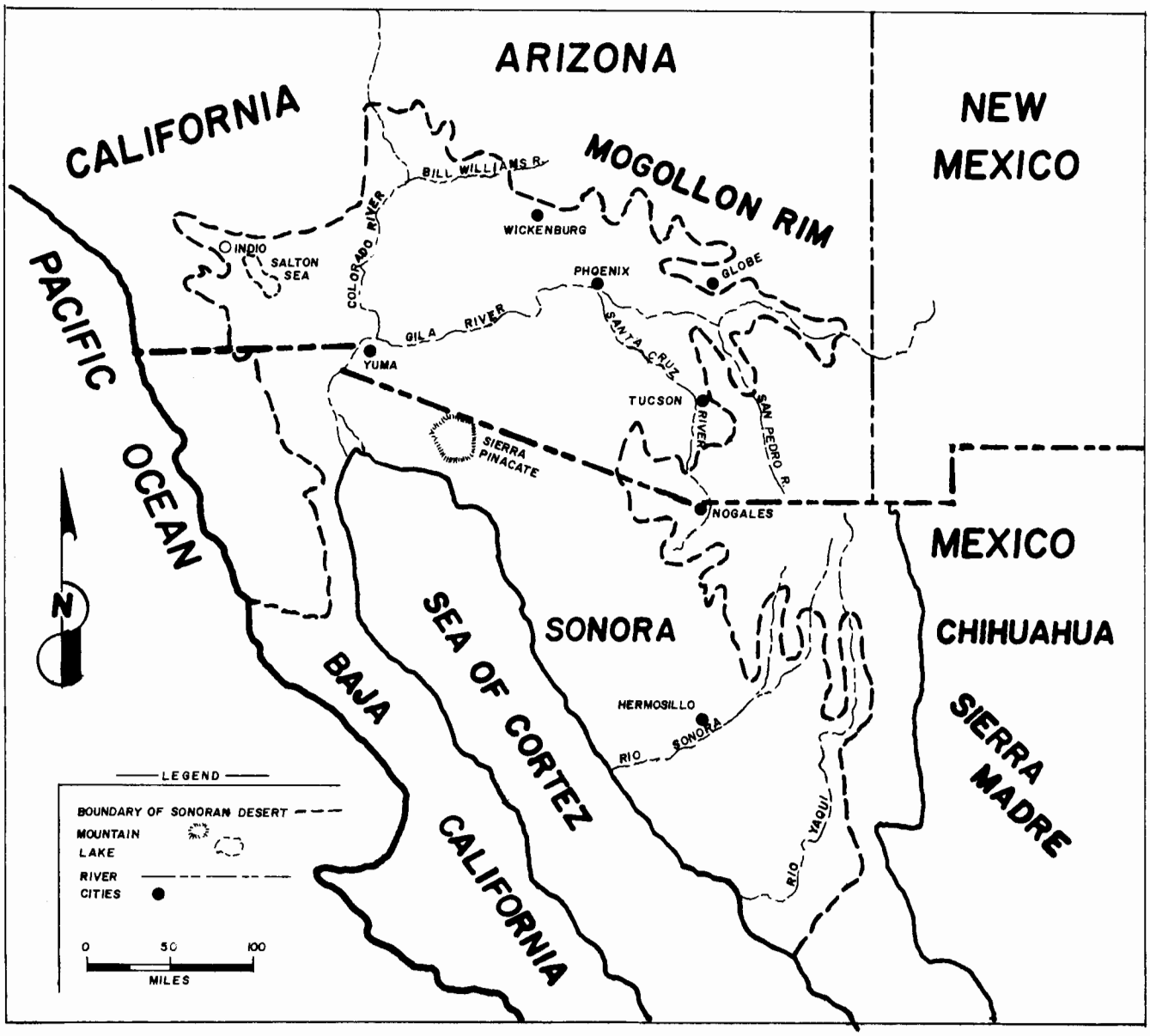
PHYSIOGRAPHY AND GEOLOGY

In the southern or Sonoran Desert section of the Basin and Range Physiographic Province, elongated subparallel mountain ranges rise abruptly to heights up to several thousand feet above vast areas of relatively flat desert. The intermontane basins cover approximately 75% of the province and up to to 80% of the area in southwestern Arizona (Bryan 1925; Blackwelder 1931). The narrow mountain ranges are generally oriented north-south or northwest-southeast. Range crests tend to be sinuous but continuous. In cross profile, opposite slopes are assymmetrical; one slope is generally steeper than the other. The topographic contrast between mountains and plains is the most distinctive aspect of the desert landscape.

This landscape has been shaped by four major geomorphic processes: normal faulting, volcanism, wind erosion, and deposition and erosion by running water. The vertical movement of faults, fractures in the earth's crust, caused the subsidence of valleys in relation to upraised blocks forming mountain ranges. In the Basin and Range Province, normal faulting produced a series of roughly north-south trending fault blocks. The valleys or basins subsequently were filled with debris carried by running water and winds. Both stream and sheet floods have moved quantities of rock and soil debris downslope into the basins. Volcanism and wind erosion have had more localized effects.

Basins are bowl-shaped in cross-section. Pediment and bajada slopes consist of a series of coalescing alluvial fans radiating from the base of mountain ranges (Bloom 1969; Bryan 1925). The relatively steeper pediment slopes merge imperceptibly with the more gently sloping bajadas. The degree of slope decreases toward the center of the basin, and a large portion of the area may appear to be virtually flat. Differences in slope and sediment texture are sometimes employed to distinguish upper from lower bajadas, although a strict division is rarely perceptible on the ground. Pediments are generally narrow, the lower portions buried by rising bajada alluvium (Bloom 1969). Berry (1978) noted that the pediments of the study area are less extensive than those of the Papagueria. These landforms are particularly narrow along the upfaulted mountain fronts and wider along the more gradually inclined opposing faces (Brown and Stone 1982:10).

Erosion has exposed Precambrian schist, gneiss, granite, and quartzite from the most ancient era of geologic time. A more limited occurrence of sedimentary and igneious rock types dates to the Paleozoic and Mesozoic eras, the age of dinosaurs. The subsequent Cretaceous and early Tertiary periods witnessed one of the major geologic "events" in western Arizona, extensive metamorphism which created a "metamorphic core complex" with distinctive structural and compositional characteristics (Reynolds 1980). Core complex ranges are composed of thick sequences of quartzo-feldspathic gneiss and schist interlayered with granite, marble and quartzite. These mountains occur in a northwest-southeast trending zone through western Arizona. Within this zone, most core complex ranges follow a northeast-southwest orientation, contrary to the usual trend in the Basin and Range Province. The Buckskin, Harcuvar, and Harquahala ranges are manifestations of the metamorphic core complex.



MAP 2-1 THE SONORAN DESERT
(Based on Nabhan 1985:2)

Mid-Tertiary volcanic activity from 25 to 15 million years ago produced a second major geologic episode in western Arizona (Rehrig, Shafiqulla, and Damon 1980; Reynolds 1980). The volcanic formations consist of rhyolite, andesite, and nodular obsidian capped by basalt flows. Thick sections of ash-flow tuff, volcanic breccia, and flow-banded rhyolite are found in the Vulture and Eagletail Mountains. Like the metamorphic core complex, this geologic activity is represented in a series of parallel mountain ranges with a distinct directional trend. A nearly continuous northeast-southwest trending area of mid-Tertiary volcanic rocks extends through the Vulture, Big Horn, Eagletail, Kofa, and Castle Dome ranges to the Colorado River. Within this area, the individual ranges follow a northwest-southeast alignment. This directional trend is opposite that of the metamorphic core complex. Later volcanic activity consisted of isolated basalt flows during the late Tertiary period.

The final major geologic event in west central Arizona was the formation of the present ranges and basins through normal faulting between 14 and 5 million years ago. During this period, the Colorado River established its present drainage, and basins became interconnected in the Colorado watershed. Well-developed pediments and the sinuous boundaries of mountain fronts indicate that faults have been inactive for several million years (Reynolds 1980).

Regional Landforms

Landforms are shown on Map 2-2, a general map of the desert study area. Brief descriptions of specific mountain ranges and basins will follow a roughly northwest to southeast progression. Basic geologic information is taken from Reynolds (1980) and Wilson, Moore, and Cooper (1969).

Buckskin Mountains: The Buckskins are an east-west trending range bordering the Bill Williams River, with a maximum elevation of 3927 feet (1190 m). The steepest slopes and loftiest peaks occur in the eastern portion of the range, where the mountains rise nearly 2000 feet (606 m) above Butler Valley. The western portion is lower in elevation, consisting of a "broken group of irregular individual mountains, ridges, and scattered peaks"; extensive erosion has made these mountains "less compact than other large ranges" in the region (Keith 1978:68). They are composed of granite, gneiss, and schist.

Black Mountains: This range borders the Santa Maria River in the northern portion of the study area. It is less a separate range than an extension of the mountainous wilderness north of the river. Ives Peak, at 4072 feet (1234 m), rises over 1000 feet (303 m) above the Date Creek Basin. Deep, narrow canyons drain north to the river, and there are many outlying peaks and hills. The range is composed primarily of basalt and andesite.

Bouse Hills: This series of low hills reaches a maximum elevation of 1924 feet (583 m). They are composed of granite with intrusive andesitic lava flows.

Granite Wash Mountains: This rugged northwest-southeast oriented range reaches a maximum elevation of 3991 feet (1209 m). The eastern face is particularly steep, while the western portion contains large, deep canyons and outlying hills. Metamorphosed schist, gneiss, and phyllite, in addition to Mesozoic sedimentary rocks, are the dominant constituents.

Little Harquahala Mountains: This small range extends to the southeast of the Granite Wash Mountains, and they share a similar composition. Additional constituents include Paleozoic limestone and quartzite in addition to Mesozoic rhyolite. The Little Harquahalas include a series of broken peaks and hills with an extensive pediment slope and a maximum elevation of 3084 feet (935 m).

Harcuvar Mountains: Aside from a northeast-southwest directional trend, the Harcuvars fit the standard description of mountain ranges in the Basin and Range Province. They rise precipitously to heights up to 3000 feet (909 m) above the McMullen and Butler valleys. The relatively continous ridge crest is breached by only a few narrow passes. The south slope is steeper than the north. This range extends for a distance of at least 30 miles (48 km), breaking up into lower hills at its eastern end. Several peaks exceed 4500 feet (1364 m) in elevation, with Smith Peak at 5242 feet (1588 m). The topography consists of steep slopes and narrow canyons rapidly descending from the high peaks and ridgelines. At the base of the slopes are dissected bajadas and broad canyon mouths. Granite, gneiss, schist, and shale are major constituents.

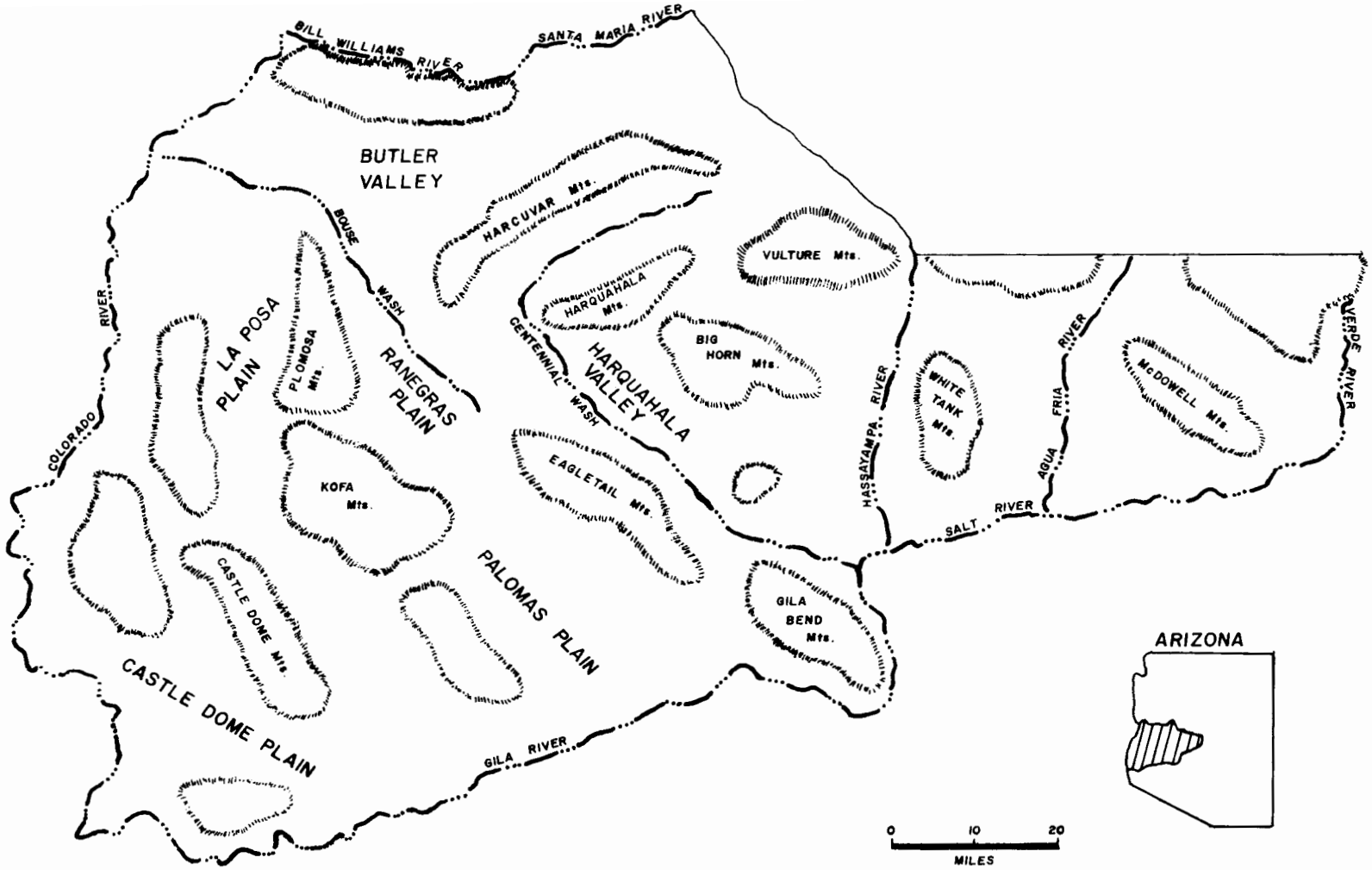
Harquahala Mountains: This range on the opposite side of McMullen Valley is a twin to the Harcuvars. The two ranges are similar in orientation, topography, elevation, and composition. The Harquahalas reach a maximum elevation of 5681 feet (1722 m) at Harquahala Peak. The northern exposure exhibits the steepest slopes. The southern slope is irregular and incised with numerous narrow, steep canyons. The Harquahala Peak Observatory, a scientific facility listed on the *National Register of Historic Places*, is located at the summit of the Harquahalas.

Eagletail Mountains: This rugged range reaches a maximum height of 3186 feet (965 m). Basal metamorphic rocks are overlain by horizontal strata of lava flows and tuff. Early explorers commented on the beauty of the fine-grained, multi-colored volcanic rocks (Ross 1923).

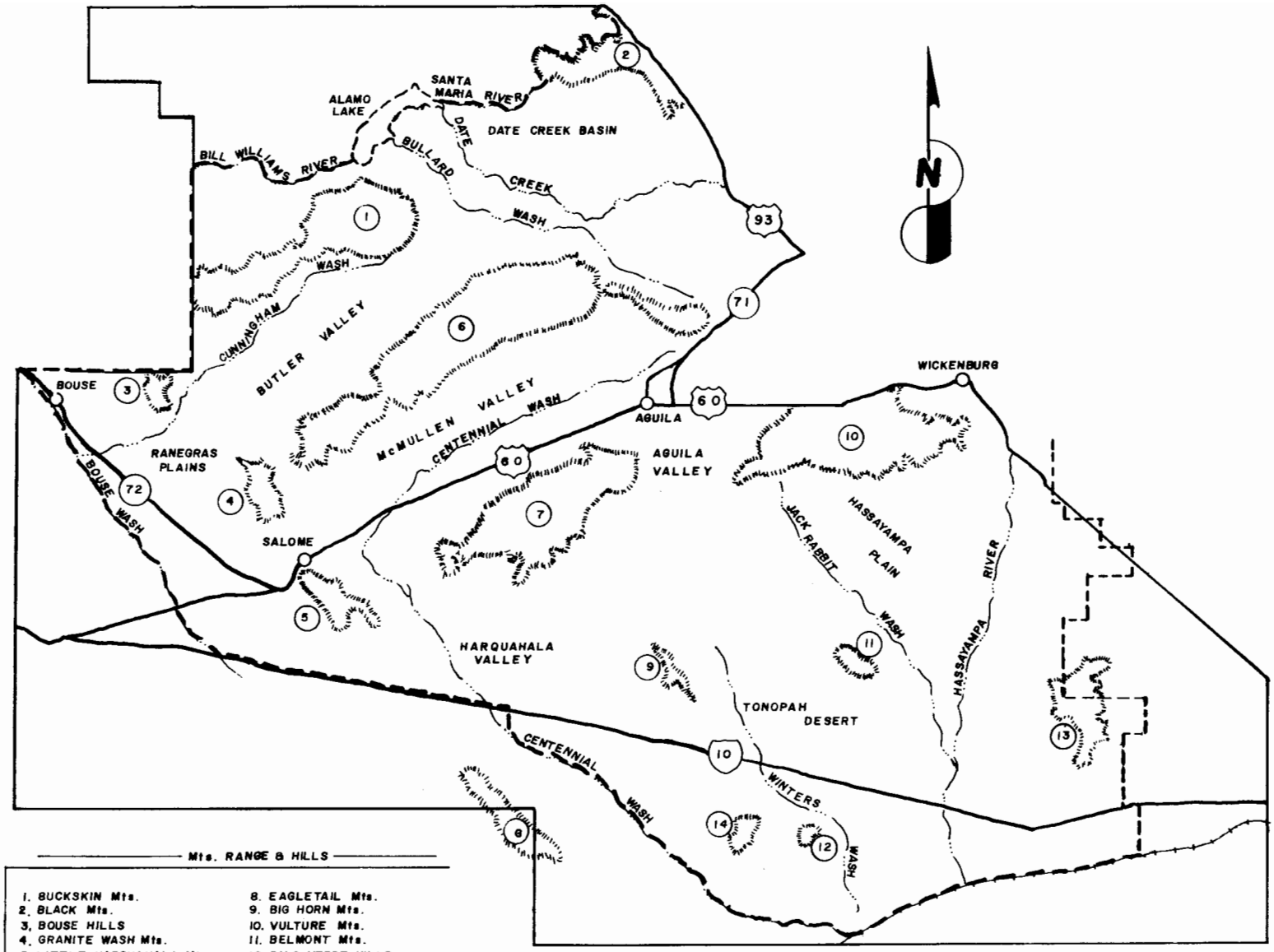
Big Horn Mountains: This highly eroded range is diffuse in comparison to the massive, relatively compact Harcuvars and Harquahalas. The dissected and rugged terrain incorporates numerous foothills and isolated peaks separated by canyons and areas of bajada. The steepest, highest, and most compact portion of the range occurs in the vicinity of Big Horn Peak, which reaches an elevation of 3480 feet (1055 m). A metamorphic core is overlain by extensive mid-Tertiary volcanic formations of basalt, andesite, and rhyolite.

Vulture Mountains: The Vultures are similar in composition to the Big Horns. They are also highly eroded, with many low peaks and a maximum height of 3612 feet (1095 m) at Black Butte. The historic Vulture Mine was among the richest gold mines in Arizona (Nicolson 1974:159).

Belmont Mountains: This small range on the Hassayampa Plain has steep slopes reaching an elevation of 2790 feet (845 m). The Belmonts are composed primarily of Precambrian granitic and metamorphic rocks.



MAP 2-2a: WEST OF PHOENIX: THE ARIZONA OUTBACK



Mts. RANGE & HILLS

1. BUCKSKIN Mts.
2. BLACK Mts.
3. BOUSE HILLS
4. GRANITE WASH Mts.
5. LITTLE HARQUAHALA Mts.
6. HARCUVAR Mts.
7. HARQUAHALA Mts.
8. EAGLETAIL Mts.
9. BIG HORN Mts.
10. VULTURE Mts.
11. BELMONT Mts.
12. PALO VERDE HILLS
13. WHITE TANKS Mts.
14. SADDLE Mts.

—Mountain ranges are drawn at 2500 ft. contour.—

MAP 2-2b THE DESERT ZONE

LEGEND

STUDY AREA BOUNDARY
PLANNING AREA BOUNDARY
MOUNTAIN RANGES
TOWNS

INTERSTATE HIGHWAY 10
U.S HIGHWAY 60
STATE HIGHWAY 71

RAILROAD

10 0 10
MILES

Palo Verde Hills: These low hills at the southern edge of the study area are volcanic in origin, with exposures of andesitic and basaltic lava flows. Saddle Mountain, a distinctive landmark to the immediate west, is composed of fine-grained igneous rocks, quartz, and chalcedony.

White Tank Mountains: This range at the eastern edge of the study area separates the Hassayampa Plain from the Salt River Valley. A compact range with steep slopes, its crest attains an elevation of 4018 feet (1218 m). The eastern face contains deep canyons grading into a gentle bajada slope at the base of the mountains. The western slope is more rocky and precipitous. The White Tanks are composed primarily of granite, gneiss, and schist.

In summary, the mountain ranges in the study area can be assigned to two major categories based on differences in composition and topography. The ranges of the metamorphic core complex tend to have steep faces, high summits, serrated crest profiles, and deep canyons. Their relatively continuous crests constitute distinct drainage divides. Such ranges include the eastern Buckskins, Harcuvars, Harquahalas, and White Tanks. Tertiary period volcanic ranges are non-symmetric and diffuse, with a maze of rugged peaks, ridges, flats, and canyons. The Vultures, Big Horns, and Eagletails are characteristic ranges.

Date Creek Basin: Bounded by the Black, Harcuvar, and Buckskin ranges, this plain slopes to the north toward the Santa Maria and Bill Williams rivers. Drained by Date Creek and Bullard Wash, it is highly dissected, with numerous low, parallel ridges between entrenched washes. Documentary evidence indicates that this erosion is not necessarily recent. In 1854, the army surveyor Whipple described the area as a "wide, arid-looking prairie, apparently cut into deep arroyos" (Foreman 1941:222). Elevations range from 1200 to 2800 feet (364-848 m).

Butler Valley: This plain is surrounded by the Buckskin and Harcuvar ranges and the Bouse Hills. The area, drained by Cunningham Wash, incorporates an elevational range from 1400 to 2200 feet (424-667 m). The terrain is very flat, with dunes near portions of the major drainage.

Ranegras Plain: This northwest-southeast trending basin exceeds 40 miles (64 km) in length and is bordered on the north and east by the Bouse Hills and the Granite Wash and Little Harquahala ranges. Bouse Wash is the major drainage. Elevations range from 1000 to 1600 feet (303-485 m). Ross (1923:181) referred to the Ranegras Plain as a scene of "utter barrenness and desolation".

McMullen Valley: The lofty Harcuvar and Harquahala ranges bound this southwest trending basin drained by upper Centennial Wash. The minimum and maximum elevations are 2000 and 2400 feet (606-727 m).

Aguila Valley: This is essentially an eastern extension of McMullen Valley, reaching to the Vulture Mountains and Wickenburg with a similar elevational range. Isolated hills and peaks rise from the valley floor.

Harquahala Valley: This vast area, approximately 48 by 15 miles (77 x 24 km), is bounded clockwise from the northwest by the Little Harquahalas, the Harquahalas, the Big Horns, Saddle Mountain, the Gila Bend Mountains, and the Eagletails. Elevations range from 1000 to 1800 feet (303-545 m). Centennial Wash, a major tributary of the Gila, passes through the length of the plain.

Tonopah Desert: This low plain, ranging from 1000 to 1400 feet (303-424 m), is surrounded by the Big Horn and Belmont mountains, the Palo Verde Hills, and the Hassayampa River to the east. Winters Wash is the major drainage.

Hassayampa Plain: This area extends between the White Tank Mountains, the Vultures, and the Belmont mountains. West of the Hassayampa River, it is drained by Jackrabbit and Star washes. Elevations range roughly from 1400 to 2000 feet (424-606 m).

Soils and Surfaces

Soil formation, a relatively slow process in arid climates, occurs when rock disintegrates as a result of physical weathering (Fuller 1975). Heating and cooling stresses, acids produced by lichens, wind abrasion, and the growth of salt crystals in cracks can contribute to this process of disintegration (Crosswhite and Crosswhite 1982:188). Desert soils have a low organic content, since there is little accumulation of organic debris on the surface. Soils are deposited into the basins by water and wind. Physical sorting and alluvial processes result in variable depths and textures in different portions of a basin. Mountain slopes contain soil in shallow pockets. Pediment and upper bajada soils tend to be well drained, coarse loams capped with gravel or cobbles. The deeper alluvial soils of the basin flats have a much finer texture. Sandy clay "adobe flats" occur where water occasionally collects in depressions or "playas" (Bryan 1925).

Caliche, an accumulation of lime which cements desert soils, is the bane of archaeologists. It is created when calcium carbonate from surface deposits is carried in solution as water percolates downward into the soil, where evaporation results in its precipitation. Thus caliche deposits are sheet-like and roughly parallel to the ground surface. The desert climate, with its summer thundershowers followed immediately by conditions favoring quick evaporation, is conducive to caliche formation (Pewe 1978:8).

The surfaces of pediments and upper bajadas often consist of a layer of highly compacted pebbles or cobbles known as desert pavement. Such surfaces appear to be stable, and they sometimes contain archaeological features, such as trails, that would be difficult or impossible to detect on other types of surfaces. Some archaeologists have assumed that desert pavements are ancient, stable surfaces containing remains of great antiquity as well as more recent materials (Hayden 1965,1967; Rogers 1966). Others have cautioned that processes of pavement formation affect the validity of such assumptions (McGuire and Schiffer 1982:16).

The deflation hypothesis of pavement formation suggests that the removal of sediments by wind and water exposes an impervious layer of surface cobbles and gravel (Cooke and Warren 1973; Fuller 1975; Hayden 1976). An alternative hypothesis states that soils containing clay particles swell and contract in response to wetting and drying, forcing pebbles toward the surface (Howard, Cowan, and Inouye 1977; Springer 1958). Experiments conducted by

geologists from Arizona State University provided support for the latter hypothesis (Bales and Pewe 1979). The regeneration of desert pavement was monitored on cleared surfaces. After two years, most plots regained 25% of the original pavement density despite only a half centimeter of deflation. Since all plots contained expanding clays, researchers concluded that stones had been displaced upward. It is possible that a combination of several processes contributes to pavement formation.

The second hypothesis has several implications for archaeological interpretation. Pavements may be less stable than assumed, thus surface materials may have intruded from below. The possibility of rapid formation indicates that pavement surfaces are not necessarily ancient. On the other hand, archaeological sites on pavement have rarely exhibited any depth, and such manifestations as intact stone tool "chipping stations" indicate stability.

Desert pavements often exhibit a reddish brown or black coating known as desert varnish. This layer is composed of clay and oxides of iron and manganese. Both chemical processes involving soil accretion to rock, as well as organic processes involving the action of microorganisms, have been suggested as mechanisms of varnish formation (Elvidge 1979). Moore and Elvidge (1982) rejected the latter in favor of the former, arguing that microorganisms create acidic surfaces corrosive to varnish. Desert varnish forms best in arid zones with alkaline soils and frequent dust storms. Microenvironmental factors affect rates of formation and thus the thickness of varnish layers (Dorn et al. 1986; Moore and Elvidge 1982).

Depositional processes affect the physical structure of archaeological sites. Sites with subsurface remains may exist in alluvial deposits near larger drainages, as evidenced by the Bouse site (Harner 1958) and by buried archaeological deposits explored in arroyo walls north of Wickenburg (Rogers n.d.). Rockshelters and caves may also contain stratified deposits. In general, the accumulation of soil deposits in desert basins appears to be a very slow process, and sites characteristically have little depth (Brown and Stone 1982; Waters n.d.). However, the extent of deposition varies. Sites on upper bajadas have yielded archaeological deposits to depths of 70 cm (Brown 1977; Doelle 1980; Rice and Dobbins 1981). Yet on the basin flats of the Papagueria and the Harquahala Valley, researchers have found Archaic sites with a maximum depth of 10 cm (Bostwick 1984; Brown and Stone 1982; Huckell 1979). Brown and Stone (1982:19) suggested that rather than being buried, "desert sites will be subject to forces which cause the lateral movement of cultural material and vertical mixing within the active, surface layer of soil".

Geologic Resources

The region offers a variety of rock types suitable for the manufacture of implements and structures. Fine-grained igneous rocks, such as rhyolite, andesite, and basalt, combine properties of hardness, tenacity, and homogeneity which make them highly suitable for the manufacture of chipped stone tools. Some of these materials have a distinctive geochemical composition potentially useful for source studies: "if viewed in asociation with other mid-Tertiary volcanics in the southwestern Basin and Range Province, the Vulture ultrapotassic rhyolites are unique due to their exceptionally high potassium and silica contents" (Rehrig, Shafiqulla, and Damon 1980:99). Veins of chert, jasper, and chalcedony are known to occur in the Bouse Hills, Little Harquahalas, Soccoro Peak at the west end of the Harquahalas, and Saddle Mountain (Berry 1978; Keith 1978; Varga 1977). In general, superior raw materials for chipped stone tools are concentrated in the mid-Tertiary volcanic ranges and are relatively rare in the mountains of the metamorphic core complex.

Obsidian in the form of small nodules or "Apache tears" is known to occur in the Vulture Mountains and the gravels of the Tonopah Desert and Hassayampa Plain. Brown (1982) conducted geochemical and distributional analyses of Vulture obsidian. She concluded that aboriginal use of the Vulture source was primarily for local procurement and distribution in the area west of the Agua Fria River (Brown 1982:240). The Vulture source is the only known occurrence of obsidian within a 50 mile (80 km) radius. Other deposits are reported in the Kofa Mountains to the southwest and the Bradshaw Mountains and Burro Creek area to the north (Gifford 1936; Jeter 1977; Rogers n.d.).

Sedimentary and metamorphic rocks are less easily flaked although they are suitable for the production of grinding implements, anvils, and hammerstones. In southwestern Arizona, materials commonly used for such purposes include coarse-grained or vesicular basalt, granite, and quartzite. These are present in many of the regional mountain ranges.

Southwestern Indians used minerals for both practical and aesthetic purposes. Modern rockhounds collect Apache tears from the Vulture source and fire agate from Saddle Mountain. The Mohave obtained quartz crystals in the Eagletail Mountains (Bean et. al. 1978). Hematite and chrysocolla, raw materials for pigments, occur in the Harcuvar Mountains (Keith 1978).

Landforms can be considered as resources. Caves, rockshelters, and large boulders provide areas for shelter and storage. Bedrock surfaces can be transformed into grinding areas. Peaks, mountain ridges, and isolated hills are vantage points from which it is possible to survey weather patterns and the movements of game animals and humans over a wide area. From the ground, distinctive topographic landmarks can be used to orient trails. Finally, natural features which facilitate travel, such as mountain passes, can be considered as resources. Among others, these include Cunningham Pass in the Harcuvars and Granite Wash Pass between the Granite Wash and Little Harquahala ranges.

HYDROLOGY

Western Arizona is located in the southwestern portion of the Colorado River Basin. The Colorado drains an area of over 244,000 square miles (Castetter and Bell 1951). Its flow is derived largely from precipitation in the Rocky Mountains. In southern Arizona, its principal tributary is the Gila River. The Colorado and Gila rivers are the most reliable and productive water sources in southwestern

Arizona. Even so, only portions of the lower Gila River carried water in dry years (McGuire and Schiffer 1982:22).

Three rivers pass through the study area. Flowing west to the Colorado River, the Santa Maria and Bill Williams rivers form a portion of the study area's northern border. The Bill Williams River commences at the confluence of the Santa Maria and the Big Sandy rivers, the latter draining the area to the north. Both the Bill Williams and Santa Maria are "perennial interrupted" streams (Wolcott, Skibitzke, and Halpenny 1956). Surface flows vary greatly from year to year in response to variation in upland precipitation. Certain reaches tend to be perennial, while water flows below the surface in other areas. The Bill Williams River, perennial at its point of origin, formerly went dry two miles (3.2 km) downstream during low stages. It flowed again for several miles below the entry of Bullard Wash (Wolcott, Skibitzke, and Halpenny 1956). The construction of Alamo Dam in 1968 created a reservoir extending to the confluence area during high stages (Stone 1977).

The Santa Maria River drains an area in excess of 1200 square miles of mountainous territory. Its maximum flow has been gauged at 23,100 cfs (cubic feet per second). The Bill Williams watershed exceeds 5,000 square miles, and the maximum flow below the Alamo Dam site has been recorded at 105,000 cfs. Periods of low flow correlate with periods of low rainfall in May, June, September, and October (BLM 1981; White and Garrett 1984).

Flowing south to the Gila River, the Hassayampa River has its source in the Bradshaw Mountains. It drains an area of approximately 1500 square miles. The upper Hassayampa north of Wickenburg has perennial segments, but the lower portion is "little more than a very large wash" (Ross 1923:167). Flows are most likely to occur in winter and early spring. The maximum flow at the Gila confluence has reached 39,000 cfs (BLM 1981; White and Garrett 1984). In pioneer folklore, those who drink the water of the Hassayampa are rendered incapable of telling the truth.

The majority of drainages consist of intermittent washes which carry water for only a short time following rains. Flows generally occur during periods of summer and winter rainfall, particularly following localized summer thunderstorms (Metzger 1957; Ross 1923). Velocity decreases on the basin flats, where flows may dissipate or become sheet floods. In the west central desert, the major washes are Date Creek, Bouse Wash, and Centennial Wash, respective tributaries to the Santa Maria, Colorado, and Gila rivers. Date Creek is perennial only in its upper portions northeast of the study area.

In addition to washes, other surface water sources found in deserts include temporary lakes or playas, charcos, rock tanks, and springs (Bryan 1925). Playas exist in the Basin and Range Province where basins have no external drainage. These lakes were particularly common and extensive in Utah, Nevada, and southern California during the Pleistocene period or Ice Age. There is little evidence for the existence of temporary lakes in the study area during the Pleistocene or later periods. All major basins are linked into the Gila-Colorado watershed system (Ross 1923). Nonetheless, Metzger (1952) suggested the recurrence of temporary playas on the Ranegras Plain. Extensive floods, common in that area after thunderstorms, led to the failure of historic attempts at settlement (Stone and Myers 1982:337). Metzger (1957) also argued that faint remnants of shorelines and terraces indicated the presence of a late Pleistocene lake in the southeastern portion of the Harquahala Valley. He suggested that this lake formed when a temporary lava dam diverted the flow of the Gila River. Ross (1923:17) noted that an area somewhere between the Vulture and Big Horn mountains was "reported to be covered with a shallow sheet of water for several months after heavy rains".

Charcos are natural water holes occurring in the relatively nonporous sediments of adobe flats (Ross 1923). The adobe flats southeast of Lone Mountain in the Harquahala Valley are a likely area for the occurrence of charcos or temporary playas.

Rock tanks or tinajas occur as depressions in bedrock or mountain streambeds. These depressions collect water and often form as "plunge pools" at the base of rock faces (Bryan 1925). Their reliability is dependent on their size and the variable amount of rainfall or spring flow available for catchment. The White Tank Mountains were named for a series of tinajas formed in white granite (Maricopa County Parks and Recreation Commission 1964). Saddle Mountain and the Big Horn Mountains are also reported to contain large tinajas (Ross 1923).

Groundwater is accessible primarily at springs which tap rainwater stored in rock fractures (Bryan 1925:161). Since the rocks are generally less permeable than alluvial deposits, the principal aquifers are the alluvial fill deposits of the basins. In these basins, groundwater generally occurs at depths of several hundred feet, approaching the surface at only a few locations (Kam 1961; Metzger 1952, 1957; Stulik 1974). The water table is less than 40 feet (12 m) deep near Bouse at the mouth of the Ranegras Plain. At the upper end of the Harquahala Valley, a buried rock ridge between the Harquahala and Little Harquahala ranges acts as an underground dam, forcing water upward.

Springs are concentrated in mountain ranges where water circulates in fracture systems and tends to emerge at canyon heads. They are relatively rare in the more arid volcanic ranges. Many springs exist in the higher reaches of the Harcuvar, Harquahala, and White Tank mountains. The words "Harquahala" and "Harcuvar" are apparently derived from Yuman terms for "water", although Gifford links the term "Harcuvar" to the Yavapai word for "cottonwood" (Gifford 1936:250). In the northeastern canyons of the Harquahala range, water may have been available at all seasons (Ross 1923:175). Historic maps designate this area as "Agua del Alio Mundo" (Eckhoff and Riecker 1880). The Spanish "alijo" (Alio?) translates as "alleviation". To the north, there is a series of springs bordering the Santa Maria and Bill Williams rivers. Further north in the Hualapai country, the frequency of springs increases dramatically due to changes in geologic and hydrologic conditions.

Aboriginal Use of Water Sources

The availability of water is the most important limiting factor for human settlement in the northern Sonoran desert. Away from the few rivers, most water sources are

scarce and ephemeral. The more reliable springs are concentrated in particular mountain ranges, while vast areas have only scattered tinajas. The availability of water in tanks, springs, and intermittent washes fluctuates seasonally and annually in response to variations in the amount of rainfall. Water sources are thus unpredictable as well as scarce.

Among the most reliable water sources are the Bill Williams and Santa Maria rivers. These streams are subject to annual and seasonal variations in flow, but the floodplain water table is high, and water can be obtained through digging. In June of 1977, Alamo Reservoir was at a low level following a period of drought. Despite the drought and the summer dry season, water continued to flow at the Bill Williams-Santa Maria confluence.

Groundwater is relatively accessible in the few areas where it approaches the surface. Occupants of a prehistoric site near Bouse excavated wells in order to tap the high water table in that area (Harner 1958; Rogers n.d.). Indians of the California desert also dug wells where groundwater approached the surface (Bean 1978).

The study area is generally too arid for primitive farming strategies. Papago techniques of floodwater farming along washes were employed in areas receiving higher average annual rainfall than west central Arizona (McGuire and Schiffer 1982:39). Crops could be planted on the Bill Williams and Santa Maria floodplains, and the Yavapai did so (Gifford 1936). The lower Hassayampa, normally dry, offered limited possibilities for floodwater farming or irrigation. Its relatively low runoff effectively blocked the expansion of prehistoric Hohokam settlements which occurred along other tributaries of the Gila River (Ackerley 1981). Despite these limitations, the possibility of floodwater farming along washes or alluvial fans should not be discounted in regional settlement models.

CLIMATE

The regional climate has been succinctly described as one of "little and unevenly distributed rainfall, low humidity, and high air temperature with great daily and seasonal ranges" (McGuire and Schiffer 1982:18). The experience of summer in the desert has been likened to "walking between two great fires" (Shreve and Wiggins 1964:18).

The annual pattern of precipitation is bimodal, with winter and summer rains each contributing about 40% of the total annual rainfall (Sellers and Hill 1974). Winter rains occur in December through March when moist Pacific air masses move eastward. Moist air masses from the Gulf of California and Gulf of Mexico contribute to summer rainfall. The superheated desert air has a great capacity for moisture. Clouds form in the afternoon over mountains, producing "monsoon" rains that fall in localized, heavy thunderstorms (Crosswhite and Crosswhite 1982). Summer storms are more localized and geographically variable than winter rains, and they tend to be less dependable (Hasting and Turner 1965). In the Sonoran Desert of west central Arizona, May and June are the driest months, and little rain falls in September or October.

Average annual precipitation ranges from 5 inches (13 cm) at Bouse to 11 inches (28 cm) at Wickenburg. Bouse occasionally receives only one inch (2.5 cm) of rain in an entire year. At the other extreme, most areas received rainfall exceeding 10 inches (25 cm) in 1965 as a result of very heavy winter rains. Amounts of rainfall can vary greatly from year to year at single locations. For example, the Harquahala Valley meteorological station recorded the following figures for the years 1964 through 1969: 6.8, 12.5, 5.1, 8.6, 2.9, and 7.3 inches (Sellers and Hill 1974:3852).

Areal differences in average precipitation are correlated with variations in elevation and latitude (Brown and Stone 1982:22; McGuire and Schiffer 1982:21). The average amount of precipitation rises with the general increase in elevation toward the northeast. The following areas receive the least rainfall: the Buckskin Mountains, Bouse Hills, Butler Valley, Ranegras Plain, and Harquahala Valley. A triangular area of relatively high precipitation is delimited by the Black Mountains, Wickenburg, and Salome. High mountain ranges, such as the Harcuvars, Harquahalas, and White Tanks, intercept rainfall and become "wet islands anchored in a dry sea" (Hasting and Turner 1965:10). On mountain gradients, precipitation may increase as much as 5 inches per 1000 feet (13 cm per 300 m) (Lowe 1964:10). In the upper reaches of these higher ranges, annual rainfall probably varies between 12 and 18 inches (30-46 cm) (Brown 1978).

Average minimum and maximum daily temperatures range from 30 to 67 degrees Fahrenheit in January. In July these temperatures range from 70 to 108 degrees (Sellers and Hill 1974). Extremes exceeding 120 degrees have been recorded at Bouse, Alamo Dam, and the Harquahala Valley. Readings exceed 90 degrees at least 150 days of the year, and the thermometer dips below freezing an average of 36 days at Tonopah and 65 days at Wickenburg.

Temperatures tend to decrease as the general elevational gradient increases toward the northeast. Alamo Dam and Bouse, the westernmost meteorological stations at elevations below 1500 feet (455 m), consistently have the highest average temperatures. Wickenburg and Aguila, both above 2000 feet (606 m), have the lowest average temperatures and the most days below freezing. More localized factors also influence variability in temperatures. Southern slopes are obviously warmer than northern slopes. However, valleys are not necessarily warmer than upper bajadas. Temperature inversions occur when cold air drains down mountain slopes and canyons into low-lying valleys, creating thermal belts along the bajadas (Hastings and Turner 1965:17). This phenomenon is a common occurrence in the McMullen Valley, a basin sandwiched between the steep, high slopes of the Harcuvars and Harquahalas.

VEGETATION

The Sonoran Desert contains the most varied flora of the four North American deserts (Lowe 1964:24; Shreve and Wiggins 1964:33). Plants include a great variety of trees, shrubs, cacti, leaf succulents, and annuals, although grasses are less abundant than in the higher Chihuahuan Desert. Shreve and Wiggins (1964) wrote the basic reference on the patterned diversity of Sonoran Desert vegetation, focusing on the description of principal plant communities and the investigation of habitat requirements and environmental factors in plant distributions. Forrest Shreve, the pioneer ecologist of the Sonoran Desert, traversed west central Arizona many times in the course of fieldwork (Shreve and Wiggins 1964:7).

Environmental Factors in Plant Distributions

The density and distribution of desert plants depends on the complex interrelationships among many environmental factors, including the physiographic, hydrologic, and climatic conditions discussed previously. Although these factors can interact in a complex manner, vegetation patterns are predictable. Shreve and Wiggins (1964:38) concluded that "for a situation of given altitude, physiographic character, and slope exposure, the composition of the vegetation may be predicted with great certainty".

The volume and distribution of rainfall and water sources affect the distribution of plants. Vegetational density and diversity decline as rainfall decreases toward the west. Shreve (1936:15-7) stated that "the plains and mountains which border the lower course of the Colorado River have the smallest flora and the most scanty vegetation of any part of the North American Desert". For example, creosotebush (*Larrea divaricata*) grows more densely in the Harquahala and McMullen valleys than in the basins closer to the Colorado River (Shreve and Wiggins 1964:57). The density of saguaro cacti (*Cereus giganteus*) also declines toward the west. This decline reflects the seasonality as well as the lack of precipitation. Saguaro grows best where summer rainfall is dominant, and winter rainfall is dominant at the western edge of the Sonoran Desert (Hastings and Turner 1965:16).

Riparian zones near drainages and springs suppport a diversity of plants including species rarely found in other localities. In general, the density, size, and height of riparian plants are proportional to the size and permanence of the drainage (Ohmart and Anderson 1982:434; Shreve and Wiggins 1964:59). Cottonwood (*Populus fremonti*), willow (*Salix goodingii*), and mesquite (*Prosopis velutina*) trees grow on the terraces of the Bill Williams and Santa Maria rivers. Lesser drainages support the growth of mesquite, *Acacia* species, wolfberry shrubs (*Lycium spp.*), and paloverde trees (*Cercidium spp.*). Even along small washes, sand retards evaporation, and normally non-riparian plants like saguaro and paloverde tend to concentrate in these areas.

The texture, depth, salinity, and acidity of soils affect plant growth. Soil texture and depth influence the amount of moisture available to plants. Plants that can grow well on the thin, coarse, and well-drained soils of eroding mountain slopes include ocotillo (*Fouqueria splendens*) and species of *Yucca* and *Agave*. Paloverde and most cacti prefer the coarse, well-drained pediment and upper bajada soils. The fine-textured basin soils yield less moisture to plants; creosote can tolerate such conditions (Benson and Darrow 1944; Yang and Lowe 1956). Creosote also favors alkaline soils and can grow where caliche hinders the water supply and root development of other plants. In contrast, paloverde and jojoba (*Simmondsia chinensis*) favor the more acidic soils developed from igneous parent rocks (Crosswhite and Crosswhite 1982:207).

Metamorphic and granitic substrates support denser vegetation than more recent volcanic substrates derived from rhyolite and basalt. According to Shreve and Wiggins (1964:67), "when the vegetation of granitic mountains is compared with that of nearby volcanic ranges, in localities with nearly identical rainfall, it will be noted that there is a heavier cover on the former and a greater number of large perennials". Granitic and metamorphic surfaces weather more rapidly, soils retain more water, and boulders retard runoff. Plants common on these substrates include paloverde, ironwood, saguaro, jojoba, ocotillo, and cholla cacti (*Opuntia spp.*). Creosote, cholla, and ocotillo are dominant on younger volcanic substrates (Crosswhite and Crosswhite 1982:216).

Vegetation zones correlate strongly with elevational differences (Shreve 1922). Climatic conditions contribute to this "factor of altitude". As elevation increases, temperatures drop and precipitation increases. Cold air drains downward through canyons, creating extensions of higher elevation plant communities. On northern slopes, high elevation species may extend as low as 3000 feet (909 m) into canyons (Shreve 1922:271). Mesic plant species and chaparral extend to relatively lower elevations on mountains of greater summit height (Shreve and Wiggins 1964:16).

South-facing slopes are warmer and drier than those facing north, and plant distributions vary accordingly (Crosswhite and Crosswhite 1982:208). Paloverde and saguaro reach their highest stature and density on southern and southwestern slopes. They also extend to higher elevations on these slopes. Other plants, including jojoba and agave, are concentrated on north-facing slopes.

Plants vary in their sensitivity to cold temperatures. Saguaro and ironwood (*Olneya tesota*) are frost-sensitive, while creosote is cold hardy. The distribution of these plants is affected by the phenomena of cold air drainage and temperature inversions, which render the upper bajadas warmer than the low basins during the winter (Hastings and Turner 1965).

Summary Description of the Study Area

Shreve and Wiggins (1964) divided the Sonoran Desert of Arizona into two provinces on the basis of differences in overall elevation and precipitation. The Lower Colorado Valley Province is more arid and includes elevations below 1500 feet (455 m). Much of the study area is included within this zone. Elevations in the wetter Arizona Uplands Province can exceed 3000 feet (909 m), and its vegetation

exceeds that of the Lower Colorado Valley in stature, density, and diversity (Shreve and Wiggins 1964:57). The major portion of the Arizona Uplands Province is located in the southeastern Papagueria, but it extends into the the study area, incorporating portions of mountain ranges and the Bill Williams watershed (Shreve and Wiggins 1964). Map 2-3 depicts major vegetation zones.

Creosotebush and bursage (*Franseria dumosa*) dominate the wide plains, at a higher density in the Arizona Uplands. Mesquite occurs along the larger washes in both provinces. In the Arizona Uplands, vegetation of the basin flats also includes small cholla cacti on the plains and desert willow (*Chilopsis linearis*) and *Acacia* species along drainages.

The density and diversity of plants increase as one ascends the bajada. These changes reflect gradients in soil texture as well as increased rainfall and moisture retention near mountain masses. Some plants such as paloverde become more dispersed and less localized along drainages, although the highest plant densities still occur near washes. The vegetation of upper bajadas and pediments is particularly lush, consisting of paloverde, ironwood, saguaro, ocotillo, creosote, cholla, and other cacti (Shreve and Wiggins 1964:62). Agave, yucca, and jojoba occur on northern slopes.

Upper bajada species extend into mountain valleys and canyons. In the mountains, the plant cover is heaviest in canyons and at the base of slopes. Where channels are clogged with large boulders, mesquite, lycium and other plants grow in pockets of soil. Slope vegetation tends to be sparse, particularly in volcanic ranges.

The northeastern portion of the study area is a transitional zone between the Sonoran and Mohave deserts (Lowe 1964:32-33). In the Aguila Valley, Black Mountains, and eastern Date Creek Basin, Joshuatrees (*Yucca brevifolia*) and Mohave yucca (*Yucca schidigera*) occur in association with paloverde, saguaro, and creosote. The tall yuccas, typical plants of the Mohave Desert, are a distinctive addition to the Sonoran landscape.

Open chaparral, a relatively rare vegetation community in the west central desert, occurs at elevations above 4000 feet (1212 m) in the Harcuvar and Harquahala mountain ranges (Brown 1978). Plants of the chaparral include scrub oak (*Quercus turbinella*), mountain mahogany (*Cercocarpus breviflorus*), squawbush (*Rhus trilobata*), desert ceanothus (*Ceanothus greggi*), and prickly pear cacti (*Opuntia spp.*). Agave and yucca are also present. Juniper (*Juniperus erythrocarpa*) is occasionally encountered in the Harquahalas. Vegetation is particularly diverse at the chaparral-desert interface in the northern canyons.

Botanical Resources

The Sonoran Desert provided a wealth of plant species for use as food, medicine, and raw materials for tools, shelter, and fuel. Hodgson (1982) catalogued over 200 edible native plants in the Sonoran Desert north of Mexico. Gifford (1936) listed at least 30 wild plants that were probably used for food by the Western Yavapai, who historically occupied the study area.

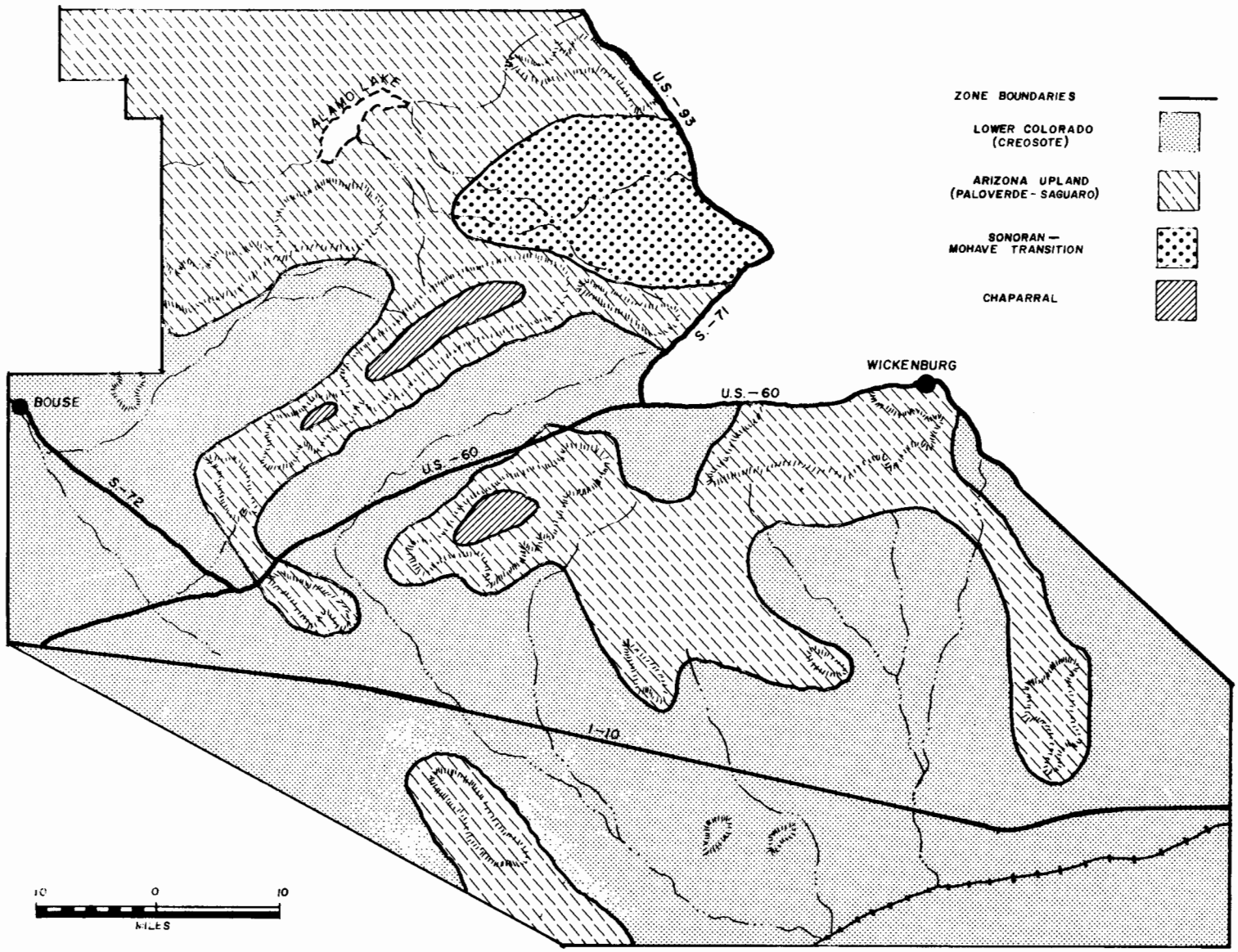
Broad generalizations can be drawn with regard to the productivity of different environmental zones. In general, the abundance and diversity of edible plants is greatest in riparian zones and the upper bajada (Doelle 1980; McGuire and Schiffer 1982:31-38). When such areas also offer game and reliable water, they are particularly rich in exploitable resources. Such zones include the Santa Maria and Bill Williams river terraces and the Harcuvar and Harquahala mountain ranges.

Anthropological researchers have tended to focus on the study of important or "critical" resources rather than environmental zones. Although aboriginal groups can and do exploit scores of wild resources, they tend to concentrate on a much smaller number of staple foods (Felgar and Nabhan 1976:34-36; Gasser 1977:297). Doelle (1976, 1980) and Goodyear (1975) described the characteristics of many important edible plants of the Sonoran Desert. Their seasonal availability, in addition to spatial and annual variations in yield, promoted a mobile seasonal round as the dominant settlement pattern of the Western Yavapai (Gifford 1936).

Important edible plants should include relatively dense, productive, and reliable resources of documented significance to ethnographic and prehistoric groups in the Sonoran Desert of Arizona. Prehistoric evidence of plant use is rare in the study area. The Arizona State University archaeological collections include a dessicated ball of saguaro pulp and seeds taken from a cached pot in a cave within the Harquahala Mountains. In other areas of southern Arizona, preserved prehistoric botanical remains have indicated important wild resources (Gasser 1982).

Important plant resources in the study area probably included agave, tree legumes (mesquite, paloverde, and ironwood), and cacti (saguaro, prickly pear, and cholla). Agave (*Agave deserti*) grows on the slopes of the Harquahala, Harcuvar, and Black Mountains at elevations above 2500 feet (757 m) (Gentry 1982). The heart or caudex and the flower stalk are edible if baked, and the fibrous leaves are a raw material for cordage. Agave hearts are available year-round, and the flower stalks emerge in spring. The Western Yavapai roasted agave in large pits and transported it back to their camps (Gifford 1936:260). Castetter and Bell (1938) wrote the most comprehensive ethnobotanical reference on agave exploitation.

Mesquite, paloverde, and ironwood trees produce edible pods and seeds. These resources are available in the late summer months. The Indians pounded the pods and seeds into meal in bedrock and wooden mortars. Mesquite, primarily a riparian plant, reaches its highest density along the Bill Williams and Santa Maria rivers. Centennial Wash supported a dense mesquite community prior to the extensive pumping of groundwater for agriculture (Berry 1978:30; Metzger 1957). Mesquite trees tap groundwater through long tap roots and produce abundant pod crops in most years. Paloverde and ironwood crops are dependant on rainfall which may vary from year to year, and pod production sometimes fails (Gasser 1982:226; Nabhan, Weber, and Berry 1979; Turner 1963). Desert legume exploitation has been examined in detail by Doelle (1976, 1980), Goodyear (1975), and Nabhan, Weber, and Berry (1979).



MAP 2-3: MAJOR VEGETATION ZONES
Source: Map of S.W. Biotic Communities
(Brown & Lowe 1980)

Saguaro cactus fruits and seeds were a major food resource for the Pima and Papago (Crosswhite 1980). This early summer fruit was harvested by the Western Yavapai (Gifford 1936:260). Large saguaro stands occur on the south-facing slopes and bajadas, but these do not attain the density and stature of stands in the eastern Papagueria, where a dominant pattern of summer rainfall enhances their growth (Hastings and Turner 1965:16). Doelle (1976, 1980) and Goodyear (1975) discussed the economic and nutritional qualities of saguaro. Crosswhite (1980) provided an ethnobotanical review, with an annotated bibliography by Bernard Fontana (1980). The latter included a historical illustration of Indians walking through a saguaro grove near the Bill Williams River (Mollhausen 1858:2:218).

Prickly pear fruits and cholla flower buds from cacti of the *Opuntia* genus are additional resources in the study area. Cholla buds, available in late spring, were pit-roasted by prehistoric and historic groups (Doelle 1976; Gasser 1982; Goodyear 1975). Fruits of the prickly pear ripen in the early fall in the Black, Harcuvar, and Harquahala mountains. The dynamics of Opuntia exploitation were investigated by Goodyear (1975).

The Western Yavapai utilized many additional plants (Gifford 1936:256-261). Greens, wolfberries, and squawberries were gathered near washes and springs. Jojoba nuts were parched in baskets and ground on metates. Yucca fruits and flower stalks were eaten, and acorns were available in the chaparral community of the high summits. Several types of roots, leaves, and stems were used for medicinal purposes. Ocotillo and mesquite branches and saguaro ribs were used in the construction of huts and shades. Agave, yucca and beargrass (*Nolina microcarpa*) were raw materials for basketry and cordage. This list is incomplete; the use of numerous and diverse resources was a foundation of the Yavapai adaptation to the western Arizona desert.

WILDLIFE

The density and distribution of wildlife species are influenced by the availability of food, water, cover, breeding areas, and space. In the western Arizona desert, the distribution of scarce water sources is a powerful limiting factor for many species. Nonetheless, the region supports a variety of mammals, birds, reptiles, and amphibians.

Rarely observed carnivores include the mountain lion (*Felis concolor*) and bobcat (*Lynx rufus*), residents of remote, rocky canyons. In contrast, the kit fox (*Vulpes macrotis*) tends to inhabit the creosotebush community. The ubiquitous coyote (*Canis latrans*) is the most common predator. Other carnivores are the grey fox (*Urocyon cinereoargenteus*) and the ringtail "cat" (*Bassariscus astutus*). Raccoons (*Procyon lotor*) frequent stream and river bottomlands (Cockrum 1964).

Big game species include the mule deer (*Odocoileus hemionus*) and the bighorn sheep (*Ovis canadensis*). Forage, water, and cover are important elements of the mule deer habitat. Water sources are particularly significant. In the summmer, deer require at least six quarts of water per day, and pregnant does need two to three times more (Ough, Miller, and DeVos 1980:59). Deer congregate near water during dry periods, and vegetation near perennial and ephemeral water sources provides food and cover. Washes in areas of relatively flat topography offer cover for resting, travel, and escape. In the study area, the best forage and densest deer populations occur in the chaparral communities of the Harquahala and Harcuvar mountains (Ough, Miller, and DeVos 1980). Creosote flats have the lowest incidence of deer. Mule deer have been displaced from the river floodplains by cattle, and they compete with feral burros in the area of Alamo Lake.

Bighorn sheep were once common in most of the mountain ranges of western Arizona. Their numbers decreased drastically between 1860 and 1960 due to mortality and stress from livestock-introduced diseases, overhunting, and competition with livestock and feral burros (Cooperrider 1985:476). Sheep are presently being reintroduced into desert mountain ranges. The largest populations currently exist in the Kofa and Plomosa mountains west of the study area. Bighorns inhabit the Harquahalas, and they range into the Granite Wash, Little Harquahala, and Big Horn ranges during relatively wet years (Ough, Miller, and DeVos 1980:39). Lambing areas are located on the steep, rugged slopes near Socorro Peak in the Harquahalas and Big Horn Peak in the Big Horn Mountains. In some respects, similar factors influence the distribution of bighorn sheep and deer. They generally range within five miles (8 km) of water, covering wider areas during rainy seasons. In general, desert bighorns inhabit rough terrain in the chaparral and paloverde-saguaro zones, entering the basins only to travel between mountain ranges (Cooperrider 1985).

Pronghorn antelope (*Antilocapra americana*) once ranged in the Harquahala Valley (Gifford 1936:265). They now are found on the La Posa Plain southwest of the study area (Cockrum 1964:258).

Wild burros are the descendants of animals brought to the desert by miners and settlers. Burro populations are concentrated in three areas: Alamo Lake, the Little Harquahala Mountains, and the Big Horn Mountains (BLM 1982:52). They have overgrazed the former two areas, particularly the mountains near the permanent water supply of Alamo Lake. In 1980, the burro population was estimated at 750. By that time, the BLM had already captured nearly a thousand Alamo burros and offered them for public adoption.

Small mammals include desert cottontails (*Sylvilagus audubonii*), black-tailed jackrabbits (*Lepus californicus*), packrats (*Neotoma lepida*), and kangaroo rats (*Dipodomys merriami*). In general, the Mohave-Sonoran transition zone, the creosote flats, and the chaparral have the lowest incidence of small mammals. Highest densities occur in the paloverde-saguaro zone and along drainages of different sizes in all zones (Taylor, Walchuk, and DeVos 1980).

More than 200 species of birds have been sighted in southwestern Arizona (Monson and Phillips 1964). The most common birds include Gambel's quail (*Lophortyx gambelii*), mourning doves (*Senaida macroura*), roadrunners (*Geococcyx californianus*), turkey vultures (*Cathartes aura*), and red-tailed hawks (*Buteo jamaicensis*). Waterfowl sighted near the Santa Maria and Bill Williams rivers and Alamo Lake include ducks, great egrets

(*Casmerodius albus*), snowy egrets (*Egretta thula*), and black-crowned night herons (*Nycticorax nycticorax*).

Amphibians and reptiles include a diverse range of snakes, lizards, and frogs. Rare or declining species are the Gila Monster (*Heloderma suspectum*), the only poisonous lizard in Arizona, and the desert tortoise (*Gopherus agassizi*). Drought and overgrazing limit the forage available to desert tortoises; in conjunction with higher female mortality rates, these lead to population declines (Schneider 1981).

At least 25 species of native fish once inhabited Arizona's streams. Competition with introduced species, habitat changes related to the disruption of river flows by dam construction, the disappearance of springs and marshes, stream entrenchment, and water pollution have all contributed to a drastic reduction in native fish populations (Cole 1981:477).

Large fish species native to the rivers of southwestern Arizona included the Colorado River salmon or squawfish (*Ptychocheilus lucius*), the Gila chub (*Gila robusta*), and the humpback sucker (*Xyrauchen texanus*). Smaller native species existed in the more marginal habitats of springs and nonpermanent streams. The longfin dace (*Agosia chrysogaster*), desert pupfish (*Cyrinodon macularius*), and Gila topminnow (*Poeciliopsis occidentalis*) could tolerate extreme environmental conditions such as flash floods and low water levels (Minckley 1973).

Aboriginal Use of Faunal Resources

Prehistoric and historic Indians of the Sonoran Desert varied in their relative emphasis on the hunting of small versus large game (Bayham 1982; Doelle 1980). Researchers have argued that residents of sedentary villages along the major rivers and washes focused on the specialized hunting of large game, while desert foragers incorporated a broad range of faunal resources into their diet. The Western Yavapai fell into the latter category.

Deer were an important resource for the Yavapai, providing raw materials for clothing and tools as well as food. Bighorn sheep were also hunted. The distribution and behavior of big game species influenced the effectiveness of hunting techniques (Doelle 1980). These animals were usually ambushed near water sources or game trails (Castetter and Bell 1951:214-217).

Rabbits were taken by a variety of hunting techniques including fire drives and spring traps. Young men made a game out of hunting by piling on top of one another on a bush under which a rabbit had taken refuge; the rabbit usually escaped under these circumstances (Gifford 1936:266). Woodrats were caught in traps and boiled or baked whole. The Yavapai were expert at extracting rodents and lizards from burrows and crevices. Doves, quail, and desert tortoises were also hunted. Tortoises were baked in small pit ovens, and pieces of shell were preserved for "medicinal purposes" (Gifford 1936:268). Large, yellow-striped caterpillars were a seasonal delicacy. Archaeological survey crews found that these insects were particularly abundant on the Hassayampa Plain after the heavy winter and spring rains of 1978.

Fish were the major protein source for Indians living along the Colorado and Gila rivers (Castetter and Bell 1951; Spier 1933). The Colorado salmon, Gila chub, and suckers were abundant, palatable, and easily harvested from backwaters and stream margins (Minckley 1973). Fish were not a significant resource to Indians of the interior desert, since they were relatively scarce, small, and rapid. In the study area, the Bill Williams River was probably the best fishing locality.

Aboriginal hunters stood to gain by concentrating their efforts in the more productive wildlife habitats. These areas included the mountains and riparian zones. Prior to the introduction of domestic stock, riparian plant communities near drainages and springs were wildlife oases. In 1854, a party of U.S. Army surveyors camped near the Bill Williams-Santa Maria confluence to await a rendezvous. They exhausted their supplies but survived by hunting ducks, rabbits, and deer (Foreman 1941:220). In contrast, the creosote flats were a poor hunting ground.

THE PREHISTORIC ENVIRONMENT AND HISTORIC CHANGES

Archaeologists have based settlement analyses and predictive models on assumed continuities between past and present environments (Brown and Stone 1982; Doelle 1976, 1980; Goodyear 1975). An interpretive reliance on modern environmental conditions presents obvious difficulties. While physiographic conditions have remained relatively stable, past climatic changes may have affected floral distributions. Localized changes have undoubtedly resulted from modern land use practices. Thus caution must be exercised in the association of archaeological remains with the present distribution of subsistence resources.

With the exception of stratified but undated pollen profiles from the Harquahala Valley (Brown and Stone 1982:79-80), archaeological sites in the study area have yielded little information relevant to the reconstruction of prehistoric environments. This situation reflects conditions in the Sonoran Desert as well as the lack of excavation or discovery of stratified sites. Pollen preservation tends to be poor, and such common desert trees as paloverde and mesquite do not exhibit the distinct growth rings amenable to dendrochronological analyses. However, other data sources and broad regional climatic reconstructions can provide a preliminary view of environmental changes within the past 20,000 years.

Reconstructing the Prehistoric Environment

Three major paleoclimatic sequences, based on different lines of evidence, have generated controversy in the Southwest and Great Basin (McGuire and Schiffer 1982:44-52). Resolution of differences will require additional data as well as an interdisciplinary approach to paleoenvironmental reconstruction.

The oldest paleoenvironmental model, applied over the Southwest and Great Basin, was based on fieldwork by Ernst Antevs and Kirk Bryan (Antevs 1948, 1952, 1955; Bryan 1941). Their studies of geomorphology focused on

alternating episodes of erosion and alluviation extending back to the late Pleistocene period. Antevs (1955:317) argued that droughts and associated reductions in plant cover resulted in arroyo cutting, while alluviation or redeposition occurred during wetter periods. His research resulted in a proposed sequence of four Quaternary climatic phases known as the late Pleistocene Pluvial, Anathermal, Altithermal, and Medithermal.

Antevs (1948:168) argued that the southward movement of continental glaciers resulted in a displaced storm pattern, causing wetter and cooler conditions during Pleistocene glacial advances. Lakes formed in the Great Basin and California desert, but this was a relatively rare occurrence in western Arizona (Meinzer 1922). Plant communities were displaced downward in elevation, and they supported large, now extinct fauna. The earliest cultural level at Ventana Cave in the Papagueria, dated to approximately 9000 B.C., yielded remains of extinct jaguar, ground sloth, tapir, and horse (Haury 1950:141). Mammoth bones, tentatively dated to the late Pleistocene, were recently found in a bank of the Agua Fria River near Prescott (*Arizona Republic* 3/25/84:B20).

The post-Pleistocene Anathermal phase began between 8000 and 7000 B.C. and ended by 5000 B.C. (Antevs 1948:9-11). As the glaciers withdrew, the climate remained more moist than at present but became increasingly warmer and drier toward the end of the phase.

The Altithermal phase between 5000 and 2500 B.C. was much warmer and drier than today's climate. Antevs (1948:12) cited as evidence the dessication of lakes, arroyo cutting, and caliche formation.

The Medithermal phase, extending to the present, was milder and wetter than the Altithermal. Evidence for climatic change included the reappearance of playa lakes and mountain glaciers in the Great Basin and the redeposition of silts and clays in arroyos (Antevs 1948:12-15). Antevs also noted a trend of increasing aridity toward the present.

The Antevs sequence has generated considerable controversy, much of it centered on the relative severity of the Altithermal phase and its effects on human occupation of the deserts. Researchers in the Great Basin suggested that the climatic changes resulted in major settlement shifts including the depopulation of large areas (Baumhoff and Heizer 1965). However, an analysis of floral and faunal remains from stratified caves in the eastern Great Basin revealed no major shifts in patterns of settlement or resource use (Fry and Adovasio 1976:70). The authors concluded that "in the case of human adaptation as in the case of human settlement patterns, the Altithermal interlude in the Eastern Great Basin is an event of little or no consequence". They conceded that temperatures may have been slightly higher than those of the previous phase. Such arid regions as southwestern Arizona may well have been used less intensively during that period.

Paul Schulz Martin (1963 a,b) used pollen data from southeastern Arizona to challenge Antevs' scheme and to present an alternative climatic reconstruction. He agreed that the late Pleistocene was a cool, moist period with a downward shift in life zones of as much as 3000 feet (909 m) (Martin 1963a:vi). Otherwise, he argued that post-Pleistocene conditions were stable and similar to those of the present. To Martin, the fossil pollen record indicated wetter rather than drier conditions during the Altithermal phase. He suggested that Antevs mistook fossil evidence of riparian conditions for evidence of pluvial conditions and that a shift to summer dominant rainfall, rather than aridity, contributed to arroyo cutting (Martin 1963b).

Antevs (1962), Sayles (1965), and Haynes (1968) responded with criticisms of Martin's study. They stressed the link between arroyo cutting and drought, and they argued that sediments of Altithermal age were missing from Martin's profiles. However, Schoenwetter and Dittert (1968) reemphasized the link between channel entrenchment and summer dominant rainfall.

The third and most recent approach to paleoenvironmental reconstruction has been the analysis of fossilized packrat (*Neotoma*) nests (Wells 1976; King and Van Devender 1977). Packrats construct nests from fragments of vegetation obtained within a 100 meter radius of the den. The nests are cemented with urine, and these indurated masses can survive for thousands of years in rockshelters and caves. The organic constituents provide samples for radiocarbon dating. Packrat nests represent a local index of environmental conditions, in contrast to pollen samples, which contain windborn specimens from a broad region. Interpretive problems include complex nest stratigraphy and the probability that packrat nest remains represent preferred plant species rather than an unbiased sample of the local environment.

Fossilized packrat nests have been collected and analyzed from several locations in western Arizona, including the New Water and Kofa mountain ranges, Picacho Peak north of Yuma, and Artillery Mountain near Alamo Lake (Burgess and Nabhan 1983; Cole and Van Devender 1984; King and Van Devender 1977; Van Devender and King 1971; Van Devender and Spaulding 1979). These data have contributed to the reconstruction of Quaternary vegetation change in western Arizona.

From late Pleistocene remains (20,000 to 9,000 B.C.), researchers inferred that the climate was one of cool summers, mild winters, and winter dominant precipitation (Van Devender and Spaulding 1979). Many of the plant species found in packrat middens are presently responsive to winter rainfall. Up until 16,000 B.C., pinyon pines (*Pinus edulis*) extended down to elevations of 2200 feet (667 m). Juniper woodlands and chaparral species existed down to 1500 feet (455 m); plants included juniper, scrub oak, beargrass, ceanothus, and yucca. A xeric juniper-yucca woodland existed between 1500 and 1000 feet (455-303 m). There were few plants now characteristic of the Sonoran Desert. However, arid conditions persisted below 1000 feet (303 m) in the Colorado River Valley. This zone, a "desert refugium" for desertscrub species, contained creosote and Joshua trees (Cole and Van Devender 1984:58).

During the early Holocene period between 9000 and 6000 B.C., juniper-scrub oak woodlands persisted. Creosote increased its range, and creosote-bursage communities became well established below 1000 feet (303 m). The slow

glacial retreat inhibited the development of summer monsoon rains and the expansion northward of desert plant species.

After 6000 B.C., the retreat of the early Holocene juniper woodlands appears to have been widespread, synchronous, and rapid (Van Devender and Spaulding 1979:707). Woodland and chaparral species retreated upward and northward, and they were replaced by modern Sonoran Desert plants including saguaro, ironwood, paloverde, and ocotillo. Climatic conditions approximated those of the present, and researchers found little evidence for an Altithermal interval. Van Devender and Spaulding (1979:707) concluded that "later fluctuations in the structure and composition of the plant communities in the Sonoran and Mohave deserts were of small magnitude and were relatively minor events within the present vegetational regime".

Surface and subsurface pollen samples from the Harquahala Valley portion of the Granite Reef Aqueduct provided indications of past environmental conditions (Brown and Stone 1982:79-80). These data must be interpreted with caution. The subsurface samples were collected up to depths of one meter from undated sediments within archaeological sites. Preservation was poor, and the samples yielded small numbers of pollen grains. Finally, airborn pollen can travel great distances, as indicated by small amounts of pine pollen in the surface samples. Oak pollen occurred in subsurface but not in surface samples. The pollen record also indicated a more lush growth of mesquite along Centennial Wash in the past, although frequencies may have been biased by prehistoric exploitation of this resource.

In summary, evidence indicates that late Pleistocene and early Holocene environments were quite different from those of the present. For the past 5,000 years, floral and climatic conditions have been fairly stable. In the southern Great Basin, data from packrat nest studies, pollen records, and stratigraphic and geochemical analyses of lake sediments provide a similar picture (Weide 1982). Within the past five millenia, "short-lived, low intensity climatic oscillations" have characterized the climates of the Southwest and Great Basin (Miksicek 1984; Weide 1982:23).

It is unwise to assume a long-term, direct correspondence between past and present distributions of plant species. However, existing evidence indicates that no radical shifts have occurred within the past several thousand years. In addition, physiographic factors (substrate, aspect, and soil texture) as well as climatic conditions affect the density and distribution of plants, and the former tend to be quite stable (Goodyear 1975:20). Assumptions of environmental stability should be regarded as working hypotheses and starting points for the generation and evaluation of predictive models, subject to modification in response to specific, contrary evidence.

Historic Modifications

Widespread changes in the southern Arizona landscape have occurred within the past century (Dobyns 1981; Hastings and Turner 1965). Arroyo cutting, the loss of riparian habitat, and shifts in the composition of plant communities have been attributed to both climatic shifts and historic land use practices.

Hastings and Turner (1965) conducted a diachronic study of vegetation change by examining documentary sources and photographs taken at the same localities at different points in time. They focused on the woodlands, grasslands, and high desert of southeastern Arizona, where changes had been more noticeable and drastic than those in the lower, more arid deserts of western Arizona. However, several study plots were located in the Lower Colorado Valley Province in northern Sonora.

A period of arroyo cutting began in the late 1800s and changed the character of major drainages. Channel entrenchment caused the disappearance of marshy areas and riparian vegetation. The woodlands and grasslands of southeastern Arizona were invaded by shrubs, primarily mesquite. In the Arizona Uplands portion of the Sonoran Desert, saguaro populations remained stable on rocky slopes but declined on level areas of homogeneous soil. For desert areas in general, Hastings and Turner found a decline in the density of creosote, paloverde, and mesquite, with some contraction in their distributions. Paloverde had shifted its range upward (Hastings and Turner 1965:270).

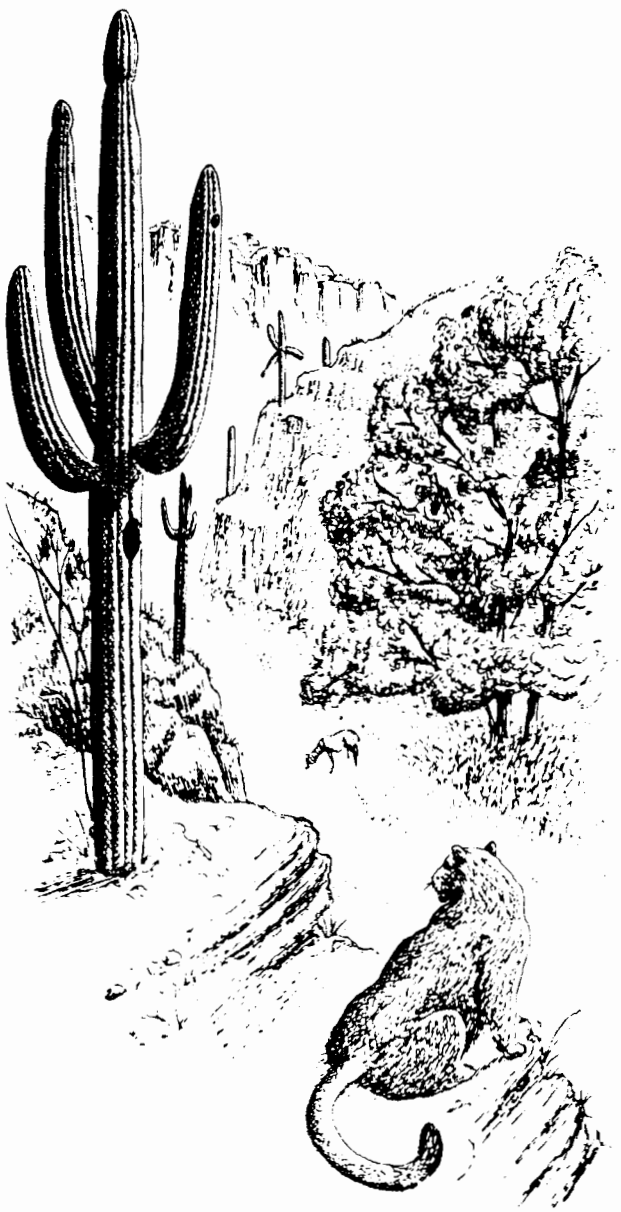
Hastings and Turner provided an insightful discussion of the problems of causal interpretation. They pointed out that it was difficult to isolate the separate effects of cultural and climatic factors, particularly if changes in land use practices and climate had occurred at the same time. Channel entrenchment and shrub invasion had been widely attributed to the reduction of vegetation cover through overgrazing. Although Hastings and Turner did not discount this factor, they noted that grazing by large Spanish herds in the previous century had produced relatively little alteration of the landscape (Hastings and Turner 1965:43). Moreover, channel entrenchment had taken place over the entire Southwest, including ungrazed areas, in the late nineteenth century. Hastings and Turner (1965:280-285) postulated an overall trend of increasing aridity and higher temperatures, and they attributed environmental changes to a combination of cultural and climatic factors. In the low deserts, where grazing had been less intensive, climatic factors were particularly important. Hastings and Turner (1965:6) noted the necessity for further studies: "almost nothing is known about the extent to which a given change in rainfall or temperature can dislocate the range of a species". They suggested that plant species are more stable at the elevational centers of their distributions and that climatic changes tend to affect marginal distributions (Shreve 1915). This approach indicates some long-term stability in areas of highest density. To archaeologists, it implies that prehistoric sites may well be associated with contemporary, high density areas of economic species (Goodyear 1975). On the other hand, marginal fluctuations indicate that sites might occur in areas apparently devoid of economic resources.

Grazing and groundwater depletion are factors possibly contributing to historic environmental changes in the study area. Livestock grazing can alter the distribution and density of plants. An obvious effect is the reduction of grasses and other forage plants. In southeastern Arizona,

an increase in woody shrubs accompanied the destruction of grasslands (Martin and Cable 1974). Niering and Whittaker (1965) suggested that grazing promoted invasion by cholla and prickly pear and that it was an important factor in the demise of young saguaros. Trampling, soil compaction, and browsing of nurse plants can adversely affect saguaro growth (Doelle 1976:40).

Although most areas within the western desert have been subject to grazing, relative intensities of use have varied. Paloverde-saguaro communities have been least affected, since they have a relatively low incidence of palatable shrubs and grasses (BLM 1981). Riparian zones, particularly cottonwood-willow communities along major drainages, have experienced the most adverse impacts. Along the Hassayampa, Bill Williams, and Santa Maria rivers, plant growth has been affected by seedling consumption, soil compaction, and bank sloughing.

Long taproots help to insure an adequate water supply for mesquite trees. In the 1920s, Ross (1923) reported an abundance of mesquite along lower Centennial Wash in the Harquahala Valley. Dead and dying mesquite trees now indicate a drastic decline which may be related to the pumping of groundwater for agriculture (Berry 1978:30; Metzger 1957). A similar dramatic decline in mesquite at the Casa Grande National Monument was attributed to a documented historic drop in the water table (Judd, Laughlin, Guenther, and Handegarde 1971). From available indications, it appears that prehistoric groups may have occupied a challenging yet more hospitable environment than that of the present.



CHAPTER 3

THE ENVIRONMENT AND NATURAL RESOURCES OF THE SKULL VALLEY ZONE

In comparison to the desert zone of the study area, the Skull Valley zone is quite diverse in topography and vegetation (Map 3-1). This diversity is related to the abrupt transition between the Desert and Mountain regions of the Basin and Range Physiographic Province (Wilson 1962:87-96). The rugged topography and the rapid increase in overall elevation to the northeast account for a great variety of floral microenvironments.

For prehistoric and historic Indian populations, this relatively lush area offered a variety of resources unavailable to the south, a greater number of reliable water sources, and a greater potential for farming. In accordance with this abundance and diversity of resources, available evidence indicates that Skull Valley area populations were less mobile and that they relied to a greater degree on farming than those residing in the more arid desert zone (Jeter 1977). The desert-based Yavapai bands frequently visited their brethren in the Skull Valley area (Gifford 1936).

PHYSIOGRAPHY AND GEOLOGY

As previously noted, the transition between the Desert and Mountain regions of the Basin and Range Province occurs in the Skull Valley zone (Wilson 1962:87-96). This transition is marked by the Weaver Mountains, which roughly bisect the area from northwest to southeast. The Weaver Mountains are the highest and most massive of the ranges in the study area, reaching a maximum elevation of 6710 feet (2033 m). To the south and west of the Weavers, there is an abrupt dropoff to the low, broad basins and isolated ranges of the Desert Region.

Desert ranges include the Date Creek Mountains, with a maximum elevation of 4800 feet (1455 m). To the northwest, the Santa Maria River cuts through a mountainous wilderness ranging between 3000 and 5000 feet in elevation (909-1515 m). This area incorporates Bismarck Mountain, the McCloud Mountains, and Grayback Mountain.

The Mountain Region of the Basin and Range Province includes the country north and east of the Weaver Mountains. Upland alluvial valleys border the major creeks. These include Peeples, Skull, and Kirkland valleys, all at elevations above 4000 feet (1212 m). They are surrounded by mesas and rugged mountains cut by deep canyons (BLM 1981).

The mountain ranges are composed primarily of Precambrian granite, schist, gneiss, and intrusive granodiorite and quartz diorite (Wilson, Moore, and Cooper 1969). These older rocks are capped by later Tertiary basalt and andesite flows. The region contains extensive remnants of lava flows, primarily basalt, in the Weaver Mountains and the valleys and mountains to the northeast of that range.

Extensive deposits of gold, silver, copper, lead, and zinc occur in Yavapai County (Wilson 1969:160-163). These mineral resources were responsible for the early settlement of the area in the mid-1800s. The mountainous areas have a long history of gold and silver production through placers and the mining of lodes (BLM 1981). Octave and Weaver are among the many ghost towns in the Weaver Mountains.

Regional soil types vary in their chemical and physical composition, depth, and topographic associations, and their patterns of distribution are complex (BLM 1982:46-47; Jeter 1977:26-28). Soil erosion tends to be low except in the vicinity of mines (BLM 1982:46). Deep soils occur on the alluvial bottomlands, and these areas have been reported to contain buried archaeological deposits (Rogers n.d.; Wood 1980).

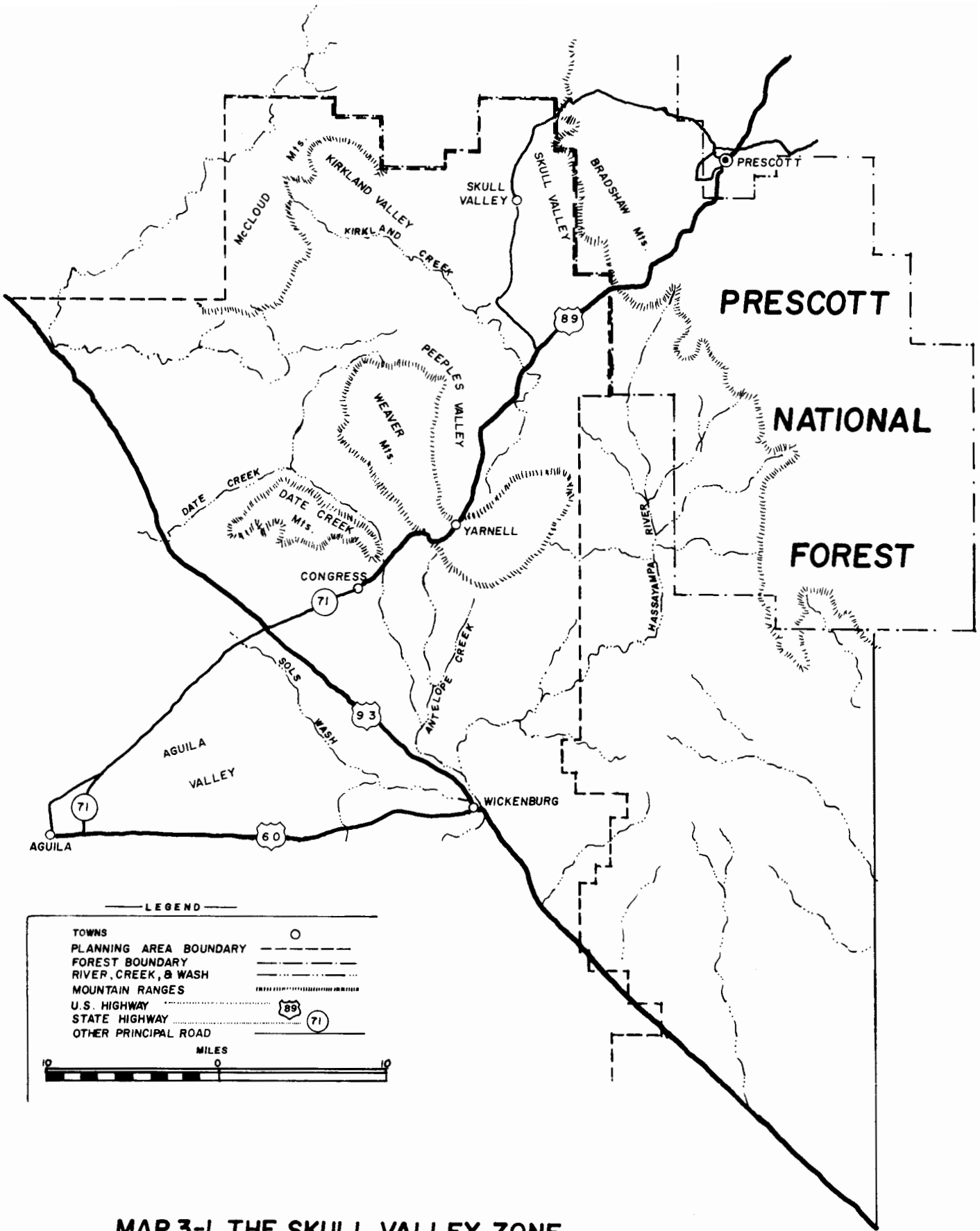
Geologic Resources

Raw materials for the production of stone tools are abundant in the region. Local basalt and rhyolite were the most common materials in the lithic collections from the Copper Basin archaeological sites immediately northeast of the study area (Jeter 1977:390-393). Jasper and chalcedony occur as veinlets in rhyolite formations. Obsidian is not known to occur in the Skull Valley zone, but "Apache tear" sources exist in the surrounding Vulture and Bradshaw ranges (Brown 1982; Jeter 1977:393).

Raw materials for the production of grinding implements include rhyolite, granite, and basalt. The bed and terraces of Kirkland Creek contain abundant vesicular basalt cobbles (Jeter 1977:192). Sedimentary rocks are rare, and only one sandstone implement was found at Copper Basin (Jeter 1977:393).

Jeter (1977:193) was unable to locate good clay sources near Copper Basin, but he suggested that geologic conditions indicated their occurrence in Kirkland and Peeples valleys. Bureau of Land Management (1981) descriptions of mineral resources list clay sources in these valley floodplains. Phyllite and mica, materials commonly used as temper in ceramics, are constituents in existing rock formations.

Jeter (1977:228-233) found that the major known archaeological sites in the Prescott region were located near concentrations of the Lynx loam soil type. The Lynx series of loams and clay loams includes relatively deep soils with high available water capacity and moderately slow permeability (Jeter 1977:158). These are the best agricultural soils in the region. In the Skull Valley area, Lonti-Lynx soils occur along creeks in the Peeples, Skull, and Kirkland valleys (BLM 1982:47). These soils represent a major resource for aboriginal floodwater or irrigation farming. Dry farming occurred in Peeples Valley in the early part of this century, when precipitation levels were above normal



MAP 3-1 THE SKULL VALLEY ZONE

(Russell 1977:333-334). However, Jeter (1977:162) argued that low average amounts of early summer rainfall would have limited the aboriginal practice of dry farming.

HYDROLOGY

The Skull Valley zone is traversed by numerous creeks, many of which are perennial in their upper reaches where they are fed by springs and mountain runoff. Segments of flow over impervious rock dikes typically alternate with dry portions where the water sinks into sands (Jeter 1977:25). Flows vary seasonally in response to variable precipitation; by the early summer, streams sometimes dry up completely.

North of the Weaver and Date Creek mountain ranges, Kirkland Creek and Date Creek are major tributaries of the Santa Maria River. Their watersheds incorporate the major upland alluvial valleys. Date Creek is perennial only in its upper portion near the Cottonwood Creek confluence. For both streams, flows are greatest in spring and late summer and minimal in May and June (Jeter 1977:24).

Streams south of the Weaver and Date Creek ranges flow toward the upper Hassayampa River. They include Weaver Creek, Antelope Creek, and Sols Wash. Segments of the Hassayampa are perennial, and peak flows occur in mid-spring. In the early summer, flows sometimes cease and pools remain in the river and creek bottoms (BLM 1981).

Other water sources include mountain springs. Their frequency is greatest along the northern and eastern edges of the study area, particularly in the bordering Prescott National Forest.

Aboriginal Use of Water Sources

Aboriginal inhabitants had access to many reliable water sources for domestic use. However, they had to cope with seasonal and annual variations in flow caused by varying amounts of precipitation. In the late spring and early summer, it may have been necessary to conserve water or travel further to obtain it.

Where the more reliable streams flowed through areas of Lonti-Lynx soils, the combination of arable land and water would have provided the best conditions for floodwater farming. Such areas occurred along Kirkland Creek. Farming along more ephemeral streams was possible but risky. For example, Jeter (1977:161) observed that summer flows in lower Copper Basin Wash were confined to the channel and would not have reached farm plots on the lower terrace. Simple irrigation ditches could have transported water to arable land, but it is unclear whether prehistoric Indians employed such techniques.

CLIMATE

The Skull Valley zone is higher, cooler, and wetter than the desert zone of the overview area. There is a similar biseasonal pattern of rainfall, with most precipitation occurring in the winter and late summer. Snow occasionally falls on the higher northern peaks.

Statistics on precipitation and temperature have been recorded at several stations including Wickenburg, Walnut Grove, and Stanton south of the Weaver Mountains; and Hillside, Yava, and the Tonto Springs Ranger Station north of the Weavers. The following description summarizes data listed in Sellers and Hill (1974).

With the exception of Wickenburg at 2095 feet (635 m) and Tonto Springs at 4800 feet (1455 m), all stations are located at elevations ranging from 3300 to 3800 feet (1000-1152 m). Average annual precipitation ranges from 14 to 16 inches (36-41 cm). For Wickenburg and Tonto Springs, the respective figures are 11 and 17 inches (28 and 43 cm). In the eastern portion of the area, rainfall exceeded 30 inches (76 cm) in 1965, when winter rains were particularly heavy in western Arizona. Dry years have yielded precipitation in the range of 3 to 8 inches (8-20 cm).

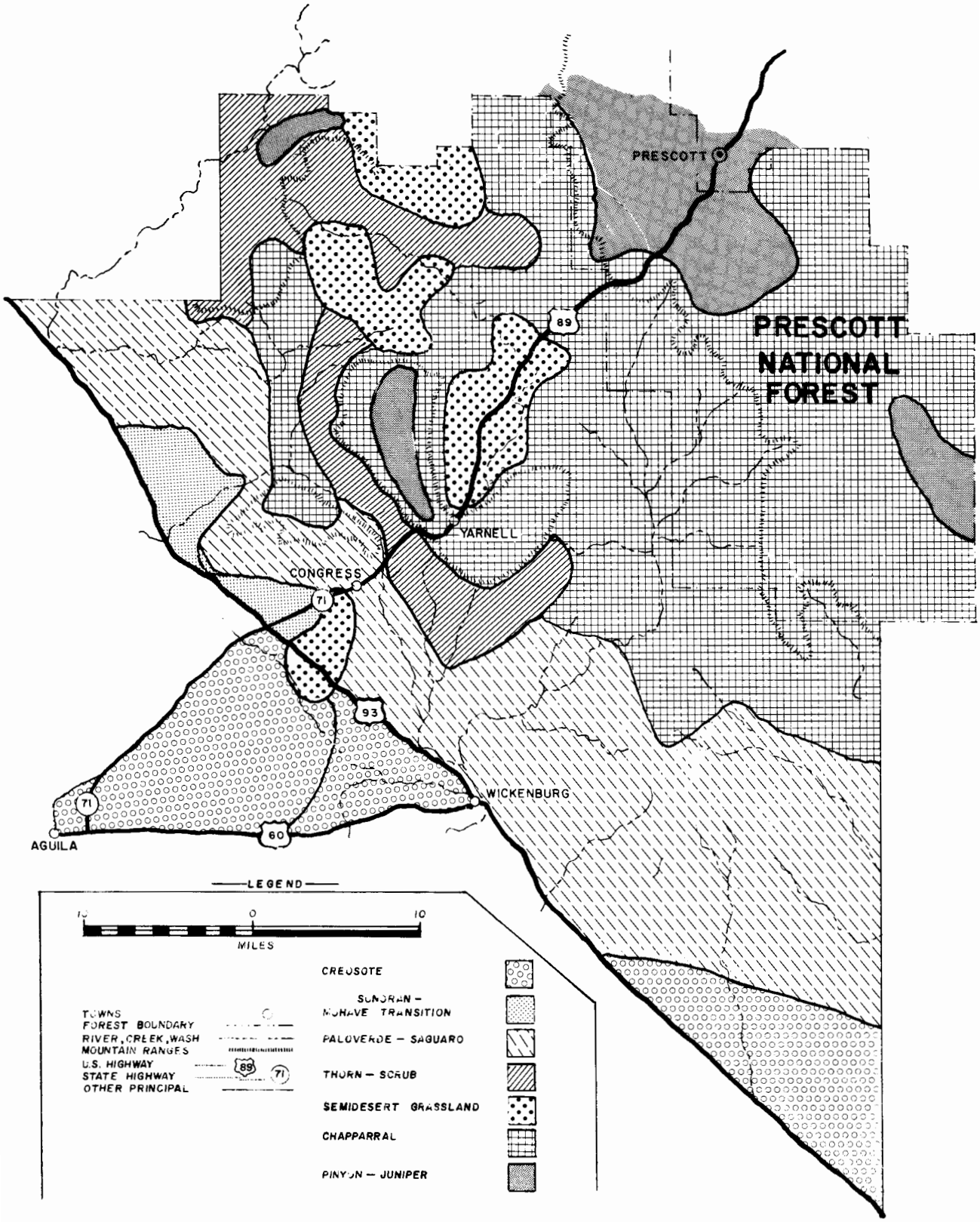
Average daily temperatures in January range from the 60s to minima of about 30 degrees Fahrenheit. In July, average maximum temperatures exceed 90 degrees and range downward to the high 60s. Wickenburg is the warmest spot, with summer readings often exceeding 100 degrees.

At Stanton south of the Weaver Mountains, the growing season has an average duration of 252 days extending from late March to late November. At Hillside northwest of the Weavers, an average growing season of 173 days ranges from early May to late October. The frost-free season at Prescott averages 140 days (Sellers and Hill 1974:400). Judging from their location and elevation, Peeples and Kirkland valleys probably have a growing season similar to that at Hillside. This interval would have allowed sufficient time for the production of aboriginal garden crops (Jeter 1977:22).

VEGETATION

The division between the Desert and Mountain physiographic regions also represents the division between the Lower and Upper Sonoran life zones (Lowe 1964:18). As elevation increases toward the northeast in the study area, the number and diversity of vegetation zones increase in response to higher rainfall, complex topography, and a diversity of soil types (Map 3-2). Areas below 3000 feet (909 m) in elevation, encompassing the zone south and west of the Weaver Mountains, are dominated by Lower Sonoran or desertscrub associations (Lowe 1964). Desert grasslands and chaparral occur in the higher northeastern portion of the study area. The following description of vegetation patterns is taken from Bureau of Land Management (1981, 1982:42) environmental assessments and Jeter's (1977) background studies for the Copper Basin archaeological project.

Desertscrub associations include creosote flats in the Aguila Valley extending north to the Date Creek Mountains. Along Highway 93 west of the Date Creek range, the eastern edge of the transition zone between the Sonoran and Mohave deserts contains a mixture of typical species including paloverde (*Cercidium microphyllum*), creosote



MAP 3-2 : SKULL VALLEY AREA VEGETATION ZONES

SOURCE : B.L.M. 1982, and Brown & Lowe (1980). Map of S.W. Biotic Communities

(*Larrea divaricata*) and Joshuatree (*Yucca brevifolia*) (Lowe 1964:32). A paloverde-saguaro association typical of the Sonoran Desert occurs in the Date Creek Mountains and the vicinity of Wickenburg.

Areas of "desert shrub" or "thorn-scrub" mark the transition from Lower to Upper Sonoran lifezones between 3000 and 4000 feet (909-1212 m). Overgrazing has resulted in an increase or invasion of shrubs in a former desert grassland (BLM 1981; Lowe 1964:40). However, grazing is not the sole factor contributing to the dominance of shrubs. The shallow, rocky soils tend to support a higher density of shrubs and cacti relative to grasses (Lowe 1964:41). Dominant plants are snakeweed (*Guterrezia sp.*), *Acacia* species, and prickly pear cacti (*Opuntia spp.*), in addition to perennial grasses. Areas of thorn-scrub include the Congress-Stanton area just south of the Weaver Mountains, the pass between the Weaver and Date Creek Mountains, Sunflower Flat north of the Date Creek range, and portions of Kirkland and Skull valleys.

At higher elevations in the relatively level upland valleys, desert grasslands with a lower incidence of shrubs exist on deeper soils. Perennial grasses, snakeweed, prickly pear, and shrubby buckwheat (*Eriogonum wrightii*) are dominant. Such areas occur in Peeples and Kirkland valleys and the plateau southwest of Hillside.

Open chaparral exists on plateaus, mesas, and mountains between 3700 and 5500 feet (1121-1667 m). Dominant species include scrub oak (*Quercus turbinella*) mountain mahogany (*Cercocarpus montanus*), and desert ceanothus (*Ceanothus greggi*). There is also a growth of perennial grasses and prickly pear. Major areas of open chaparral occur in Skull Valley and the slopes surrounding Peeples Valley.

Closed chaparral differs from open chaparral in the presence of manzanita (*Arctostaphylos pungens*) and juniper (*Juniperus spp.*) and a more dense cover of scrub oak. It is transitional between open chaparral and the pinyon-juniper zone. The largest stands are adjacent to the pinyon-juniper zone in the Weaver Mountains, and closed chaparral also occurs on the eastern margin of Skull Valley.

Pinyon-juniper woodlands occur in the higher elevations of the Weaver Mountains, on Bismarck Mountain near the Santa Maria River, and at the eastern margin of the study area near Copper Basin. Pinyon pines (*Pinus edulis*) are the dominant species, with scattered juniper and scrub oak.

Riparian or streamside associations include cottonwood (*Populus fremonti*), mesquite (*Prosopis velutina*), and willow (*Salix spp.*) trees in valleys and chaparral canyons. Mixed broadleaf associations are found above 4500 feet (1364 m) in rugged canyons bisecting closed chaparral and pinyon-juniper woodlands. These areas support the growth of walnut (*Juglans major*), ash (*Fraxinus pennsylvanica*), and Emory oak (*Quercus emoryii*) in addition to chaparral species. Such areas include French Gulch and Placerita Creek in the eastern portion of the Weavers.

Botanical Resources

Archaeological and ethnographic evidence indicates that Indians exploited a variety of wild plants in the study area (Gasser 1977; Gifford 1936; Jeter 1977). The Copper Basin archaeological sites yielded remains of nuts, fruits, and berries from walnut, pinyon, juniper, prickly pear, and manzanita plants (Gasser 1977:310). Gasser noted that these resources shared several characteristics: (1) known use by the historic Yavapai; (2) copious amounts of food on individual plants; (3) little difficulty in harvesting; and (4) a tendency to occur in concentrations. The latter three characteristics indicate that the Indians could efficiently exploit these resources.

Gifford (1936:256-257) documented the range of plant resources used by the historic Yavapai. Chaparral species exploited by the Indians included acorns, juniper berries, manzanita berries, and prickly pear fruits.

Acorns of the scrub oak were bitter and were apparently used infrequently by the Yavapai. They were available in August and September. Jeter (1977:168) gathered acorns and stored them for several months, after which their flavor was said to have improved.

Juniper berries ripened in September and October, but good yields were only produced every two to five years (Jeter 1977:175). The Yavapai pounded and ground the berries and molded the meal into cakes for storage.

Manzanita berries ripened in June and July. The Yavapai pounded them and mixed the pulp with water to produce a beverage.

Fruits of the prickly pear cactus were boiled or eaten raw. They were gathered from August through September. Jeter (1977:176) observed a temporal progression in ripening from south to north. In the Yarnell area, fruits ripened in late July, but they were not available until late August in the higher reaches of Copper Basin.

Berries of the squawbush (*Rhus trilobata*) were an additional chaparral resource. Available in August and September, they were mashed and mixed with water to produce a drink resembling lemonade in flavor.

Pinyon nuts were the most important resource of the pinyon-juniper woodlands in the highest elevations of the study area. Available in September and October, their delicious flavor and high fat content justified a rather laborious process of gathering and processing. After picking the pine cones, one had to separate the nuts from the cones and the meats from the hulls. Pinyon yields tended to be unreliable, averaging two to five years between good crops. Local informants told Jeter that there had been one good crop every five years (Jeter 1977:170).

Walnuts and Emory oak acorns were important but relatively scarce resources found along streams in rugged upland canyons. Walnuts were gathered and stored by the Yavapai. Good crops occurred every one to three years in September (Jeter 1977:175).

Acorns of the tall Emory oak were highly prized for their sweet flavor. The Yavapai stored them in baskets covered with stones and hidden under clumps of bear grass. Jeter (1977:169) found Orme Ranch Plain, a probable Yavapai pottery type, near a concentration of Emory oaks.

The upland valley grasslands offered prickly pear fruits, grass seeds, and greens. The latter grew in damp spots near

creeks. The variety of utilized species is unknown. The importance of agricultural resources (arable land and water) may have outweighed that of wild plants in the valley grasslands.

At lower elevations in the study area, the paloverde-saguaro zone offered a variety of resources including fruits of saguaro, prickly pear, and cholla cacti and legumes of mesquite, paloverde, and ironwood. The creosote flats and thorn-scrub zone produced fewer edible resources.

Agave (*Agave spp.*), an important Yavapai food source, grows in the mountains west of Skull Valley and the rugged areas along the Santa Maria River. It is also available in the mountains north and east of the study area (Gifford 1936:259).

Maps compiled for Schroeder's (1959) study of Yavapai land claims show that the Yavapai gathered prickly pear in Peeples Valley, acorns and berries in the Weaver Mountains, and agave along the Santa Maria River. Agave and acorns were also obtained in the mountains west of Skull Valley. The mountains in the Prescott National Forest to the east offered a variety of resources including pinyon nuts and walnuts. Saguaro fruits were obtained east of Wickenburg. In general, desert resources were available in the summer, and higher elevation resources were present in late summer and fall months. The uses of wild plants were not limited to their consumption as food. Gifford (1936) described the use of various species for medicines, structures, firewood, perishable artifacts, and adhesives and sealants.

WILDLIFE

Mule deer (*Odocoileus hemionus*), cottontail rabbits (*Sylvilagus sp.*), and jackrabbits (*Lepus californicus*) are among the most common and conspicuous mammal species in the study area (BLM 1981; Jeter 1977:34). Deer range primarily in the pinyon-juniper and chaparral zones, particularly near dense populations of ceanothus, a favorite browse plant. The Weaver Mountains are deer territory. Jackrabbits prefer relatively open country, such as the upland valleys, while cottontails seek areas of denser cover in the chaparral (Jeter 1977:183-184).

Bighorn sheep (*Ovis canadensis*) and pronghorn antelope (*Antilocapra americana*) historically occupied the study area but are not present today (BLM 1981). Sheep ranged in the Weaver Mountains, and antelope grazed in Peeples Valley. These animals have been replaced by domestic stock.

Other common animals include wood rats (*Neotoma sp.*), coyotes (*Canis latrans*), skunks (*Mephitis sp.*), and bobcats (*Lynx rufus*). Common birds are hawks, Gambel's quail (*Lophortyx gambelli*) and mourning doves (*Zenaidura macroura*). Various species of reptiles, amphibians, and native fish inhabit the region.

Aboriginal Use of Faunal Resources

Mule deer may have been the most important single resource utilized by the Yavapai, providing not only a staple meat source but also bone and antler for tools and hides for clothing (Gifford 1936). Both cottontail rabbits and jackrabbits were hunted regularly. The prehistoric animal bones from Copper Basin indicated that these were also important game species in the past (Bayham 1977).

Deer tend to congregate in larger groups during the rutting season from December to February (Swank 1958:20). The fat content of deer peaks in the fall, then declines to its lowest level in March (Wallmo et al. 1977). Fall and winter would appear to have been the best time for deer hunting. The Yavapai employed both drive and ambush techniques (Gifford 1936:264). Lines of runners drove deer into narrow canyons, surrounded them, and killed them with bows and arrows. For ambushes, single men or small groups wore stuffed deer head masks while they stalked their prey. Downed animals were skinned and butchered, and hunks of meat were carried back to camp and shared among the occupants. Much of the cooking and processing of the meat occurred away from camp. The prehistoric case may have been similar to Yavapai hunting and processing. The Copper Basin faunal assemblage indicated that certain bulky portions of the deer skeleton were not returned to base camps (Bayham 1977:348).

In the spring and fall, the Yavapai burned brush in order to drive rabbits to their burrows (Gifford 1936:266). They then pulled them from the burrows by twisting sticks into their fur. Rabbits were also caught in traps.

"Wekepaka", experts in the use of fire in hunting, led Yavapai antelope drives (Gifford 1936:265). Ten or more hunters lit fires around the antelope herd, circled the animals, and shot arrows as the antelope milled around. Antelope were occasionally taken by stalking, but only the best hunters were successful. Pronghorn bones were present but rare in the Copper Basin faunal assemblage (Bayham 1977).

Other animals taken by the Yavapai included wood rats, quail, and doves. Coyotes were occasionally trapped when venison was scarce (Gifford 1936:266). They were caught in large deadfall traps baited with wood rats.

THE PREHISTORIC ENVIRONMENT AND HISTORIC CHANGES

There is very little data concerning paleoenvironmental conditions in the Prescott region. Studies of fossilized packrat nests in western Arizona have yielded evidence of vegetation patterns during the Pleistocene and early Holocene periods (Cole and Van Devender 1984; King and Van Devender 1977; Van Devender and King 1971; Van Devender and Spaulding 1979). The results indicate that pinyon-juniper woodlands and chaparral species occurred over most of the study area prior to 6000 B.C., with a shift to essentially modern conditions after that time.

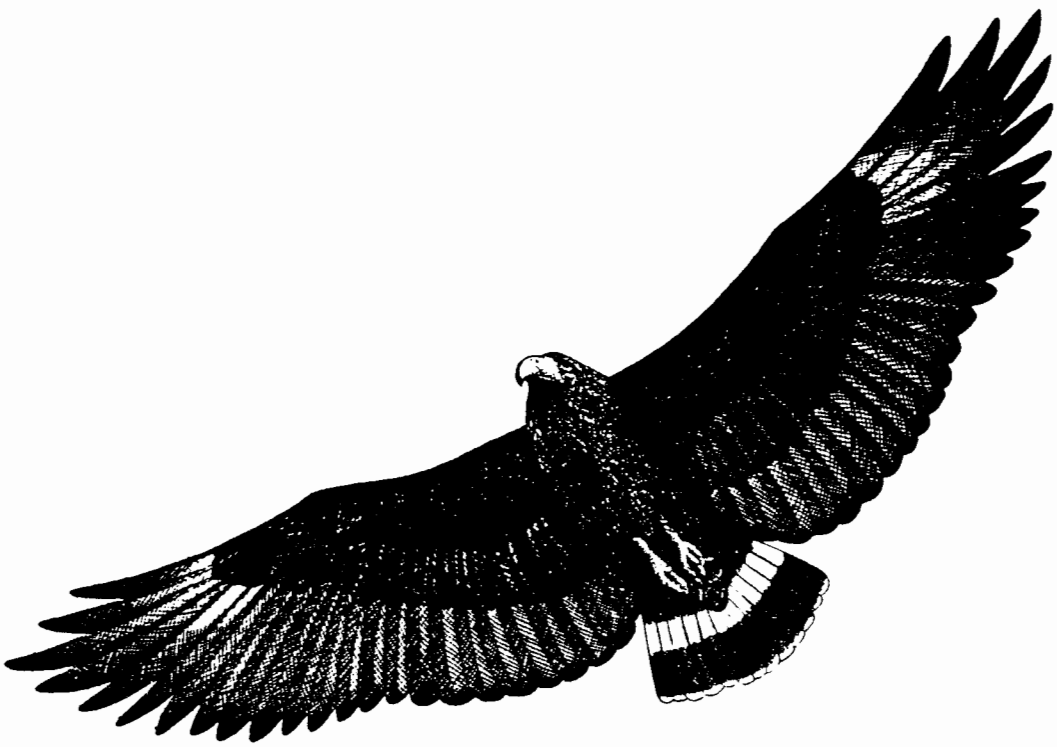
Jeter (1977) addressed the problem of late prehistoric environmental change, since the major occupation of Copper Basin apparently occurred at about A.D. 1100. He utilized dendroclimatological (tree-ring) data in this endeavor, but his analysis was hampered by a lack of tree-ring studies in the Prescott region (Jeter 1977:261). Tree-ring widths respond to variations in moisture.

Researchers have interpolated a series of regional dendroclimatic sequences for the northern Southwest, based on networks of local tree-ring chronologies (Dean and Robinson 1977). Jeter (1977:262-263) used this information to extrapolate a preliminary dendroclimatic sequence for the Prescott region.

On the basis of this model, Jeter concluded that prolonged periods of significantly high or low rainfall probably did not occur between A.D. 700 and 1900 (Gasser 1982:88; Jeter 1977:264). There was little evidence of a period of extreme drought in the late 1200s and early 1300s, when the area was apparently abandoned by prehistoric occupants. The greatest deviations from normal seem to have occurred in the current century, with wet years through 1930 and an ensuing dry trend. These conclusions are provisional; tree-ring data need to be collected from the ponderosa forests and archaeological sites surrounding Prescott.

Gasser (1982) suggested that there may have been periodic advances and retreats in the northern and southern borders of vegetation zones in response to variations in precipitation. These shifts should not have exceeded two or three kilometers. Fires may have promoted the expansion of chaparral (Gasser 1982:91). Gasser concluded that overall changes were minor, but he stressed the need for additional studies.

Historic overgrazing has probably resulted in the expansion of thorny shrubs and prickly pear cacti in desert grassland areas (Gasser 1982). Gasser discussed the difficulty of assessing the magnitude of change, since the above species occur naturally in the grasslands and are not strictly invaders. The southeastern portion of the study area near Wickenburg has been subjected to particularly heavy grazing, and shrub invasion or expansion is likely to have occurred in that area (BLM 1981).



CHAPTER 4
A REGIONAL ETHNOGRAPHIC REVIEW

The Indians of west central Arizona belonged to the Yuman subgroup of the Hokan language family. The Yumans inhabited large areas of southern California, northern Baja California, and western Arizona (Map 4-1). Kroeber (1943) divided the Yuman speakers into four branches: the Colorado delta groups (Cocopa, Kohuana, and Halyikwamai); the river Yumans along the Colorado and Gila (Quechan or Yuma, Mohave, Halchidhoma, and Maricopa); the upland Yumans of western Arizona (Yavapai, Walapai, and Havasupai); and the California or western Yumans (Diegueno, Kamia, Kiliwa, and Paipai). With minor modifications (Kendall 1983), Kroeber's classification still stands.

The distinction between river and upland Yumans is relevant to the study region. Kroeber's divisions reflect not only linguistic and geographic differences but also variation in subsistence economies, settlement patterns, and social organization. All groups gained sustenance from a combination of hunting, gathering, and farming. The river Yuman habitat promoted a more sedentary existence based on floodwater farming and the storage of crops and riparian resources, while the Yavapai were highly mobile hunter-gatherers who planted crops periodically at favorable localities.

The river-upland distinction will structure the presentation of ethnographic information. However, it is important to note that variation existed within as well as between these branches. In addition, flexibility in decisions concerning subsistence and settlement practices, as well as processes of social interaction, may have periodically blurred the distinction.

The principal sources of information are ethnographic studies conducted between 1900 and 1960. McGuire and Schiffer (1982:57) discussed the limitations of the ethnographic literature for southwestern Arizona, such as the limited temporal and geographic extent of studies and the bias introduced by the small number of native informants. The ethnographies present a "memory culture" reconstruction of pre-reservation life. Yet for the majority of studies, those conducted prior to 1940, the cultural "memory" of aboriginal lifestyles spanned only one or two generations. Most aged informants were children or grandchildren of those who had lived in the old way. These oral historians were valuable human resources; some have continued to play this role in cooperation with contemporary anthropologists (Bee 1981; Mariella 1983; Williams and Khera n.d.).

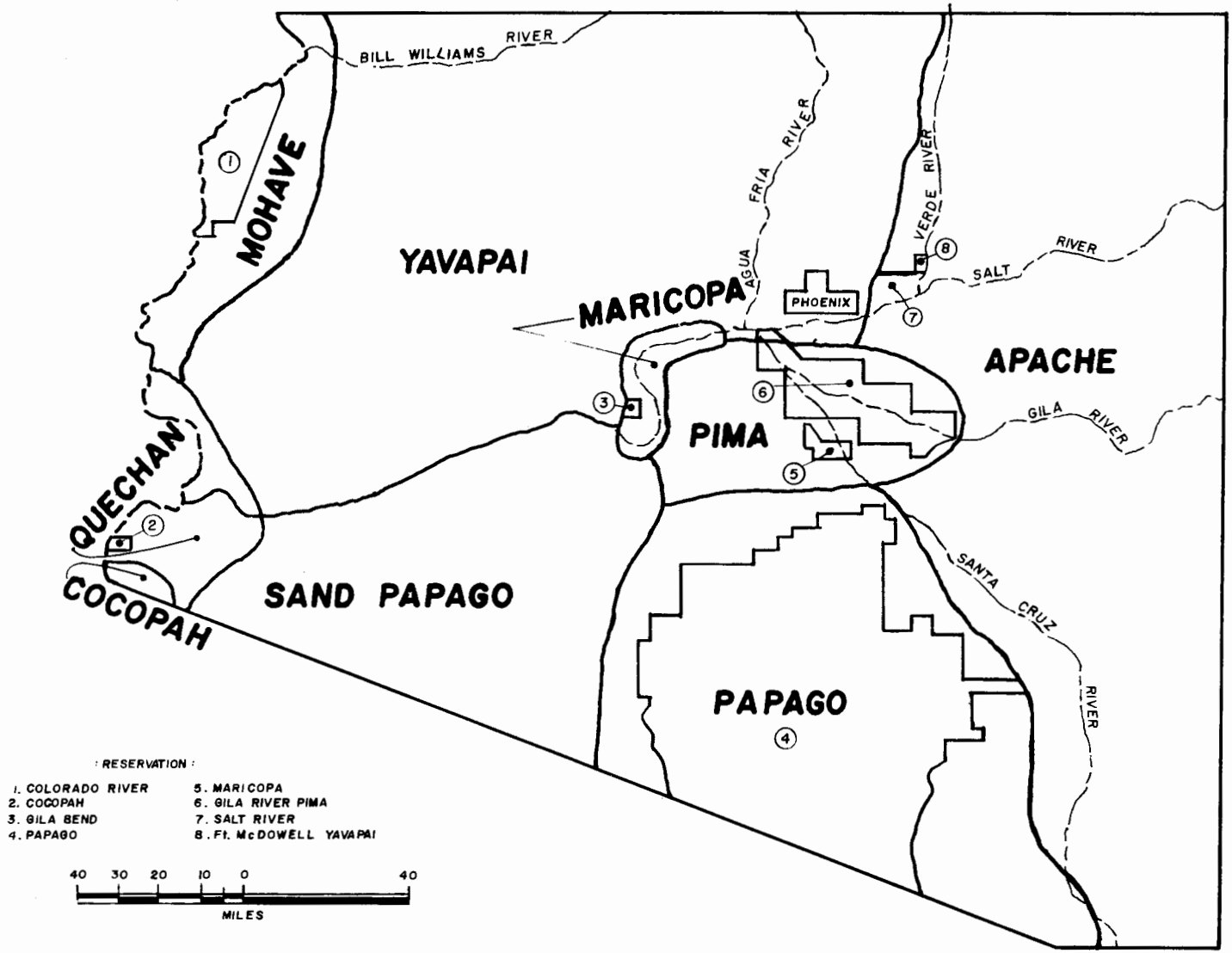
THE RIVER YUMANS

A number of Yuman groups resided along the lower Colorado and lower Gila rivers. Researchers have attempted to correlate historic tribes with ethnic designations assigned by Spanish explorers (Forbes 1965). These studies have indicated a history of frequent repositioning. However, it is difficult to define and track the ancestors of modern tribal groups, since Indian group names often consisted of generic "people" terms or such locational designations as "people to the south" (Hicks 1963). In addition, the Spaniards and Anglos sought to identify and deal politically with separate tribes (McGuire and Schiffer 1982:61; Spicer 1962:9). Recent researchers have emphasized the kinship and overall similarity among river Yuman groups (Bean et al. 1978; Harwell 1979; Harwell and Kelly 1983). Bean et al. (1978) defined the Colorado and Gila river Yumans as a single ethnic entity, the "Panya" (a Yuman term for "people").

The major Yuman ethnographic works were produced after 1900 by anthropologists from the University of California at Berkeley. Alfred L. Kroeber and his colleagues worked in the Boasian tradition of salvage ethnography, seeking to reconstruct aboriginal cultures as they existed prior to the establishment of reservations. Kroeber (1902, 1920, 1925) studied the Mohave between 1900 and 1911, and C. Daryll Forde (1931) conducted fieldwork among the Quechan. These researchers produced comprehensive reports addressing subsistence, social organization, religious practices, and folklore. Leslie Spier (1933) wrote the basic ethnographic description of the lower Gila Yumans. Philip Drucker (1941) of the University of California published Yuman-Piman economic and social trait lists collected for the university's culture element distribution survey.

Other researchers produced both general and specialized studies. William H. Kelly (1977) wrote an ethnography of the Cocopa based on fieldwork conducted during the 1940s. George Devereux, a French anthropologist, reported on Mohave ethno-psychiatry, manners, and religion based on fieldwork between 1930 and 1950 (Devereux 1937, 1950, 1951, 1961). Kenneth M. Stewart, William J. Wallace, and George Fathauer worked among the Mohave during the 1940s and 1950s, contributing to land claims studies and publishing articles on subsistence, warfare, and religion (Fathauer 1954; Stewart 1947a,b,c, 1957, 1965, 1966, 1969a,b, 1970, 1974, 1977, 1983; Wallace 1947, 1955). Specialized works by archaeologists included studies of Yuman pottery manufacture (Kroeber and Harner 1955; Rogers 1936). The eminent ethnobotanists Edward Castetter and Willis Bell co-authored a book on Yuman agriculture and subsistence (Castetter and Bell 1951). Paul Ezell (1963) reviewed Maricopa documentary sources.

Recent studies include Robert Bee's doctoral research among the Quechan during the 1960s and 1970s. Bee (1981) described the history and consequences of changing federal policies on the Quechan. Recent studies of Maricopa social organization and ethnohistory by Henry Harwell (1979) have questioned the validity of the tribal concept and stressed the unity among the river Yumans of the Gila and the Colorado. Bean et al. (1978) summarized the ethnographic literature and recorded Indian reactions to the construction of the Palo Verde to Devers transmission line and its potential impacts on modern reservations and aboriginal use areas.



MAP 4-1: 19th CENTURY TRIBAL LOCATIONS & MODERN RESERVATIONS
(Based on McGuire & Schiffer 1982:60)

The Colorado River Yumans

The historic Colorado River tribes, the Mohave, Quechan, and Cocopa, shared a similar habitat, subsistence and settlement pattern, social organization, and religion. However, different geographic locations along the Colorado River affected resource availability and intertribal contacts, producing some variation in subsistence practices and external social relations. For example, the Cocopa of the delta had access to coastal, estuarine, and mountain resources not available to the Mohave and Quechan (Kelly 1977). This discussion will focus primarily on the latter groups.

Yuman subsistence strategies combined farming, wild plant gathering, fishing, and hunting (Castetter and Bell 1951). Cultivated crops included corn, beans, squash, melons, and grasses. The spring floods of the Colorado River deposited large quantities of silt on the floodplain, constantly renewing the fertility of the soil. Floodwater farming techniques involved the initial clearing of brush followed by the removal of debris and the planting of seeds after recession of the flood. The residual moisture matured the crops, which grew rapidly in the hot sun. Although harvested crops were stored in elevated granaries for the winter, much of the harvest was consumed as soon as it was available. Green corn was eaten in large quantities. During the harvest, people ate three or four daily meals instead of the usual two, and they even kept food nearby at night so that they could eat if awakened (Kelly 1977:32).

Gathered resources were extremely important and were not mere supplements to agricultural foods. Castetter and Bell (1951:179-209) provided a long list of wild plant foods utilized by the river groups, including 37 seed varieties, 16 types of greens, 16 varieties of berries and cactus fruits, and 7 types of roots, tubers, and rhizomes. Most of these resources were present in the riparian environment of the floodplain and terraces, although many were available only in the outlying desert (Driver 1957). Some were staples while others were used only occasionally as famine foods. Staple plant resources were mesquite beans and screwbeans. Ethnographers noted that mesquite was among the few wild foods still used in the twentieth century. Mesquite and screwbeans were "more important than maize . . . and virtually supplied the living through the winter and until the next cultivated crop was ready" (Castetter and Bell 1951:180). Mesquite was abundant, dependable, and nutritious, the primary food stored for winter use (Stone 1981). Although palatable, it did not inspire the gluttony aroused by cultivated foods. Kelly (1977:34) remarked that his experience with mesquite meal would class it with marshmallows as a steady diet.

Fish and small game were the major sources of protein because large game was scarce along the river (Castetter and Bell 1951). In the winter, small hunting parties pursued deer and bighorn sheep in the desert mountain ranges. However, rabbits, wood rats, and ducks were the most important game in terms of their continuous contribution to the diet. Fish constituted the primary protein source, although their availability fluctuated seasonally. Native food species included the humpbacked sucker and the Colorado salmon or squawfish. The Cocopa also exploited marine fish and shellfish from the Gulf of California.

The schedule of subsistence tasks and the availability of different resources varied through the year. Table 4-1 describes the typical annual subsistence schedule. An annual lean period of short supplies occurred in the spring, particularly in April, May, and early June. The duration and severity of this lean time depended on the amount and rate of consumption of stored foods from the previous seasons.

Early observers of the Colorado River tribes described bountiful agricultural harvests (Coues 1900:170-174). Castetter and Bell (1951:66) stressed that the large areas of fertile and periodically inundated soil were highly productive. Yet these and other observers commented on the failure to devote greater time and effort to agriculture. Escobar wrote in 1604 that "it did not seem to me that they had a great abundance of maize, and I attribute this to their laziness, for the very spacious bottoms appeared to offer opportunity to plant much more" (Hammond and Rey 1953:1017). Kelly (1977:1) and Castetter and Bell (1951:249) noted that the surplus of arable land would have enabled an increase in production. Despite this production potential, the Indians rarely stored enough food to last through winter and early spring.

Early observers attributed this agricultural deficit to indolence. Castetter and Bell (1951:69) rejected this value judgment in favor of the consideration of environmental and economic limiting factors. Stone (1981) reviewed economic limitations on agriculture along the lower Colorado River. The planting season was a short period of peak labor demand. Planting had to be accomplished quickly in order to take advantage of floodwater moisture, since there was little summer rainfall. However, since planting coincided with the end of the lean season, other subsistence tasks such as gathering and fishing took precedence. It was the busiest time of the year, and the average family rarely planted more than two or three acres (Castetter and Bell 1951:75).

The massive volume of the spring floods, often as much as four miles (6.4 km) wide, inhibited the construction of food storage facilities close to fields. The floods would have also destroyed canals or water control systems constructed for crop irrigation. However, the Cocopa did construct some levees and ditches on a small scale, a practice which Kelly (1977:27) viewed as ancient and not inspired by contact with Anglo farmers.

The risk of failure was probably the most important factor inhibiting a primary dependence on agriculture. The annual floods were variable and unpredictable in their volume and timing (White 1974). The unpredictability derived from the remote source of most of the Colorado River flow: Rocky Mountain snowmelts. Floods sometimes failed to materialize, or flows were too low to inundate cleared fields. At other times, late or excessive floods necessitated late plantings which produced poor harvests. Late surges washed out seeds or waterlogged the soil, causing seeds to rot. It is difficult to determine the frequency of poor harvests. Between 1850 and 1900, less than half of Mohave and Quechan harvests were successful (Castetter and Bell 1951:8). This period may not have been typical of earlier times, yet unpredictability and failure were facts of life, and poor harvests resulted in famine (Hicks 1963; Stratton 1857).

TABLE 4-1

ANNUAL SUBSISTENCE SCHEDULE
for
COLORADO RIVER YUMANS

Month	Agriculture	Wild Plants	Animals
January	Available stored crops	Stored mesquite, wild tubers	Rabbits, rats, birds, fish
February	"	" Few available	" Low fish supply
March	New farm plots cleared	"	Dependence on hunting
April	Old plots cleared, flood begins	"	Rabbits, birds; Game scarce
May	Annual flood	Cocopa gather "wild rice" of delta	Increase in fish supply as river rises
June	Peak flood	Few available	Fish rabbits, birds
July	Planting	Mesquite beans, amaranth greens	Fish, rabbits
August	Weeding	Mesquite beans, screwbeans	"
September	Green corn	Screwbeans	"
October	Harvest	Greens, grass seeds	" Fish supply diminishing
November	Storage	"	"
December	Stored crops	Relative inactivity	"

Mesquite beans were a more dependable resource and provided a more secure subsistence than did agriculture (Nabhan, Weber, and Berry 1979; Stone 1981). It is interesting to note the difference in consumption patterns between corn and mesquite. Corn was a feast food and a medium of local, informal exchange and long distance trade. Much of the supply was consumed at harvest time. Mesquite was diligently stored each year, with consumption spread over a number of months.

Castetter and Bell (1951:74) suggested an increasing dependence on agriculture as one moved north along the Colorado River. Differences in population density, intertribal trade relations, or access to wild resources might account for such variation. The estimated proportion of cultivated food in the diet ranged from 30% to 50%. These figures are difficult to interpret as their derivation is unclear. As Castetter and Bell noted, these proportions were rarely the same in any two successive years. During poor harvests and the spring lean period, groups intensified their use of mesquite and ranged into the desert to exploit wild resources. Stratton (1857) documented a long-distance gathering foray in his account of a white Mohave captive. Malcolm Rogers believed that agriculture along the Colorado never produced the combined food yield of wild plant and game resources. He cited the "custom of penetrating in small parties back into the desert mountains, over well laid out trails, for a distance of 50 miles or more to advantageous centers for the gathering of wild plant harvests and the taking of game" (Castetter and Bell 1951:74).

According to the ethnographic references, River Yuman material culture consisted primarily of utilitarian household objects and subsistence implements. Although painted designs were common on pottery, aesthetic expression reached its apex in personal adornment through body painting, tattooing, and hairstyling.

Wooden digging sticks were the major agricultural implement. The bow and arrow were used for hunting and fishing. The unbacked willow bows had limited power, and cane or wooden arrows had sharpened, fire-hardened points. Stone points were used infrequently; the most common forms were small and triangular with side notches. Small game and rabbits were also captured with wooden throwing sticks and a variety of traps and snares. Fish were sometimes caught by hook and line, with hooks manufactured from mesquite wood or cactus spines. They were usually harvested from sloughs after the recession of floods, with a variety of implements including fiber drag nets, basketry traps, and large scoops constructed from willow branches. Household implements included paddle-and-anvil manufactured pottery, woven "bird's nest" storage baskets, woven carrying nets, manos and metates, and mesquite log mortars with stone or wooden pestles.

Little clothing was worn in the hot climate of the low desert. Vestments were limited to loincloths for men and willow bark skirts for women. Personal decoration for both sexes incorporated multi-colored body painting, facial tattooing, and ear piercing. Long, dark hair was highly valued. Men proudly rolled their hair into numerous pencil-thin braids, plastered with reddish mud or boiled mesquite sap.

Despite their river location, the Yumans traveled primarily by foot rather than canoe. Known as superb swimmers, they also crossed the river on rush or willow log rafts. Babies were ferried across in baskets.

Storage facilities included elevated granaries and subterranean pits. Elevated storage on roofs and platforms protected stores from moisture, floods, children, and animals. Storage platforms of logs and thatch were about five feet high. Resting on these platforms were pots, baskets, or large "bird's nest" baskets constructed of woven willow stems to diameters exceeding a meter.

Winter houses consisted of rectangular or square pithouses approximately 15 feet (4.5 m) on a side. Four upright posts supported roof beams overlaid by smaller branches and dirt, with walls of similar construction. For warmth, live coals were placed in a central floor depression. Open shades or ramadas were separate structures. Summer shelters near fields were small, round pole and thatch structures.

The Colorado River groups occupied dispersed settlements consisting of sets of related families. Variation in the volume of annual floods affected the distribution of farmable plots, resulting in residential instability (Castetter and Bell 1951:70). As Bee (1981:4) described the situation, "strictly speaking, these settlements were not villages in that their arrangement, composition, and location shifted from year to year, and even from season to season". Many people abandoned the valley and moved to higher ground during the floods. An additional factor in residential instability was the temporary abandonment of farm plots and dwellings after the death of family members.

Although land was loosely inherited through the male line, there were no formalized rules of ownership. Due to the presence of irregular patches of land unsuitable for cultivation, farmland consisted of numerous small, dispersed plots for which boundaries were difficult to define. Castetter and Bell (1951:141) suggested that the specification of boundaries for extended family holdings was a post-reservation phenomenon. Boundary markers were sometimes destroyed by floods, and the resulting disputes were resolved through conciliation or regulated combat. Local groups claimed exclusive gathering rights to mesquite groves and sometimes marked individual trees with bunches of arrowweed (Drucker 1941; Kroeber 1925:737).

There was little accumulation of property. An ethic of generosity prevailed, and variations in food production were leveled through the informal redistribution of food at harvest feasts. Ritual practices also inhibited the accumulation of wealth. Families capable of marshalling the necessary resources sponsored commemorative mourning ceremonies at which were distributed food and property. The possessions of the deceased were destroyed or distributed outside the family. As Castetter and Bell (1951:251) stated, these practices of destruction and redistribution resulted in "the permanent preclusion of any possibility for the family or the tribe to accumulate and build capital goods, resources, surplus food, storage facilities, and equipment from one generation to the next".

The Colorado River Yumans recognized a series of totemic patrilineages, each linked symbolically to a particular

plant, animal, or natural phenomenon. The role of these "clans" is unclear. Stewart (1983:64) argued that they played no direct role in religious or secular life. They were exogamous and thus served to regulate the choice of marriage partners. Due to a tendency toward patrilocal residence, local groups generally included people related through the male line. However, as Kelly (1977:110) said of the Cocopa, "there was a certain grouping by lineages within the delta, but . . . there was no feeling that any particular section of the delta belonged to any specific lineage". Bee (1981:6) suggested that the threat of the United States Cavalry increased tribal cohesion at the expense of patrilineage autonomy.

The tribe was "not a continually obvious grouping" (Bee 1981:7). Tribal members shared a common identity and language, and they cooperated in ceremonies, harvest festivals, and war expeditions against other tribes. Yet there was no centralized leadership. The Mohave and Quechan emphasized tribal solidarity: "in spite of a loose internal social organization, the tribe seems to have regarded itself as very distinct from all others" (Kroeber 1902:279). Intense native warfare and the U.S. military threat may have contributed to nineteenth century tribal "nationalism".

Tribal chiefs and subchiefs had limited authority (Bee 1981:9; Stewart 1983:55). The most influential leaders were probably the local headmen. All leaders gained influence through respect rather than inherited, coercive authority, although *de facto* inheritance of leadership roles occurred in some family lines. Respect and prestige were based on age, social conduct, talents, generosity, and oratorical ability (Kelly 1977:112). The latter quality was particularly important, since decisions were based on discussion and consensus at both settlement and tribal levels.

The Colorado River Yumans conducted few public ceremonies and placed little emphasis on harvest fertility rituals. Life cycle ceremonies focused on the commemoration of deaths. Funeral rites incorporated speeches, dancing, and primary cremations. The kerauk, a commemorative mourning ceremony, lasted six days and concluded with the burning of ceremonial structures (Kelly 1977:96). Shamans conducted private curing rituals but had little role in the few public ceremonies.

Concern with the supernatural was expressed through the importance of dreaming. Individuals acquired supernatural power, skills, and talents from dreams. Oratorical abilities were given expression through dream recitation, the singing of song cycles, and the verbalization of long, detailed myths. Kelly (1977:138) viewed the dream experience as a manifestation of individual and family independence and self-sufficiency.

The Gila River Yumans

The Maricopa Indians historically occupied the lower Gila River between the Salt-Gila confluence and the present town of Agua Caliente (Spier 1933). Their range shifted further eastward in the late 1700s, when Pima and Maricopa settlements consolidated in response to attacks by other Yumans and the Apache (Harwell and Kelly 1983; Winter 1973). The Maricopa were an amalgamation of groups united through a history of migration. These included the "original" and easternmost Maricopa; the Kaveltcadom of the Gila Bend area; and the Halchidhoma, Kohuana, and Halyikwamai, later migrants from the lower Colorado River. These groups were very similar in language, customs, and material culture. They intermarried and co-existed as a "mixed community" (Spier 1933:ix). However, they did recognize group distinctions, and their lore included "ethnic jokes" based on these differences (Spier 1933:46).

Eighteenth century Spanish explorers found "Opa" and "Cocomaricopa" living along the lower Gila River (Bolton 1919 a,b; Coues 1900). The "Opa" upstream from Gila Bend were probably the original Maricopa, while "Cocomaricopa" likely referred to the Kaveltcadom below Gila Bend (Harwell and Kelly 1983). Ethnographers have argued that all Maricopa groups resided originally along the Colorado, from whence they migrated eastward (Harwell and Kelly 1983; Spier 1933:11). Spier (1933:12) believed that the original Maricopa migrated prior to A.D. 1500, possibly from the vicinity of the Colorado-Gila confluence. The Kaveltcadom, closely related to the Halchidhoma, moved upstream somewhat later. These movements may have occurred in response to conflict and competition over resources (Spier 1933; Stone 1981). The final migration occurred when the Halchidhoma, Kohuana, and Halyikwamai were driven from the Colorado River valley by the Mohave and Quechan. Victims of the intense native warfare of the early nineteenth century, they were forced to abandon the area between Yuma and the confluence of the Colorado and Bill Williams rivers. Moving south, they initially sought refuge with a northern Sonoran group, but the threat of an epidemic within the Sonoran community prompted a final movement to the Gila by 1840 (Spier 1933:14).

In language, subsistence practices, social organization, and religion, the Gila River Yumans were similar to the Colorado River tribes. This similarity "underscores common origins and sustained diachronic contact" (Harwell and Kelly 1983:71). However, environmental differences between the Gila and Colorado rivers, in addition to close relations between the Maricopa and adjacent Pima, altered these shared patterns. As McGuire and Schiffer (1982:94) stated, "adaptation and material culture reflect the Maricopa Colorado River heritage as applied in a different social and natural environment".

The Maricopa utilized a range of resources similar to those exploited by the Colorado River Yumans. However, there were differences in scheduling and emphasis. In general, the Gila River groups relied to a lesser extent upon agricultural produce and fish, with relatively greater emphasis on the use of mesquite and small game (Castetter and Bell 1951; Spier 1933).

Agricultural techniques of floodwater farming were virtually identical to those of the lower Colorado groups. However, the floods of the Gila and Colorado rivers differed in intensity and periodicity. In comparison to the Colorado, the Gila was a stream of low gradient where floods were mild, slow, and rarely extensive (Castetter and Bell 1951:79; Spier 1933:60). Castetter and Bell argued that the relatively limited floods rendered the Gila floodplain less conducive to floodwater farming. On the other hand, the

flow conditions were more favorable for canal irrigation, practiced by the prehistoric Hohokam and the historic Gila Pima, and by the Maricopa after 1850. Whereas the Colorado River usually produced a single spring flood, there were two annual high water periods on the Gila, resulting from melting snow and later from summer rains along the upper tributaries. Floods occurred during winter and midsummer, enabling two plantings, in February and July (Spier 1933:49). This dual harvest reduced the relative severity of the spring lean period along the Gila.

The typical annual subsistence schedule is shown in Table 4-2. Mesquite prevailed as the staple wild resource. Ironwood legumes and screwbeans were also harvested. The Gila Yumans had access to resources rare along the Colorado, the most notable of which was the fruit of the saguaro cactus. Saguaro fruit was a major resource for the Pima and Papago, and the saguaro wine ceremony figured prominently in their rituals and annual calendar (Crosswhite 1980; Fontana 1980). Spier (1933:56) argued that for the Maricopa, the saguaro harvest provided more "an occasion for celebration and debauch" than a substantial source of food.

Although the Gila River Yumans concentrated on rabbit hunting and fishing, they also went to the mountains to hunt bighorn sheep during the spring. The beavers of the Gila provided an additional game resource. Fishing was an important subsistence pursuit but less so than along the Colorado River. The extensive Colorado floods created sloughs and lagoons which trapped fish, increasing their density and the efficiency of net and scoop fishing techniques. Such conditions were not as common along the Gila River, although the Maricopa fished in the Santa Cruz slough at the northern foot of the Sierra Estrella (Spier 1933:75).

Domestic and subsistence implements were similar to those used along the Colorado River. Long but weak willow bows rarely propelled arrows more than 100 feet (30.3 m) (Spier 1933:132). Side-notched stone projectile points were sometimes added to arrows, but most sharpened reed arrows lacked stone tips.

Historic Maricopa pottery was similar to that of the Pima and Papago; slips were made of red clay obtained from the latter group. Prehistoric Hohokam sherds were collected and ground for use as temper, and their painted designs were copied. Maricopa households utilized a variety of pottery utensils but few baskets. They manufactured only burden baskets for gathering. Winnowing trays were obtained from the Pima.

The Gila River Yumans, unlike the lower Colorado groups, practiced weaving (Spier 1933:110). Men wove cotton blankets and belts on simple horizontal looms. Both the Maricopa and Pima cultivated cotton, and the adoption of weaving probably reflects Pima contact. Archaeological evidence indicates that the prehistoric Hohokam also produced cotton for consumption and possible trade (Gasser 1982:220).

Maricopa houses were built in the manner of Pima structures. These dome-shaped dwellings differed from the earth-covered, rectangular pithouses of the lower Colorado tribes. An interior rectangular frame of posts linked by rafters was surrounded by a circular wall of bent poles tied to the rafters. This framework was thatched and covered with dirt. Houses measured between six and eight meters in diameter (Spier 1933:82). Other structures included ramadas, oval thatched "storehouses" set over pits, and elevated basket granaries.

The Gila River Yumans occupied small, scattered, and shifting settlements. One documented "settlement" of the last century contained houses 50 to 70 meters apart over an area of two miles (3.2 km) along the river (Spier 1933:18-25). Shifts occurred in response to family deaths and seasonal floods. Along some stretches of the river, according to Spier (1933:22), "practically every inch of the valley had at one time or another been the site of dwellings".

In kinship, religion, and social and political organization, the Gila and Colorado Yumans shared a common system (Harwell and Kelly 1983). Public religious events included shared participation in the Piman saguaro wine ceremony, in addition to the traditional Yuman cremation and mourning ceremonies. Public social dances were frequently held, and the Maricopa sang and danced for the Pima in exchange for foodstuffs when supplies ran low.

The dream experience was the foundation of Maricopa religion. Dreams, expressed in song, incorporated spirits associated with particular caves, peaks, and mountain ranges. These natural features have remained sacred (Bean et al. 1978).

THE UPLAND YUMANS

The entire study area is encompassed within the aboriginal range of the Yavapai tribe. Speakers of a major upland Yuman dialect, the Yavapai inhabited a vast and varied territory of over 9 million acres. Mariella (1983) described this area as a triangular zone with its apex near the town of Seligman in the the north and its western and eastern base points near Yuma and the Pinal Mountains south of Globe.

Gifford (1932, 1936) defined three subtribes, each consisting of several regional bands. Mariella and Khera (1983) described four subtribes recognized by the Yavapai: the Tolkepaya, Yavepe, Wipukpaya, and Kewevkepaya. The Tolkepaya (Gifford's "Western Yavapai") inhabited much of the study area, ranging from the Kirkland Valley and Bill Williams River south to the Gila River, between the White Tank Mountains and the Colorado River. The Yavepe occupied the area surrounding present-day Prescott and Jerome. The Wipukpaya lived in the Bradshaw Mountains, middle Verde Valley, and Sedona red rock country. Gifford incorporated the Yavepe and Wipukpaya into the "Northeastern Yavapai". Finally, the Kewevkepaya, Gifford's "Southeastern Yavapai", ranged in the lower Verde Valley, Tonto Basin, and Superstition Mountains. The subtribes were differentiated by minor dialectical variations. Since the vast range of the tribe covered a variety of environmental zones, there were regional variations in subsistence patterns and the extent of reliance on specific resources. In general, the Yavapai were mobile people who followed an annual subsistence cycle of wild resource exploitation with a limited amount of farming. Gifford (1936:252) estimated the total Yavapai population

TABLE 4-2

ANNUAL SUBSISTENCE SCHEDULE
for
GILA RIVER YUMANS

Month	Agriculture	Wild Plants	Animals
January	Floods	Few available	Fish, small game
February	Planting	"	"
March		"	
April		Cholla buds	Bighorn sheep
May	Bean Harvest	Wolfberries	Small game, caterpillars
June	Corn and melon harvest	Saguaro fruit, wolfberries	Small game
July		Mesquite beans	Fish, jackrabbits
August	Secondary floods Planting	Mesquite, screwbeans	"
September		Prickly pear fruit, greens, ironwood pods	"
October		Greens	"
November	Harvest	"	Deer
December	Available stored crops	Wild seeds	"

at 1500, for an average density of one person per 13 square miles. However, according to Mariella (1983), this low estimate was based on historic observations of a population decimated by warfare, disease, and forced displacement (Corbusier 1886).

References to the Yavapai in the historical literature can be difficult to trace, as the tribe was often referred to as Apache, "Apache-Mohaves", and "Apache-Yumas" (Mariella and Khera 1983:53). The similar material culture and lifestyles of the Yavapai and Apache may have contributed to this confusion in nomenclature. At the eastern edge of the Yavapai range, the two tribes shared a common boundary, and they temporarily co-resided at the San Carlos Indian Reservation following their military defeat by General George Crook. The "Mohave" and "Yuma" portions of the above terms may reflect the common linguistic heritage and close intertribal relations with the Mohave and Quechan.

The Yavapai have not been studied as intensively as the river Yumans. William Corbusier, an army physician, observed and reported on the Yavapai at Fort Verde during the 1870s (Corbusier 1886). The basic ethnographies were produced by E. W. Gifford of the University of California during the 1930s (Gifford 1932, 1936). Albert Schroeder reviewed historical documents and produced maps of territorial ranges for land claims studies (Schroeder 1959).

Recent studies have been conducted by anthropologists working out of Arizona State University. Sigrid Khera documented Yavapai oral history through interviews with tribal elders (Mariella and Khera 1983; Williams and Khera n.d.). Patricia Mariella's (1983) dissertation examined the economic transition from aboriginal land use patterns to settled reservation life in terms of resettlement theory.

The Yavapai depended on wild resources, most of which were available seasonally. The entire tribal range included pine forests, juniper-oak woodlands, chaparral, desert, and riparian zones yielding a variety of resources. Local bands varied in specifics of scheduling and use of particular resources, but bands of all subtribes had access to several environmental zones.

The Northeastern Yavapai of the Prescott and Skull Valley areas harvested a rich variety of wild plant foods. The annual subsistence schedule is approximated in Table 4-3. It may have varied from year to year in accordance with local environmental conditions. Agave (mescal), the staple food of the Yavapai, was available year-round. The primary harvest occurred during the winter months when few other resources were available. Tubers were also exploited in winter (Gasser 1977; Gifford 1936; Mariella 1983). Spring resources included leafy greens, berries, and stored agave hearts. The summer season prompted a move to lower desert elevations, where resources included mesquite and palo verde beans and saguaro fruits. Autumn offered a relative abundance of food sources, such as acorns, walnuts, pinyon nuts, sunflower seeds, and yucca and prickly pear fruits found in the chaparral and woodland zones.

The Western Yavapai followed a similar annual round. The desert-based bands utilized some resources not available to the Northeastern subtribe, and they probably made less use of chaparral and woodland resources (Gifford 1936:258). They consumed a greater variety of cactus fruits and legumes including cholla buds and ironwood seeds.

The Yavapai supplemented wild food sources through the cultivation of corn, beans, squash, and melons. Seasonal mobility limited the time and effort devoted to farming. Crops were typically planted, neglected while the people exploited wild resources, and harvested when the planters returned. Mariella (1983) argued that farming may have been a more important pursuit prior to the disruptions of nineteenth century intertribal and intercultural conflict. She noted that subtribes and bands varied in the amount of farming undertaken, reflecting geographic variations in climate, water sources, and available personnel. In the entire Yavapai range, the Verde Valley was probably the most favorable area for farming.

The Northeastern Yavapai planted at Castle Hot Spring east of Wickenburg and Big Bug Creek east of present-day Prescott (Gifford 1936:262). They may have planted crops on patches of arable land near other drainages or springs. Water was more scarce throughout most of the Western Yavapai range. They planted in damp areas along drainages in the eastern portion of their territory near Congress Junction (Mariella 1983). They also planted crops along the Bill Williams River when flows were sufficient (Gifford 1936:263). The westernmost bands sometimes planted along the Colorado River, co-residing with the river Yumans.

Faunal resources included deer, bighorn sheep, pronghorn antelope, rabbits, woodrats, small birds and rodents, chuckwalla lizards, desert tortoises, and caterpillars. The staple was deer, providing not only venison but also raw material for clothing and tools. Antelope were hunted by the Northeastern but not the Western Yavapai. Although these animals then lived in the Harquahala Valley, they were spurned because they "ate toads" (Gifford 1936:265). Fish and waterfowl were also avoided. The river Yumans played practical jokes on the Yavapai by feeding them ground fish bones mixed in cornmeal mush (Gifford 1936:256).

Domestic implements included wooden tongs, digging sticks, bone awls, and grinding implements. Both bedrock and wooden mortars were used with stone "mullers" for grinding, crushing, and pounding. According to Gifford (1936:280), grinding implements of "unknown ancient people" were found and used, minimizing the necessity for manufacture.

Pottery vessels, tempered with fine gravel or ground sherds, included canteens, shallow serving dishes, globular water jars, and cooking bowls. The Yavapai also produced a variety of basketry containers including twined pitched water jars, burden baskets, and parching trays; coiled water bottles, trays, and serving dishes; and wicker seedbeaters (Gifford 1936:283). Raw materials for cordage and basketry included yucca and agave fiber.

Bows were made of mulberry or willow, with cane arrows. Wooden-pointed arrows were used for birds and small game. The Northeastern Yavapai produced chert and obsidian projectile points, deeply serrated by pressure flaking. Obsidian was obtained in the Bradshaw Mountains. The

TABLE 4-3

ANNUAL SUBSISTENCE SCHEDULE
for
NORTHEASTERN AND WESTERN YAVAPAI

Month	Agriculture	Wild Plants	Animals
January		Agave	Deer, rabbits, small game
February		"	"
March	Planting	Greens, berries	"
April		"	"
May		Cholla buds, berries	"
June		Saguaro fruit, berries	"
July		Saguaro fruit, mesquite beans, paloverde beans, screwbeans	"
August		Mesquite, ironwood pods	"
September	Harvest	Prickly pear fruit, juniper and manzanita berries, walnuts, acorns	"
October		Yucca fruit, sunflower seeds, pinyon nuts	"
November		Agave	"
December		"	"

Western Yavapai used a variety of lithic raw materials from the mountain ranges in their territory (Gifford 1936:287).

Both sexes wore buckskin garments and footwear. The Northeastern Yavapai manufactured heavier garments and such items as mittens, as they had to cope with colder winters. Body decoration included male nose piercing, body painting, and tattooing.

Domiciles included rockshelters and caves, huts, and shades. According to Gifford (1936:269), the Yavapai chose to live in the former where they were available for shelter. The Western Yavapai stored food in pots placed in caves. It was understood that visitors could help themselves. In the absence of natural shelters, the people constructed domed, thatched huts. Northeastern Yavapai huts were oval in shape, with a thatch of juniper bark or bear grass. Western Yavapai domed huts were constructed of a willow, ocotillo, or mesquite framework with grass thatch. When Western Yavapai groups resided along the Colorado River, they built rectangular, earth-covered pithouses of the river Yuman type (Gifford 1936:271).

The diversity and dispersed locations of seasonally available resources required a great degree of mobility, often over long distances. Small groups occupied a succession of temporary or seasonal base camps. These local groups, which consisted primarily of nuclear or extended families, included up to 10 families (Gifford 1936:297). The composition and size of local groups changed through time in response to personal conflicts and the relative abundance and concentration of food resources. Groups would periodically coalesce or split into smaller family units in response to changing circumstances (Mariella 1983).

Regional bands, composed of several local groups, were associated with particular geographic areas (Map 4-2). These bands usually traveled within their recognized tracts of land but were welcome in the territories of others. Two bands of the Northeastern Yavapai ranged into the eastern portion of the study area (Gifford 1936:250). These were the Wikutepa and Wikenichapa, whose ranges overlapped. The Wikutepa or Granite Peak band occupied the area surrounding present-day Prescott, incorporating Chino Valley, Skull Valley, and the northern portion of the Bradshaw Mountains. The Wikenichapa or Crown King band ranged over the southern Bradshaws south to the Wickenburg area.

There were three regional bands among the Western Yavapai (Gifford 1936:250). The Hakupakapa inhabited the Date Creek Mountains north of Congress, the Weaver Mountains, and Peeples Valley. The Wiltaikapaya were based in the Harquahala and Harcuvar Mountains on either side of Wiltaika (present-day Salome). They also ranged northeastward to Kirkland Creek and seasonally to Peeples Valley. Their range extended west to the Colorado River. Finally, the Haka-whatapa ("red water" or "desert" people) inhabited the Kofa and Castle Dome mountain ranges west to the Colorado River.

Local groups and bands were advised by headmen who gained their status through prowess in warfare and hunting, wisdom, generosity, and the ability to mediate conflicts. Older leaders supervised the annual round, deciding where to move and camp as well as when and where to exploit certain resources. However, headmen servd a strictly advisory role; "people went where they liked, did not necessarily accept his advice" (Gifford 1936:298).

Yavapai religious practices were dominated by shamanism and curing rituals, with little resemblance to river Yuman religion. Detailed myths concerned supernatural beings associated with geographic features. Daily prayers were addressed to the sun. The dead were cremated and their personal property destroyed. The Northeastern Yavapai burned the corpse on a pyre and did not bury the remains (Gifford 1936:302). The Western Yavapai burned the corpse in a pit far from habitations and filled it in the next day. There were no formal mourning ceremonies.

INTERTRIBAL RELATIONS

The Yuman tribes participated in wide-ranging trade networks incorporating numerous groups in the Southwest, southern California, and northern Mexico (Davis 1961; Forbes 1965; Gifford 1936; Spier 1933). The river Yumans were avid traders and middlemen, traveling as far east as Zuni Pueblo in New Mexico and as far west as the California coast (Bolton 1930; Coues 1900; Forbes 1965; Hammond and Rey 1940; Schroeder 1981).

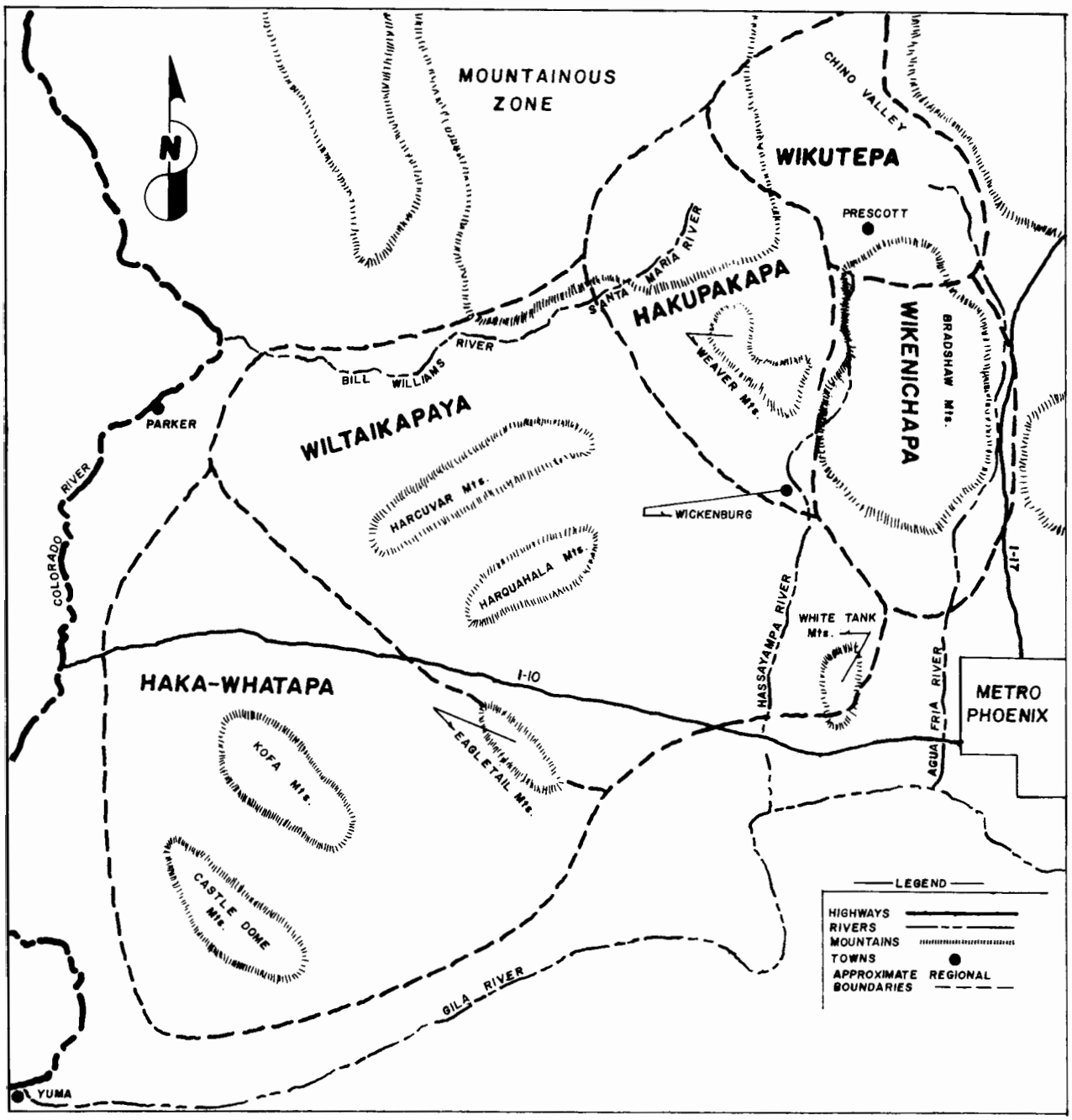
Extensive trade networks incorporated both direct and indirect, long-distance exchange. The latter often involved the movement of such exotic or highly valued goods as marine shell and cotton cloth. Adjacent groups generally traded subsistence goods and manufactured items. Exchange between river and upland Yuman groups typified a general pattern of farmer/hunter-gatherer trade, the exchange of cultivated foods and manufactured goods for animal products and wild resources (Davis 1961; Kroeber 1935; Peterson 1978). For the western Arizona Yumans, specific trade goods and exchange links are described in Table 4-4.

Kroeber (1953:596) described two major alliances of groups from western Arizona, southern California, and northern Baja California. These were loosely organized networks rather than highly structured confederations. Map 4-3, adapted from White (1974:128), depicts the alliance networks.

Groups within alliances maintained amicable relations involving visiting, intermarriage, sharing of food surpluses, cooperation in warfare, and freedom of movement between tribal areas (Gifford 1936; Spier 1933; White 1974). The existence of such wide-ranging alliances probably facilitated long-distance trade.

Relations between the two alliances were inimical; groups in one alliance were enemies of those participating in the other. Conflicts often centered on the shared use of resource zones by adjacent groups (Spier 1933). Intensive intertribal warfare during the eighteenth and nineteenth centuries involved long-distance travel by war parties, surprise raids, and occasional large battles. The last large battle occurred in 1857, when the Quechan were soundly defeated by the Maricopa and Pima (Gifford 1936:304).

Warfare affected patterns of land use. In the eighteenth century, the Maricopa abandoned the Centennial Wash



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MAP 4-2: YAVAPAI REGIONAL BANDS

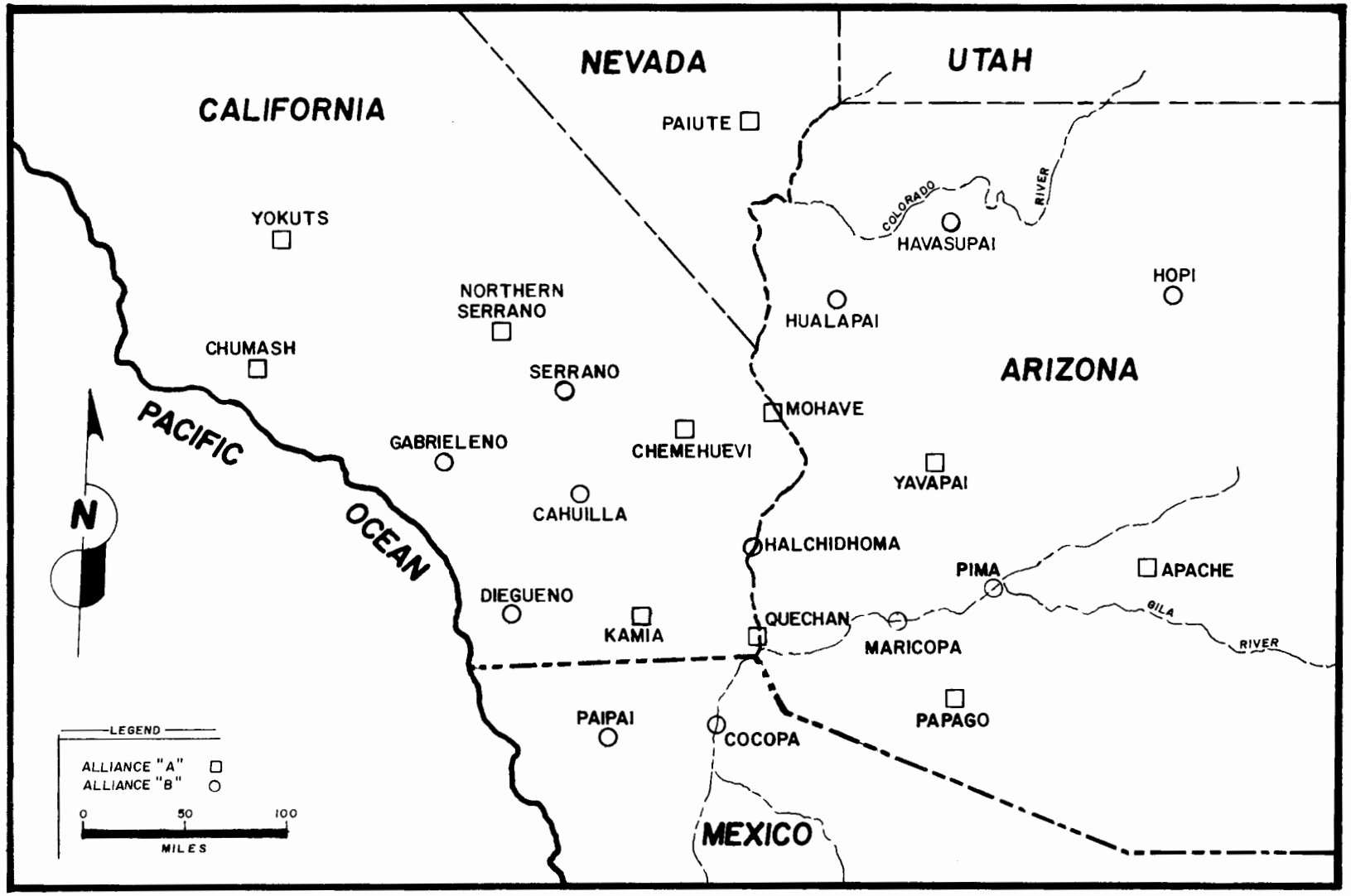
TABLE 4-4

WESTERN ARIZONA YUMANS

INTERTRIBAL TRADE

From	To	Goods
Colorado River Yumans	Upland Yumans	Agricultural crops, mesquite, shell and glass beads; pottery
Colorado River Yumans	California Indians	Pottery, seeds, gourd rattles
Colorado River Yumans	Hopi and Zuni	Marine shell
Gila River Yumans	Hopi	Cotton
Gila River Yumans	Papago	Cotton blankets
Upland Yumans	Colorado River Yumans	Deer and bighorn meat, skins and feathers, agave, baskets, natural pigments
California Indians	Colorado River Yumans	Marine shell, acorns
Papago	Gila River Yumans	Agave, red pigment
Pima	Gila River Yumans	Baskets
Hopi	Others	Cotton cloth

Sources: Davis 1961, Gifford 1936, Spier 1933



MAP 4-3: HISTORIC TRIBAL ALLIANCES
(Based on White 1974:128)

route to the Colorado River, known as the Halchidhoma Trail, in favor of an alternative route well south of the Yavapai range (Spier 1933:43). "Buffer zones" were occupied only infrequently and at great risk. Schroeder (1959:5) stated that a two day journey was required to cross the buffer zone between the Maricopa and Western Yavapai. The risk of attack was great where both groups gathered saguaro fruit (Spier 1933:50).

White (1974) studied environmental and economic factors underlying the dual alliance system. He stressed the precarious nature of subsistence resulting from unpredictability and variability in both wild and cultivated harvests. He argued that alliances facilitated the redistribution of resources through exchange, noting that both alliances included farmers and hunter-gatherers. Further, amity relationships tended to follow an east-west axis, crosscutting predominantly north-south oriented resource zones. Allies thus gained access to resources not readily accessible in their own territories. Enmity relationships correlated with a north-south axis, paralleling the resource zones, indicating that enemies competed for the same resources.

One problem with White's analysis concerns his approach to resource zonation. His north-south oriented environmental zones were defined to the west, but not to the east, of the Colorado River (White 1974:129). This dominant orientation reflects the north-south trend of the coastal ranges as well as the direction of flow of the Colorado River. In Arizona, climatic and associated environmental gradients occur along both east-west and north-south axes. In addition, resource enclaves occur in isolated mountain ranges, and several major drainages flow toward the west. The environmental factors contributing to the emergence of the alliance system are undoubtedly more complex than indicated by White's analysis. Unfortunately, there is little evidence concerning the initial formation or long-term stability of the alliances.

THE HISTORIC DISRUPTION OF NATIVE GROUPS

For Native American populations, the ultimate consequences of non-native contact were profound and irreversible, involving forced resettlement and reductions in population and territorial ranges. These changes in turn altered native economic systems, social organization, and the nature of intertribal relations (Spicer 1962).

The remote and rugged region occupied by the Yavapai and river Yumans provided respite from contact. Prior to the 1700s, there were few direct dealings with Spanish explorers and missionaries. The earliest contacts were brief and infrequent, with little apparent disruption of native economic and social systems. In 1540, Hernando de Alarcon of the Coronado expedition sailed up the Colorado River to the vicinity of present-day Yuma (Forbes 1965; Hammond and Rey 1940). Alarcon presented himself as a "child of the sun", apparently expecting some trouble from the natives, but he encountered little hostility. The Yumans, active participants in the wide-ranging trade networks of the sixteenth century (Riley 1976), had visited Zuni Pueblo and there learned of the Spaniards (Hammond and Rey 1940:134, 140-145). Also in 1540, Melchior Diaz led an overland expedition and attempted a rendezvous with Alarcon. Luck was not with him; he missed the rendezvous, was attacked by Indians, and finally died in a freak accident (Forbes 1965:89-94). Sixty-four years passed from the time that Diaz fell on his lance to the next contact between river Yumans and Spaniards. In the interim, the Espejo and Farfan expeditions encountered the Yavapai in the Verde Valley between 1582 and 1598 (Forbes 1965:102; Schroeder 1959:50). The Spaniards, preoccupied with Chihuahuan mining operations and the advancement of the New Mexican frontier, made only infreequent trips to west central Arizona.

In 1604, Juan de Onate traveled from New Mexico to the Verde Valley. He continued on to the Colorado delta by way of the Bill Williams River. Two Franciscan monks documented this journey, providing descriptions of the Indians who were friendly despite their consumption of several Spanish horses (Bolton 1908; Hammond and Rey 1953). For the remainder of the seventeenth century, the Spaniards concentrated on the conquest of Sinaloa and Sonora, extending their frontier northward.

Beginning in 1697, Father Kino of the Jesuits ventured north, visiting and later establishing missions among the Piman Sobaipuri, Papago, and Gila Pima of southern Arizona. His travels took him along the Gila and Colorado rivers. In 1745, the Jesuit Sedelmayr visited the Colorado River Yumans, traveling across the desert by means of an ancient trail between the Gila River and the area of present-day Blythe on the Colorado River (Forbes 1965:136).

Although Spanish-Yuman contacts were sporadic through most of the eighteenth century, the Yumans were not exempt from certain economic, social, and demographic changes affecting the natives of the Southwest and northern Mexico. The effects of Spanish colonization incorporated three major trends relevant to Yuman populations: (1) higher mortality rates associated with the spread of introduced diseases; (2) the introduction of livestock and new cultigens; and (3) the intensification of native warfare prompted by the Spanish slave trade.

There is little direct evidence of Yuman epidemics. The historic demographic situation is obscured by two factors: the dubious accuracy of population estimates obtained during brief Spanish visits, and the possibility of population increases from major episodes of immigration. In southeastern California, the dessication of freshwater Lake Cahuilla (the Salton Sea) after A.D. 1400 or 1500 may have caused resident Yuman groups to migrate to the Colorado River valley (Rogers 1945; Sykes 1914; Weide 1976; Wilke 1976). In 1604, chroniclers of the Onate expedition noted particularly dense populations south of the Gila-Colorado confluence, the portion of the Colorado River most accessible to the Salton Basin (Hammond and Rey 1953:1021). The deleterious effects of introduced diseases may have been obscured by population increases resulting from migration.

The situation in adjacent regions provides an indication of the possible impact of introduced diseases. Documents reveal that the Indians of Sonora suffered epidemics and

drastic population reductions during the seventeenth century (Dobyns 1976). The Yaqui population, originally estimated at 60,000, may have declined by as much as 50,000 in 80 years (Sheridan 1981:77). The Pima, Papago, and Sobaipuri were also ravaged by epidemics, as reported by Velarde in 1716 (Karns 1954) and Garces in 1770 (Coues 1900). Forbes (1965:130) noted a decline in Pima numbers as estimated by Kino in 1710 and Garces in 1776. If Gila-Colorado intertribal relations were maintained, it is possible that diseases spread to the lower Colorado River. Spanish estimates indicated a 25% decline in the Quechan population between 1702 and 1776 (Forbes 1965:132). In 1776, Garces noted that the Mohave, the northernmost river tribe, were increasing and had a larger proportion of children than did other Colorado River tribes (Coues 1900:230). Forbes (1965:132) suggested that infant and child mortality rates were higher among Yumans closer to Spanish influence.

Spanish crops introduced to Yuman horticulture included wheat and certain types of melons (Castetter and Bell 1951). Wheat, introduced to the Quechan by Kino (Forbes 1965:124), could be planted in late fall and harvested during the lean period in early spring (Castetter and Bell 1951:146). As for livestock, horses played a role in the expansion of an exchange network dominated by the Spanish slave trade.

According to Forbes (1965:135), "the Spanish-speaking people of Sonora, who were predominately of mixed ancestry, were anxious to elevate themselves economically and socially by means of the cheap labor of Indian slaves". Slaves were obtained from the Indians in exchange for horses and other goods (Dobyns et al. 1957). Since potential slaves were seized from enemy tribes, the trade in marketable captives probably intensified existing conflicts and rivalries. Prior to the slave trade, the lower Colorado River groups seem to have fought primarily among themselves (Bolton 1908:277; Forbes 1965:121; Hammond and Rey 1940:133). Warfare may have been associated with competition over natural resources, such as mesquite groves, when agricultural harvests failed (Stone 1981). In addition, population shifts resulting from the hypothesized Lake Cahuilla migrations may have caused territorial disputes. The introduction of horses may have broadened the scope of warfare by offering greater mobility for Yuman traders engaged in the distribution of such goods as marine shell over much of the Southwest and southern California (Coues 1900; Schroeder 1981). Since the Indians did not breed horses, the animals were obtained through the slave trade (Dobyns et al. 1957). The slave and horse trade probably intensified warfare by increasing its frequency and geographic range in response to the high demand for slaves and horses (Schroeder 1981:203).

By the late 1700s, the Spaniards focused their efforts on the colonization of California. Their plans included the establishment of an overland route between Sonora and California, with control of a river crossing at the junction of the Gila and Colorado rivers (Bee 1981; Forbes 1965). In conjunction with these plans, the Franciscan priest Garces visited the Quechan area several times between 1774 and 1776 and proposed a grand plan for the missionization of the Colorado River tribes (Forbes 1965:179). In 1776, Captain Juan Batista de Anza escorted the Quechan leader Palma to Mexico City, where he and three other Quechan were wined, dined, and baptized in order to enhance the Spanish position on the Colorado River (Forbes 1965:177). In 1781, the Spaniards established two small colonies, Concepcion and Bicuner, near the Gila-Colorado confluence. This colonization effort was poorly managed, with constant supply shortages including a lack of seeds and agricultural implements (Forbes 1965:190). The settlers appropriated Indian food supplies, and their livestock grazed and destroyed native agricultural plots and mesquite groves. The Spaniards were harsh in attempts to restrain such cultural traditions as shamanism (Bee 1981:12). The Quechan revolted, destroying both settlements and killing most of the settlers and soldiers, including Garces. The Spaniards subsequently deemphasized the importance of the land route to California, deferring the punishment of the Quechan in order to concentrate on the subjugation of the more troublesome Apache (Forbes 1965:225). They did attempt to restrain Yuman trade with the coastal tribes of southern California (Forbes 1965:240).

The river Yumans were less successful in dealing with the Anglo advance of the 1800s. Prior to 1850, trappers and mountain men traversed the region, maintaining wary relations with the Indians. By 1840, the trapping industry declined; but soon after, the Gold Rush increased the frequency of travel through Yuman territory. In the 1850s, U.S. Army surveyors and explorers documented the tensions between pioneer travelers and natives. According to Lt. A. W. Whipple:

> In 1849, numerous emigrants to California passed through this country and gave many accounts of the hostility of the Yumas. But, in investigating the causes of the troubles, it appeared that the Americans, by appropriating the maize belonging to the Indians, had been the first aggressors; and that, too, after having received from the natives great assistance in crossing the river [Whipple, Eubank, and Turner 1855:III:18].

Reports of hostilities culminated in the establishment of Fort Yuma in 1852. In 1858, the Army mounted a campaign against the Quechan and Mohave, defeating them in large-scale battles. The Colorado River Indian Reservation for Yuman tribes was established in 1865 near present-day Parker. The Quechan later received a reservation near Yuma. Many Mohave remained in the Mohave Valley, their ancestral territory near present-day Needles, California. The Fort Mohave Military Reserve, established in response to Indian attacks on wagon trains, was eventually designated a reservation for the Mohave (Stewart 1983).

The Colorado River Yumans thus received reservations incorporating portions of their prime farming and gathering lands. They attempted to maintain the traditional economy, but their efforts were hampered by a number of factors. Upland Yuman groups were initially relocated to the Colorado River Reservation, causing a strain on available resources (Walker and Bufkin 1979:42). Low river levels during the 1880s and 1890s led to crop failure and famine, yet the Indians were not permitted to range into the desert to exploit wild resources (Bee 1981; Schroeder 1959). They became increasingly dependent on government aid

and periodic wage labor. The loss of economic self-sufficiency and the government's policy of assimilation imposed further stress on native traditions.

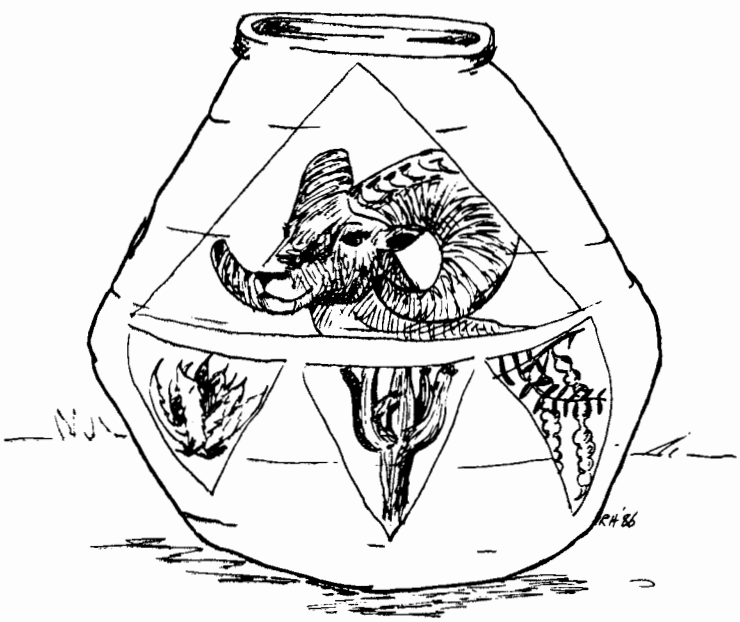
The fortunes of the Gila River Yumans were bound up with those of the Pima. In the mid-1800s, both groups supplied wheat to American settlers and travelers. They later received adjacent reservations along the Gila River, and they share the Salt River Reservation established in 1879 (Walker and Bufkin 1979).

The history and effects of contact on the Yavapai have been summarized by Mariella (1983). The Spaniards had little direct impact on the Yavapai. However, inasmuch as they participated in intertribal alliances, warfare, and trade, the Yavapai were probably influenced by the intensification of warfare related to the Spanish slave trade. In contrast to the Pima and Apache, the geographic position and alliance ties of the Yavapai were disadvantageous to the acquisition of Spanish goods, including guns. Their lack of weapons affected the balance of power in later relations with the settlers and cavalry (Mariella 1983).

The discovery of gold in western Arizona led to the first significant intrusions of Americans into Yavapai territory. In the 1860s and 1870s, mines were established in the vicinities of Prescott and Wickenburg (Hamilton 1884; Keith 1978). After the Civil War, military camps were built to protect mining camps and supply routes. Fort Whipple, established in 1864 near Prescott, served as headquarters for General George Crook (Wallace 1975). Camp Date Creek, occupied between 1867 and 1874, was established to guard the road from Prescott to La Paz, a settlement on the Colorado River (Walker and Bufkin 1979). The Yavapai raided stock and supply trains, but they generally avoided conflict due to their lack of weapons. Some Yavapai attempted to settle on the Colorado River Reservation but left when crops failed (Schroeder 1959). An increasing number of Anglo settlers appropriated native farm plots and restricted access to hunting and gathering areas, especially those in proximity to permanent water sources. The number and violence of conflicts escalated.

The Wiltaikapaya band, inhabitants of the Harcuvar-Harquahala region, managed to negotiate a written truce with Anglo residents of the McMullen Valley and "contractors, freighters, and teamsters" including Julius Goldwater. The Indians were given "the privilege of living in the valley mountains" in return for their assistance in fighting other groups who attacked the La Paz road (Davis 1868). The agreement, penned in 1868, worked for a time but was eventually doomed by the larger military campaign.

In the 1870s, General Crook conducted the U.S. Army campaign against the Yavapai. After the 1873 massacre of Yavapai at Skeleton Cave in the Superstitions, most were forced onto a military reservation at Camp Verde (Mariella 1983). By forced march, they were then relocated to the San Carlos Apache Reservation in 1875. They were later allowed to return to their homeland (Schroeder 1959). Some returned to Camp Verde, while others settled near abandoned Fort McDowell on the lower Verde River. Small groups also homesteaded along the lower Gila River near Agua Caliente, Palomas, and Arlington (Mariella and Khera 1983). Small reservations were eventually established near Camp Verde, Fort McDowell, Prescott, and Clarkdale. Few southwestern tribes suffered as drastic a reduction in territorial range; the Yavapai had inhabited some 20,000 square miles in central and western Arizona (Gifford 1936:247).



CHAPTER 5

HISTORY OF ARCHAEOLOGICAL RESEARCH IN THE DESERT ZONE

Over 20 years ago, Robert Euler (1963) reviewed the status of archaeological research in western Arizona north of the Gila River. A single paragraph dealt with the Sonoran Desert west of Phoenix. In his assessment,

> One immense problem on the southwestern scene relates to the broad, arid region essentially north of the Gila, south of the Bill Williams Fork, from Wickenburg to the Colorado River . . . a study of the prehistory of this territory is, I submit, one of the most pressing needs in Arizona archaeology today [Euler 1963:84].

This region still constitutes a spatial gap in southwestern prehistory. However, much fieldwork has been accomplished in the past decade, and the resulting information can be evaluated as a basis for generating future research directions.

Through the early part of this century, there were few roads and even fewer known water sources in this hot, arid, and rugged desert. Even so, harsh field conditions have rarely deterred southwestern archaeologists from pursuing their chosen research, particularly at large, impressive sites. However, "few other regions in the Southwest have less spectacular archaeological remains" than the desert of western Arizona (McGuire and Schiffer 1982:144). Open, stratified sites are rare, and most archaeological sites consist of surface artifact scatters of varying density. The investigation of such remains poses methodological problems only recently addressed in detail by archaeologists.

In areal syntheses, western Arizona prehistory is generally described in terms of concepts developed for surrounding regions. This practice reflects the history of archaeological fieldwork in the Southwest as well as the probability that the area was peripheral to known major concentrations of prehistoric populations. There is a need to assess the prehistory of this region on its own terms, through the analysis of archaeological evidence collected within the area. Recent investigations have increased the body of available evidence (Map 5-1). However, it is still necessary to relate the area to surrounding regions for purposes of interpretation and synthesis.

EARLY EXPLORATIONS

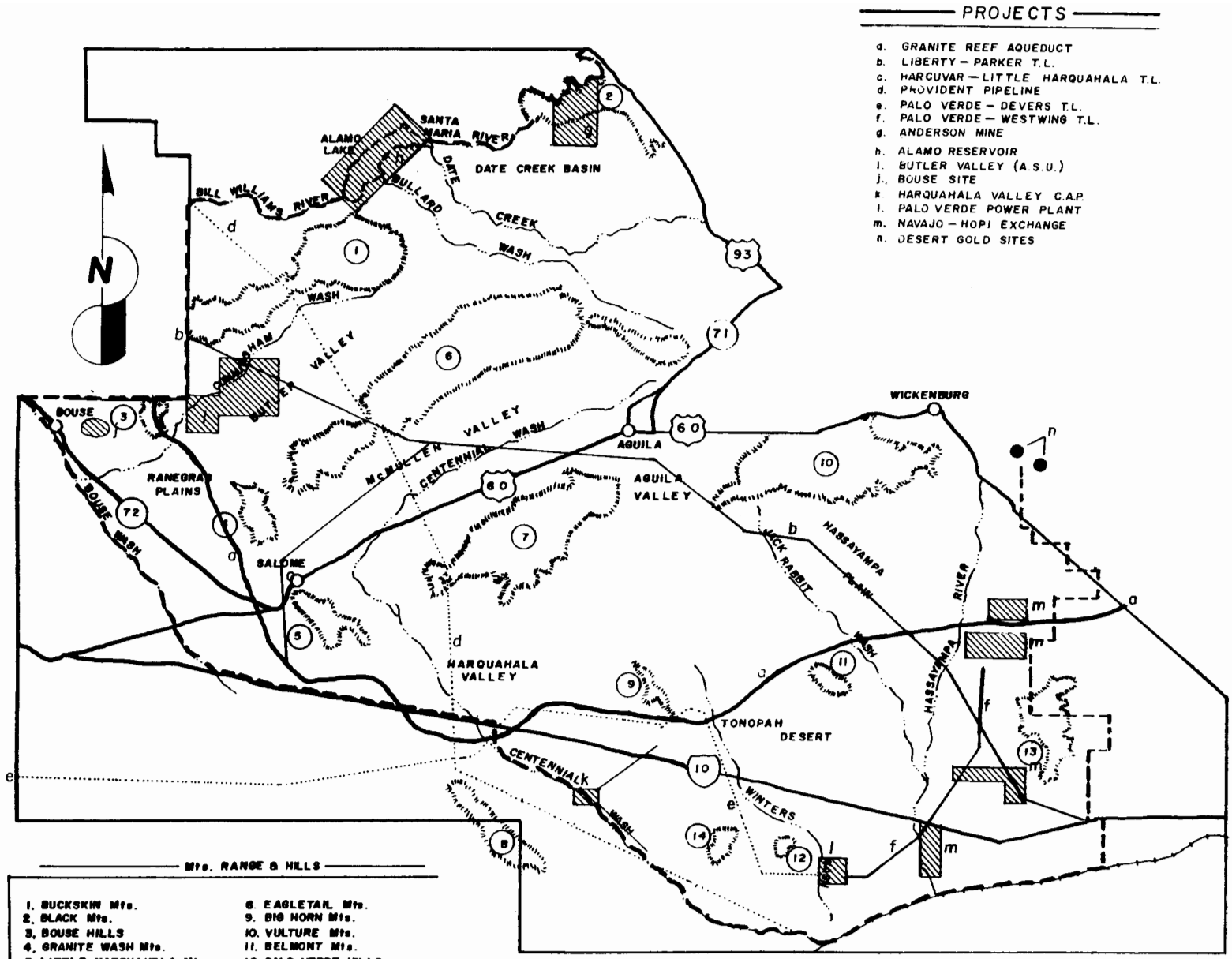
The earliest non-Indian explorers to traverse the western Arizona desert were the Spanish priests Sedelmayr and Garces, who used ancient trails later documented by historians and archaeologists (Coues 1900; Forbes 1965; Rogers n.d.; Sedelmayr 1955).

American mountain men left little written record of their explorations. Joseph Walker, the first white man to gaze upon the Yosemite Valley, considered the rough country between the Gila and Colorado rivers to be the "last big unexplored region in the territory of the Republic" (Gilbert 1973:216). In the 1860s, Walker explored west central Arizona. He encountered Mexican bandits but made no mention of Indians or ruins.

In the mid-nineteenth century, United States Army surveyors explored the Mexican border and several potential railroad routes through the West. Expedition members included naturalists and artists who recorded an abundance of data on geology and natural resources. William H. Emory, chief of the Mexican boundary survey, passed down the Gila River in 1846 and discovered numerous archaeological sites and petroglyphs in the Gila Bend area (Emory 1848). In 1854, Lt. Amiel W. Whipple traveled down the Big Sandy and Bill Williams rivers during the course of a railroad survey. In early February, his party camped for several days near the confluence of the Big Sandy and Santa Maria rivers. They reported the existence of archaeological sites and recently abandoned Indian camps (Foreman 1941:218-225). Along the Bill Williams River several miles below the confluence, they found deserted huts made of bent willow branches and thatch, with a metate "for pounding mezquites" and "three small stones . . . where an earthen vessel had been placed upon a fire for cooking purposes". As for the hearth, "the remnant of their fire consisted of the most minute pieces of charcoal". Whipple remarked on the parsimonious use of fuel given the abundance of available firewood. Whipple was the first observer of site formation processes in the western desert: "heavy rains and freshets occur but seldom in this climate; but when they do, all vestiges of these abodes are swept away" (Foreman 1941:219). On the river terraces covered with "shining pebbles of black lava" (desert pavement?) were found trails and associated rock cairns. The army explorers also observed forked harvesting poles propped against saguaros and a fish net woven from willow branches. A pictograph site discovered near a spring in the Rawhide Mountains, north of the Bill Williams River, may have been the Mississippi Canyon rock art site known to modern local inhabitants.

EARLY ARCHAEOLOGICAL SURVEYS

During the first third of this century, the techniques of stratigraphic excavation and the sherd survey were introduced and employed to establish the chronological and geographic dimensions of prehistoric southwestern cultures. In the first synthesis of southwestern prehistory, published in 1924, Kidder (1962) noted that the remains in the middle Gila region were unlike those of the comparatively well-studied Anasazi of the Colorado Plateau. Kidder encouraged Harold S. Gladwin to investigate the Gila district, and Gladwin founded the Gila Pueblo, a private



MAP 5-1: LOCATION OF ARCHAEOLOGICAL PROJECTS

research institution near Globe. Gila Pueblo initiated extensive surveys to determine the geographic range of the "Red-on-Buff culture" by mapping the spatial distribution of ceramic types. These surveys and related excavations resulted in the definition of the Hohokam cultural tradition of central and southern Arizona (Gladwin et al. 1937).

In the 1920s, Frank Midvale conducted the Gila Pueblo search for the western range of Red-on-buff pottery, covering an area roughly bounded by lines connecting Gila Bend, Yuma, Kingman, and Wickenburg (Gladwin and Gladwin 1930). He recorded 15 sites within the study area. Site records and artifact collections are now stored at the Arizona State Museum. As detailed topographic maps were not available to Midvale, it is difficult to relocate his sites. The exact areas surveyed are also uncertain. It is likely that most sites were pinpointed by local informants.

The western range was regarded as "largely a sandy waste" with "little material by which to trace the people who may formerly have frequented the region" (Gladwin and Gladwin 1930:135). Sparsely scattered Red-on-buff ware was found as far west as Bouse Wash on the Ranegras Plain, and the Gladwins concluded that Hohokam pioneers ventured that far west. They noted "a sharp break in the number and size of ruins" west of the Hassayampa River (Gladwin and Gladwin 1930:137). "Yuman" pottery was concentrated along the Bill Williams, Colorado, and lower Gila rivers, with an additional cluster near the Gila-Hassayampa and Gila-Centennial Wash confluences. The Gladwins suggested that "Yuman sherd areas" in the interior desert represented the campsites of raiding parties.

The Gila Pueblo survey was the first to incorporate the western Arizona desert into the realm of southwestern archaeology. The only other early survey, conducted in the 1930s and 1940s, was undertaken from the perspective of California desert archaeology. In the 1920s, Malcolm Rogers began surveying archaeological remains in the southern California desert. He later extended his survey into western Arizona in order to examine similarities and relationships between the two areas. His perspective differed from that of southwestern archaeologists in that the western desert was treated as the focus of research rather than a zone peripheral to major southwestern cultures. Rogers paid attention to lithic remains and features in addition to ceramics. He defined several preceramic cultures and was the first person to present a culture historical framework for western Arizona (Rogers 1939, 1945, 1958, 1966).

Rogers never produced a comprehensive survey report, but his extensive notes and collections were placed on file at the San Diego Museum of Man (Rogers n.d.). As a member of the museum staff, he ranged over a large portion of western Arizona. Again, there is little information concerning the exact extent and location of surveyed areas. Rogers was apparently guided to relatively substantial sites by local informants. He also focused on areas surrounding springs. Maps and survey notes indicate that Rogers concentrated his efforts along the Colorado River and in the Kofa, New Water, and Castle Dome mountain ranges to the southwest of the study area. He also visited the Harquahala and Ranegras plains and recorded sites along the Bill Williams River. There seems to have been a topographical focus on mountain passes and canyons, although sites were occasionally recorded in basins. Rogers recorded many of the enigmatic features that have since challenged desert researchers: rock rings or "sleeping circles", trails, and intaglios (ground effigies produced by the clearing of desert pavement). Extensive trail networks were defined, mapped, and linked to historic travel routes. Rogers employed a flexible approach to site definition, incorporating large, low density scatters into sites. He also focused on the distribution and nature of water sources and provided estimates of their volume and reliability.

Within the study area, Rogers recorded only seven sites. Three were located along the Bill Williams River. At the junction of the river and Swansea Wash, Rogers discovered a large boulder-outlined phallus intaglio. Another site incorporated a 25 mile (40 km) stretch of river terraces covered with lithic scatters and trails, possibly including those observed decades earlier by Whipple (Foreman 1941). His site A-40, the Bouse site, incorporated several loci near the confluence of Bouse and Cunningham washes. This site included diverse artifactual materials eroding out of dunes, in addition to three large groups of bedrock mortars, a prehistoric well, and several cremations. According to McGuire and Schiffer (1982:448), this site is not the same one recorded near Bouse Wash by Gila Pueblo. Further east, Rogers documented the Granite Wash Pass petroglyph site, noting that it was located on an aboriginal travel route extending from the Colorado River through Bouse, Granite Wash Pass, and down Centennial Wash to the Gila River. The largest site, mapped without boundaries, incorporated the western portion of the Harquahala Valley and the eastern portion of the Ranegras Plain. In this area, Rogers found lithic scatters, trails, and rock rings on the desert pavements of the upper bajada. He attributed these remains to "nomadic camping and quarrying" by preceramic groups. Unfortunately this area was surveyed "hurriedly" (Rogers n.d.). Finally, Rogers documented rock rings, petroglyphs, and scatters of sherds and ground stone in the Palo Verde Hills. He commented that "the entire Centennial Wash valley has scattered Yavapai occupation in sandy areas covered with mesquite" and that surrounding mountain ranges contained temporarily occupied caves (Rogers n.d.).

Few other archaeologists ventured into the west central desert until the advent of contract archaeology in the 1970s. Nevertheless, work proceeded in surrounding areas and contributed to the interpretation of prehistory in the desert region. By the 1950s, terminological controversy surrounded the definition of ceramic period cultures in west central Arizona. In the history of American archaeology, the magnitude of such controversies seems to be inversely related to the amount and quality of available data. Gladwin and Gladwin (1930, 1934) originally attributed remains west of the Hohokam, or Red-on-buff culture, to the "Yuman root". Rogers (1945) also preferred the "Yuman" term. Lyndon Hargrave and Harold Colton of the Museum of Northern Arizona introduced a Hualapai term, "Patayan", to refer to archaeological remains in western Arizona (Colton 1938, 1945; Hargrave 1938). The Patayan root, equivalent to the Hohokam, Anasazi, and Mogollon in southwestern cultural classifications, incorporated four branches: the Cohonina, Cerbat, and Prescott branches north of the Bill Williams River and the Laquish branch

along the lower Colorado River. Colton (1945) suggested that Patayan-Yuman continuity was plausible but not sufficiently supported by evidence. Thus he viewed "Yuman" an an inappropriate designation for a prehistoric tradition. In the following decade, Albert Schroeder (1957) introduced the term "Hakataya" to refer to archaeological remains in the western Southwest. At the 1956 Pecos Conference, the term Patayan was restricted to the original Cohonina, Cerbat, and Prescott branches, and Hakataya was adopted to refer to other areas. However, in 1957 the conference participants decided to retain the Patayan designation to refer to western Arizona south of the Grand Canyon (McGuire and Schiffer 1982:129). Both terms have remained in use, with most researchers favoring the Patayan alternative (McGuire and Schiffer 1982).

THE POST-WAR AND PRE-CONTRACT YEARS

The period from 1945 to 1970 witnessed much work in surrounding areas but little within the study region. Michael Harner's test excavations at Rogers' Bouse site constituted the major project and the only excavation of stratified deposits within the study area. Harner proposed a regional chronology for the lower Colorado area based on the excavated trash deposits from a walk-in well. Unfortunately, the methods and results of this investigation were poorly documented, published in a single short article (Harner 1958).

Work in surrounding areas was prompted by the investigation of Indian land claims cases and the advent of reservoir salvage archaeology. To the north, Henry Dobyns and Robert Euler revived the techniques of the sherd survey in support of Hualapai land claims (Dobyns 1974). Ceramic types were linked to historic tribes, and sherd distributions were mapped south to the Bill Williams River.

Reconnaissance surveys, funded by the National Park Service in conjunction with federal reclamation projects, were conducted along the lengths of the lower Colorado and lower Gila rivers. Albert Schroeder undertook a survey of the Colorado River from Davis Dam to the Mexican border. He recorded 74 sites including "trail camp sites", "farm camp sites", intaglios, rock rings, trails, and petroglyphs. Large "permanent" settlements were located at the edge of the floodplain near Needles, Parker and the Gila confluence. Schroeder suggested that many habitation sites would have been disturbed or destroyed by floods. His survey report presented a detailed description of lower Colorado Buffware pottery types (Schroeder 1952).

Surveys along the lower Gila River between Gila Bend and Yuma revealed a pattern of small settlements and camp sites with a mixture of Lower Colorado Buffware and Hohokam pottery types (Breternitz 1957; Vivian 1965). Sites included artifact and burned rock scatters, trails, petroglyphs, cremations, and marine shell. Other investigations focused on the Painted Rock Reservoir just west of Gila Bend. Salvage work was conducted prior to the construction of Painted Rock Dam by the U.S. Army Corps of Engineers. The reservoir area was surveyed by Schroeder (1961), and Wasley and Johnson (1965) excavated or tested 15 sites. This work revealed a major occupation by Hohokam groups as evidenced by large villages, platform mound and ballcourt features, and irrigation canals. Ceramic and stratigraphic evidence indicated a history of Hohokam-Patayan interaction culminating in the eventual replacement of the former by the latter (Wasley and Johnson 1965).

Wasley was also involved in a survey along the Big Sandy, Santa Maria, and Bill Williams rivers prior to the construction of Alamo Dam by the Corps of Engineers. The results were described in a short report for the National Park Service (Wasley and Vivian 1965). This brief "windshield survey", which revealed only two sites, would have been judged as inadequate by current standards.

To the south of the Gila River, Paul Ezell (1954) completed a reconnaissance of northwestern Papagueria, a basin and range zone with vegetation, topography, and climate similar to that of the study area. His site types included rockshelters, rock rings, trails, open camps, lithic quarry-workshops, and petroglyphs. Ezell found a mixture of Hohokam, Lower Colorado Buffware, and Sonoran pottery types and attempted to define cultural boundaries on the basis of their geographic distributions. He noted that every known water source was associated with an archaeological site, but that the reverse was not the case.

Finally, Alfred Johnson (1963) conducted a survey of White Tank Mountains Regional County Park in the northeastern portion of the mountain range. He located several Hohokam "villages" in the east-facing canyons and suggested that similar sites might be found on the west face of the range.

CONTRACT ARCHAEOLOGY AND FEDERAL MANAGEMENT

The work at Painted Rock Reservoir ushered in the era of contract archaeology in western Arizona. From 1966 on, the passage of federal legislation for environmental protection and historic preservation promoted changes in the practice of archaeology. Laws and executive orders included the National Historic Preservation Act of 1966, which established the National Register of Historic Places; the National Environmental Policy Act of 1969, which initiated the preparation of environmental impact statements to evaluate the effects of projects involving federal lands, funds, or permits on environmental and cultural resources; Executive Order 11593, issued in 1971 to require inventories of resources on public lands; and the Archaeological and Historic Preservation Act of 1974, which authorized federal agencies to expend funds for the preservation or recovery of archaeological materials (McGimsey and Davis 1977). These pieces of legislation mandated the evaluation and, if necessary, mitigation of impacts to cultural resources caused by federally sponsored or funded construction projects. In addition, government agencies were required to manage the cultural resources over which they have jurisdiction.

Federal legislation and the contracting of archaeological work were not the only factors transforming the practice of archaeology in the 1970s. The "new archaeology" embodied the same spirit of reform which resulted in the passage of preservation laws. There was a revived emphasis on methodological rigor and innovation; a strong materialist or cultural ecological orientation; and a broadening of research issues through the study of "process" in addition to culture history. A new emphasis on regional analysis introduced issues related to research designs and sampling. The new "contract archaeology", by providing funds for research, served as a testing ground for archaeological methods and approaches. Contract archaeology also directed research into areas which had received little study, "marginal" areas such as western Arizona (Brown and Stone 1982:52).

In Arizona, urban growth created demands for energy and water which were met through the construction of facilities for extraction, generation and transmission. In western Arizona, such facilities included power plants, transmission lines, pipelines, and aqueduct systems. The obvious result has been a dominance of linear surveys. Strict contract requirements for cultural resource documentation, assessment of significance, and management recommendations transformed survey procedures. In contrast to earlier reconnaissance surveys, contract surveys have been characterized by more intensive coverage of well-defined areas, standardized methods and recording procedures, and staged investigations.

Two major construction projects have dominated contracted archaeological research in the study area. The Central Arizona Project, a system of aqueducts, pumping plants, and power lines, will divert Colorado River water to central Arizona. The Palo Verde Nuclear Generating Station near Arlington is the only nuclear power plant in Arizona. Both projects have incorporated a series of surveys and mitigation studies over a number of years.

The Granite Reef Aqueduct and its associated transmission lines constitute the primary features of the Central Arizona Project in western Arizona. A series of surveys from 1968 through 1981 provide a case example of increasing sophistication in methodology, research design, and efficient project management. The first survey of the proposed aqueduct alignment, conducted by Euler (1968), consisted primarily of a brief aerial inspection by helicopter. Minimal results underscored the necessity for ground inspection. The entire proposed route was subsequently surveyed by two crews from the Arizona State Museum, who documented a number of artifact scatters, rock rings, and trails (Kemrer, Schultz, and Dodge 1972). This survey, which produced a descriptive report, had few explicit research goals.

In the mid-seventies, the U.S. Bureau of Reclamation contracted with Arizona State University to survey several "reaches" or segments of the final, realigned aqueduct route (Antieau 1977; Brown 1976 a,b,c,d). Phased investigations, consisting of intensive survey, interim evaluation, and data recovery, proved to be an effective strategy. However, by 1977 it was apparent that the system of separately contracted small projects did not facilitate either the archaeological research or the construction schedule. This realization led to the development of a contracting concept which unified and streamlined the cultural resource studies. An "on-call" contract awarded to Arizona State University covered all additional studies conducted along the Granite Reef Aqueduct and associated facilities. A series of tasks corresponding to specific construction segments were budgeted and scheduled as separate units, and results were summarized in interim reports. The on-call contract required the preparation of an overall research design as well as a final report synthesizing all study results. A programmatic memorandum of agreement provided that if a "no adverse effect" determination (according to 36 CFR 800) was made by the Bureau of Reclamation based on an appropriate data recovery plan developed by ASU, with approval of the State Historic Preservation Officer, then investigations could proceed without further consultation with the Advisory Council on Historic Preservation (Brown and Stone 1982:4-5). This PMOA was an important component of an efficient management strategy.

Fieldwork was conducted in survey and mitigation phases between 1977 and 1981. In addition to the aqueduct, field crews surveyed the Liberty-Parker, Liberty-Parker-Hassayampa, and Bouse Hills-Harcuvar-Little Harquahala transmission lines. The former line had been surveyed previously by Bair (1974). Since he covered most of the area by vehicle rather than foot, ASU archaeologists deemed it advisable to resurvey this line at a level of intensity comparable to other Granite Reef surveys. The resurvey documented the "Vulture source", a large low-density quarrying area for obsidian nodules and other lithic raw materials.

The final report for the Granite Reef Aqueduct project described 46 sites, including artifact scatters of varying size and density, food processing sites, trails, and rock rings (Brown and Stone 1982). These temporary camps and activity areas had little depth, and the overall pattern of land use was one of travel and temporary but repeated utilization of lithic and wild food resources. Diagnostic ceramics and lithics indicated occupation by Archaic, Patayan, and Hohokam groups. The report explicitly addressed regional research problems as well as methodological issues in desert archaeology. With its innovative analyses and regional perspective, it is a significant reference for west central Arizona.

The Palo Verde Nuclear Generating Station, constructed and funded primarily by Arizona Public Service Company, is located near Arlington in the southeast corner of the study area. Spider-like coverage of this area has been afforded by surveys of the power plant site and its radiating water and power transmission lines. Six alternative locations were originally considered for the plant, including areas in the Palo Verde Hills, McMullen Valley, and Hassayampa Plain (Stein 1976). In 1972, the Museum of Northern Arizona was contracted to search site files and recommend those areas having the least archaeological sensitivity (Haas 1973). The Museum also conducted small clearance surveys for geological tests (Fuller 1973). In 1974, MNA conducted an intensive survey of the proposed plant site near the Palo Verde Hills (Trott 1974a). In a survey area of approximately six square miles, 35 prehistoric sites included sherd and lithic scatters near major washes, trails, petroglyphs, rock rings, intaglios and rocks aligned

to create designs. The large number of trails, most of which ascended the basalt hills, were of particular interest. They were classified into five types based on their destinations. Ceramics included a mixture of Hohokam and Patayan wares. Trott's report provided a good review of the research issues associated with these findings. Since the surveyed area exceeded the area of the final plant site, only eight sites were seriously threatened by construction, and Trott recommended general mitigation procedures. Data recovery took place in 1975 (Stein 1976, 1981). The sites yielded radiocarbon dates and subsistence information from macrobotanical and faunal remains rarely preserved at open desert sites. Stein concluded that Hohokam and Patayan groups exploited a variety of wild plant and faunal resources and perhaps engaged in ceremonial activities in the Palo Verde Hills.

Power plant facilities included water conveyance and electric transmission lines. Alternative water conveyance routes were proposed to connect the power plant with the Phoenix water treatment plant at 91st Avenue near the Gila River. Surveys were conducted, largely outside the overview study area, in 1974 through 1977 (Stein and Sant 1976; Stein 1977; Trott 1974 b,c). The parallel Palo Verde to Kyrene electric transmission line was surveyed in 1978 (Powers, Keane and Weaver 1978; Yablon 1982). These surveys located Hohokam habitation sites along the Gila River east of the study area.

The electric transmission line connecting the Palo Verde plant to the Westwing station near the Agua Fria River traversed the Hassayampa Plain between the Hassayampa River and the White Tank Mountains. The Museum of Northern Arizona conducted a site file search and cursory field examination of two alternative routes in 1975 (Brook 1975). The Museum later conducted an intensive survey of the final route (Stein, Granger, and Freeman 1977; Yablon 1978, 1979). Prehistoric remains within the study area were relegated to the category of isolated finds: rock rings, small sherd scatters, and isolated lithics.

Preliminary surveys of transmission line routes across the western desert to California were conducted by MNA (Hallisy and Hawkins 1976; Berry 1978). Berry surveyed two alternative routes for the Arizona segment of a proposed transmission line connecting the Palo Verde power plant to a facility in Devers, California. Recorded sites included lithic scatters and quarries, rock rings, and "multiple activity" artifact scatters. In the study area, sites were clustered on the southwestern flank of Saddle Mountain. Outside the area, most remains were found on the terraces of the Colorado River.

The final Palo Verde to Devers transmission line route, which traversed the Harquahala Valley and Tonopah Desert, was surveyed by WESTEC Services, Inc. (Carrico and Quillen 1982). A phase of intensive survey and site mapping was followed by a program of data recovery at selected sites. Although avoidance was the preferred mitigation strategy, it was not feasible for all sites. Data recovery was guided by a research design "developed to address pertinent regional research problems concerning prehistoric occupation and adaptation to the Southwestern Arizona cultural-ecological framework" (Carrico and Quillen 1982:5). Surveyors documented 43 sites in the study area, primarily rock rings and lithic scatters. Many were located in the area between Burnt Mountain, Saddle Mountain, and the Palo Verde Hills. Data recovery was conducted at two of these sites, including a large lithic scatter, AZ S:8:5 (ASU), previously investigated during the Granite Reef Aqueduct project (Brown and Stone 1982). The Palo Verde to Devers report provides a good review of regional research and methodological issues.

Finally, recent studies along the Yuma 500 Kv transmission line also incorporated a strong research orientation. The northernmost portion of this line, located just south of the Palo Verde power plant, yielded few archaeological remains. However, numerous sites were located outside the study area, along the major portion of the line paralleling the lower Gila River. The intensive survey conducted by Archaeological Consulting Services Ltd. (Effland, Green, and Robinson 1982) and mitigation studies by WESTEC Inc. (Schilz, Carrico, and Thesken 1984) were methodologically sophisticated. The results of these investigations provide comparative material relevant to the study area.

In addition to the Granite Reef Aqueduct and Palo Verde to Devers transmission line surveys, other contract projects have investigated portions of the Harquahala Valley. The Soil Conservation Service of the U.S. Department of Agriculture funded surveys of lands affected by proposed flood control and water diversion projects. Intensive surveys of specified areas were conducted by Burton (1975) and Antieau (1976). Twelve prehistoric sites included the extensive lithic scatter (AZ S:8:5 (ASU)) later investigated by both ASU (Brown and Stone 1982) and WESTEC (Carrico and Quillen 1982); sherd scatters; rock rings; and low density scatters of chipped stone, sherds, grinding implements, and burned rock near major washes. Limited surface collection and testing revealed little depth to sites. Ceramics included Hohokam, Patayan, and unknown types. In 1980, archaeologists and officials from Arizona State University, the Soil Conservation Service, the Bureau of Land Management, and the State Historic Preservation Office visited one of these sites, AZ S:12:7 (ASU). They recommended that a possible hearth be tested in order to obtain archaeomagnetic samples for dating the site. This goal was viewed as a potential "significant contribution" to the prehistory of west central Arizona. ASU tested the hearth but failed to obtain a sample due to poor preservation (Larson 1980).

Northland Research Inc. recently completed survey and mitigation studies in connection with the planned delivery of Central Arizona Project water to the Harquahala Valley Irrigation District (Bostwick 1984, n.d.). Eight prehistoric sites near Centennial Wash incorporated scatters of chipped stone tools, grinding implements, rock features, and very few sherds. Radiocarbon dates and diagnostic artifacts indicated that these were Archaic campsites. Like the Palo Verde Hills sites investigated by Stein (1981), they yielded faunal remains and charcoal samples despite their shallow depth. Other Archaic sites have been found along Centennial Wash (Bostwick and Stone 1985; Brown and Stone 1982).

Several additional contract projects of a smaller scale have been completed within the study area. These include surveys of the proposed Provident Kingman to Mobile oil pipeline by Arizona State University (Henss 1983); a reconnaissance of alternative sites for a coal fired generating plant, conducted by the Museum of Northern Arizona for the Salt River Project (Keller 1981); and a survey of an access road to the Anderson Mine, located in the Black Mountains (Mayro and Breternitz 1978). The Museum of Northern Arizona conducted a sample survey of the Anderson Mine area, funded by Minerals Exploration Inc. (Powers, Granger, and Keller 1978). Stone (1977) reported on a 10% probabilistic sample survey of the Alamo Reservoir State Park conducted by Arizona State University during a period of low lake levels caused by drought. ASU also sample surveyed a portion of Butler Valley. That survey was terminated just prior to completion due to the reported presence of live shells and mines from World War II training exercises (Dobbins and Stone 1979). Finally, H.D.R. Ecosciences provided clearance surveys at scattered geological testing sites in the various basins of the study area. These spot checks were connected with MX missile siting investigations (H.D.R. Ecosciences 1977a,b; Mayro 1979). Most of the above surveys added a small number of additional sites to the regional record. The Alamo Reservoir and Anderson Mine surveys discovered campsites and rockshelters in addition to huge, dense lithic scatters. In general, these contract surveys involved little collection or artifact analysis, and reports were primarily descriptive rather than research-oriented. The primary goals were the location and assessment of cultural resources and the recommendation of management options for the sponsoring contractors. However, research issues were addressed in the Alamo Reservoir, Anderson Mine, and Provident Pipeline reports (Henss 1983; Powers, Granger, and Keller 1978; Stone 1977).

The Bureau of Land Management (BLM), having jurisdiction over two-thirds of the land in the study area, has authorized surveys for the inventory and protection of cultural resources. The Yuma District Office funded a survey of "checkpoints" along the "Parker 400" off-road vehicle race course by Northern Arizona University (Ambler, Frampton, and Ross 1976). The survey crew drove the course between checkpoints or spectator areas, which were surveyed at a higher intensity. A few checkpoints were located in the northwestern portion of the study area, and lithic scatters and rock rings were found near the Bouse Hills. A later report described the results of artifact collection, analysis, and testing (Sant, DeChambre, and Ambler 1977).

The Phoenix District Office of the BLM has conducted clearance surveys of small, scattered parcels located in the intermontane basins. These have yielded few archaeological remains. The recent People's Canyon land exchange involved a sample survey of Butler Valley which located no prehistoric sites (Miller 1984). The paucity of sites in Butler Valley was consistent with the results of an earlier sample survey by Arizona State University (Stone and Dobbins 1979).

From 1979 through 1981, the BLM carried out a 1% stratified random sample survey of BLM lands in the Harcuvar and Vulture planning units. This survey provided inventory data for a grazing environmental impact statement prepared for the Lower Gila North planning area (BLM 1982). Over 300 sample units incorporated a total survey area of nearly 17,000 acres. A small portion of the sampled area consisted of a judgmental sample of areas surrounding several springs. Otherwise, the region was divided into five strata based on differences in slope and topography. Over 80 sites and numerous isolated loci were found, including possible base camps, pictograph sites, and large roasting pits in addition to the usual rock rings, trails, and lithic scatters. This survey was significant in its coverage of a range of environmental zones. In contrast, most contract surveys have focused on the low relief basin areas which enable more efficient construction of long-distance transmission facilities. Few surveyors since Malcolm Rogers have examined the mountain pediments and canyons of west central Arizona. The BLM surveys of these zones are an important contribution to the regional data base.

In 1985, the BLM conducted a sample survey of proposed exchange parcels between the Hassayampa River and the White Tank Mountains. A 48% sample of the proposed lands included over 7000 acres. This survey, accomplished as part of the Navajo-Hopi Relocation selection process, revealed three artifact scatter and rock ring sites as well as 57 isolates or small localized clusters of sherds, chipped stone, grinding tools, and rock features. The archaeological materials were concentrated near the base of the mountains and near some, but not all, major washes (Stone 1985).

Several overviews have been produced for purposes of project planning and land management. In 1973, the BLM contracted with Arizona State Museum for overviews of its planning units (Fritz, Smiley, and Shimada 1974). These included overviews of the Harcuvar and Vulture planning units (Andrews 1975; Quinn and Roney 1973). These brief documents were completed prior to the initiation of major contract and inventory projects. Five other overviews have since covered portions of the study area, including a regional overview of rural Maricopa County (Stone and Burton 1977) and a more recent update by Stone and Quinn (1983). Recent studies include a literature and records search for the Harquahala Valley Irrigation District by Archaeological Consulting Services (Effland 1981) and a draft overview prepared by the same company for the planned All-American pipeline through the southern Harquahala Valley (Effland and Green 1984). Finally, the Museum of Northern Arizona prepared an overview and sensitivity assessment for inclusion in the environmental impact statement for the planned Mead to Phoenix 500 Kv transmission line (Keller 1983).

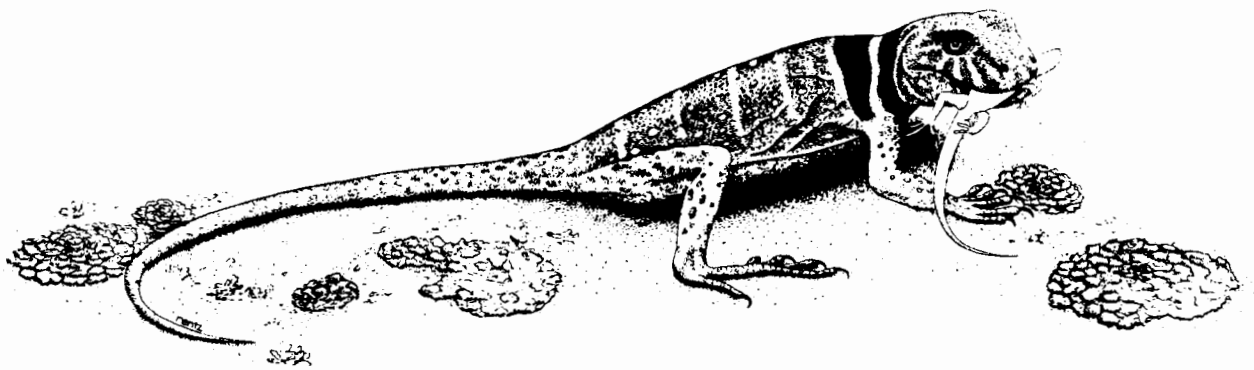
Major overviews prepared for surrounding areas include the McGuire and Schiffer (1982) volume on southwestern Arizona, an overview of the middle Gila Basin (Berry and Marmaduke 1982), and an overview of the lower Colorado River written for the U. S. Bureau of Reclamation (Swarthout 1981). Since they deal with regions adjacent to the study area, these documents provide significant interpretive information.

Recent surveys and research conducted in surrounding regions are relevant to the study area. Since social groups,

events, and land use patterns in those regions may have affected patterns of settlement and social interaction in the study area, the results of those studies can guide the development of research hypotheses and provide a firmer basis for interpretation.

To the north, the BLM conducted random sample surveys of the Hualapai and Aquarius planning units and examined relationships between site distributions and water sources. Site types were similar to those in the study area (Kincaid and Giorgi 1979). Boma Johnson, the BLM Yuma District archaeologist, has documented trail systems, shrines, intaglios, and groundstone manufacturing loci along the lower Colorado River (Johnson 1981; Solari and Johnson 1982). At the base of mountains east of Wickenburg, under contract to the BLM, Arizona State University investigated the two Desert Gold sites (Rice and Dobbins 1981). Test excavations revealed nearly a meter of depth to these sites, Archaic and ceramic period base camps. Differences in their internal spatial structure were attributed to their roles in different organizational systems. To the south, Arizona State Museum conducted additional survey and data recovery investigations at Painted Rock Reservoir. The results were incorporated into a comprehensive review of Gila Bend area prehistory (Teague and Baldwin 1978; Teague 1981). Finally, Doelle (1980) authored a dissertation on prehistoric adaptive patterns in western Papagueria, based on the investigation of sites in the San Cristobal Valley. His discussions of alternative settlement systems and lithic technological patterns are relevant to hypothesis generation and interpretation for the study area.

In conclusion, recent surveys have become more explicit and standardized, and the level of coverage has increased in intensity. Contract investigations have become more problem-oriented by incorporating research designs and the testing and evaluation of hypotheses. These changes are apparent when one examines the evolution of procedures and results through the multiple tasks of two long-term projects, the Central Arizona Project and the Palo Verde Nuclear Generating Station investigations. With continued population growth in the Southwest, it is likely that even such remote, arid zones as western Arizona will be further developed and subjected to additional archaeological scrutiny.



CHAPTER 6

A SUMMARY PREHISTORY OF THE NORTHERN SONORAN DESERT

Culture historical reconstructions for west central Arizona were generally conceived prior to much of the fieldwork and research in the area. This backwards process reflects the region's marginal position relative to more intensively studied regions. Its prehistory has been interpreted from the perspective of southern California, northwestern Arizona, and southern Arizona. These perspectives provide a meaningful interpretive context for the study area, but the relevance and adequacy of traditional schemes must be judged in reference to recent data from the northern Sonoran Desert.

THE ANTIQUITY OF DESERT OCCUPATION

Archaeologists continue to contest the antiquity of human occupation of the New World. The most secure evidence, based on reliable radiocarbon dates, exists for the Paleoindian traditions beginning with Clovis at 9500 to 9000 B.C. (Haynes 1967, 1969). A few sites, such as Meadowcroft Rockshelter in Pennsylvania (Adovasio et al. 1978, 1980) and Wilson Butte Cave in Idaho (Gruhn 1965), have yielded earlier dates, but serious questions have been raised concerning problems of radiocarbon sample contamination and stratigraphic context (Haynes 1967, 1969, 1980). On the other hand, recent information from South American sites indicates that the lower continent was occupied during the late Pleistocene period, perhaps as early as 30,000 years ago (Gruhn 1985; Guidon 1985; Hurt 1985; Politis 1985). Thus it is likely that North American occupations preceeded the Paleoindian traditions. The problem exists in obtaining reliable evidence for the earliest occupational periods.

Advocates for a pre-Paleoindian presence seem to have had a particular attraction to the Mohave and Sonoran deserts. These areas contain archaeological sites with an appearance of great antiquity, consisting of crude, heavily patinated lithics embedded in desert pavements. They are often located on landforms known or assumed to be ancient, including desert pavement, old alluvial fan deposits, and the peripheries of extinct Pleistocene lakes in California. Some researchers have drawn parallels between the large, percussion-flaked tools and Old World paleolithic assemblages (Davis et al. 1980; Jennings 1968:65-67). They have argued that these remains predate 5000 B.C. and that they may be over 10,000 years old (Davis et al. 1980). Krieger (1964) assigned such "chopper-scraper complex" sites to a pre-Paleoindian stage.

On the basis of fieldwork in the Sierra Pinacate range just south of the Arizona-Mexico border, Julian Hayden (1976) reintroduced the term "Malpais" to refer to an ancient lithic industry said to predate the Clovis tradition. The term was originally introduced by Malcolm Rogers (1929) to refer to materials later incorporated into his San Dieguito complex. According to Hayden, Malpais remains included unifacial, percussion-flaked tools (a chopper-scraper industry), trails, and intaglios occurring over the deserts of southwestern Arizona, southern California, and northern Mexico (Hayden 1976). Hayden acknowledged that similar artifacts and features are known from later cultures and are not unique to Malpais. Malpais assignments were based on a complex set of assumptions regarding processes of patination, weathering, and desert pavement formation. Both Hayden and Rogers employed this approach in their attempts to extract chronological information from surface remains.

Hayden (1976) argued that desert pavements resulted from the death of vegetation and subsequent deflation of the surface by winds during the dry Altithermal climatic phase approximately 6000 years ago (Antevs 1948, 1955). Noting that the pavements of the Sierra Pinacate were characterized by different thicknesses of desert varnish, he proposed the existence of an earlier "Malpais Altithermal" in addition to Antevs' Altithermal phase. Hayden based relative chronological assignments on varying thicknesses of desert varnish and caliche on tools and features. Very thickly varnished tools embedded in pavements were assigned to the Malpais complex. Later San Dieguito tools had a thinner layer of desert varnish. Post-Altithermal, Amargosan artifacts included unvarnished materials resting on desert pavement. Hayden also suggested that caliche had weathered away from the surfaces of rocks in pre-Altithermal features. No Malpais material was chronometrically dated or recovered from stratified deposits.

Hayden's assignments of great antiquity depend on the validity of his assumptions regarding the formation of desert pavement and desert varnish, as well as the occurrence and severity of the Altithermal drought. Recent evidence for rapid formation of pavements through the expansion and contraction of soils indicates that desert pavements need not be ancient and need not have formed only during periods of extreme aridity (Bales and Pewe 1979; Howard, Cowan, and Inouye 1977). Desert varnish formation occurs at different rates in different localities, depending on climatic and geologic conditions. Optimal conditions for varnish coating occur on basalt surfaces in arid regions with summer monsoon rains (Moore and Elvidge 1982:527). Such conditions characterize the Sierra Pinacate. Although Hayden's relative chronology is probably valid for the Sierra Pinacate, it is difficult to generalize his results to other regions. Absolute dates and pre-Paleoindian age assignments remain tenuous.

Claims of great antiquity for desert sites have also focused on skeletal remains. A recent controversy centered on the age of the "Yuha Man" skeleton found in the desert west of El Centro, California. Caliche surrounding the bone yielded a radiocarbon date exceeding 20,000 years (Bischoff et al. 1976). Critics charged that caliche is unreliable for radiocarbon dating of associated cultural materials, since it may be dissolved and redeposited after its initial formation. They also noted that the geological context was inconsistent with the reported age (Payen et al.

1978). In 1980, the Yuha skeleton mysteriously disappeared from a storeroom at Imperial Valley College (West 1983). However, a minute quantity of remaining fragments was recently radiocarbon dated by the University of Arizona particle accelerator. The results indicated an age not exceeding 5000 years (*Science 84*(4):11).

Two decades ago, Jennings (1968:65-68) reviewed the evidence for alleged pre-Paleoindian cultures. He argued that location, crudeness, and surface alteration alone are poor indicators of great antiquity. He pointed out that apparently ancient surface finds were similar to lithic specimens recovered from stratified sites in clear association with materials known to be relatively recent. Other specimens turned out to be quarry materials or items of dubious cultural origin.

Recent chronometric studies support Jennings' cautionary position. In the Mohave Desert, radiocarbon dates from the organic component of desert varnish were recently used to calibrate cation-ratio dates. Catio-ratio dating is an experimental method based on the rates at which minor chemical elements are leached out of rock varnish (Dorn et al. 1986). Dates on over 100 artifacts from 6 surface lithic scatters indicated the distinct possibility of a pre-Clovis occupation. However, scientists concluded that most sites were quarries used over long time spans extending to late prehistoric times (Dorn et al. 186:832). Until better evidence is obtained from stratified contexts or reliable chronometric techniques, "claims for extreme human antiquity in southern California will remain statements of faith rather than fact" (Aikens 1983:661). This statement also applies to western Arizona, where the earliest occupations have been interpreted from a Californian perspective.

THE PALEOINDIAN PERIOD

This period extended from roughly 10,000 to 8,000 B.C., when much of western Arizona was covered by open juniper-scrub oak woodlands (Van Devender and Spaulding 1979). Moist grasslands in southeastern Arizona supported large game, including the now extinct mammoth. That corner of the state has yielded the remains of extinct large mammals in association with the lanceolate, fluted projectile points of the Clovis tradition (Haury, Antevs, and Lance 1953; Haury, Sayles, and Wasley 1959). The traditionally assumed Paleoindian emphasis on big game hunting has recently been questioned in the light of settlement and artifact analyses (Martin and Plog 1973:156-162). It may have been an important, but not overriding, activity.

A separate, contemporaneous "western co-tradition" existed in western Arizona and the Great Basin (Davis et al. 1969). This tradition incorporated crude, percussion-flaked lithic tools rather than the finely made bifaces of the Plains-centered Paleoindian complexes. In western Arizona and southern California, the western co-tradition was manifested in Rogers' San Dieguito complex.

Clovis and Folsom

Clovis points occur in surface contexts over much of the western United States. In Arizona, finds have clustered in the eastern part of the state, where grasslands once supported game herds (Agenbroad 1967). None have been reported from the Lower Colorado Valley subdivision of the Sonoran Desert (Berry and Marmaduke 1982:117). Later Folsom tradition points have a more restricted distribution than Clovis points. However, a reworked Folsom point was recently recovered from the Dendora Valley just north of Gila Bend (Effland, Green, and Robinson 1982).

The lower levels of Ventana Cave in the eastern Papagueria have produced the earliest dated evidence for occupation of the Arizona Sonoran Desert (Haury 1950). The earliest occupational stratum yielded remains of extinct fauna, artifacts of the "Ventana complex", and a radiocarbon date of 9350 B.C. with a confidence interval of 200 years. Artifacts included scrapers, choppers, and a thin, unfluted projectile point resembling both Clovis and Folsom types in form. Controversy has focused on the cultural affiliation of the Ventana complex. Haury (1950) originally defined the complex as a mixture of San Dieguito and Folsom. In his preface to the second printing of the report in 1975, he suggested that the point was a local Clovis imitation. Rogers (1966:29) and Hayden (1976:288) defined the assemblage as San Dieguito with an intrusive Clovis point. Irwin-Williams (1979:34) dismissed the "crude concave-based point" as neither Clovis nor Folsom. She suggested that the assemblage was most comparable to those of the later Cochise culture. McGuire and Schiffer (1982:171) observed that the transitional nature of the Ventana complex reflected the environmental transition between the grassy plains of eastern Arizona and the open woods and desert to the west. They suggested that "the association of the Clovis point, megafauna, and San Dieguito artifacts demonstrates that a group that manufactured and used Clovis points, probably for hunting horse and bison, also engaged in a wider range of subsistence activities" (McGuire and Schiffer 1982:172). This view is plausible, but it is unwise to assign great interpretive significance to a single artifact.

San Dieguito

Malcolm Rogers (1966) incorporated western Arizona into the "southeastern aspect" of his San Dieguito complex. He originally defined early desert occupants as the "scraper maker people" (Rogers 1929), in reference to their most common artifact type. He later introduced the San Dieguito term and defined three phases: Malpais, Playa I, and Playa II (Rogers 1939). These were eventually renamed as San Dieguito (SD) I, II, and III (Rogers 1958).

According to Rogers, the San Dieguito lithic industry extended over much of western Arizona and southern California. San Dieguito I remains had the widest distribution, and those of the later phases were more restricted. In Arizona, SDII materials occurred along the eastern bank of the Colorado River, and SDIII remains were virtually absent (Rogers 1966:6). Except for a single isolated artifact (Rogers 1966:68), remains of the later phases have yet to be found in the desert away from the river (McGuire and Schiffer 1982:167).

Rogers' phase sequence was based primarily on his studies of surface remains. Only two stratified sites, the C. W. Harris site near San Diego and Ventana Cave, have

yielded datable evidence of San Dieguito occupations, and nowhere have all three phases been recovered in stratigraphic context (Haury 1950; Warren 1967). Rogers defined phases on the basis of topographic associations, variations in weathering and patination of artifacts, and an assumption of increasing technological sophistication through time. San Dieguito remains were associated with Pleistocene river terraces and the beaches of extinct California lakes. Presumably ancient desert pavements also yielded San Dieguito materials.

San Dieguito I assemblages included a variety of percussion-flaked chopping, scraping, and pounding tools (Rogers 1939, 1958, 1966; Warren 1967). These were generally large, crude implements; blades and projectile points were rare. According to Rogers, these earliest tools were heavily patinated and weathered, with flake scars dulled by "sand blasting".

San Dieguito II assemblages incorporated elongated, leaf-shaped points, more finely worked bifaces, and a greater variety of scrapers. San Dieguito III artifacts included smaller, pressure-flaked specimens such as points, small knives, slender blades, amulets, crescents, and new scraper forms.

Features assigned to the San Dieguito complex included cleared circles, rock rings or "sleeping circles", trails, rock alignments, and intaglios. Rogers realized that these phenomena were not exclusive to San Dieguito. He distinguished relative ages of features on the basis of topographic context, differential weathering, and associated artifact types.

Chronometric dates for San Dieguito remains are quite rare. Charcoal from the C. W. Harris site yielded radiocarbon dates in the range of 7000 to 6000 B.C. for SDIII materials (Warren 1967:179). In western Arizona, the SDIII phase is virtually absent, and attention must be shifted to the initial phase. If the Ventana complex can be confidently assigned to the SDI phase, then the radiocarbon dates from Ventana Cave indicate that SDI materials may pre-date 9000 B.C.

Researchers have questioned the validity of the San Dieguito concept, particularly its phase sequence. San Dieguito I materials have not been found in stratigraphic context below those of the other two phases. This situation, in conjunction with assemblage differences and incongruous geographic distributions, indicate a very tenuous connection between SDI and the later phases. San Dieguito I materials, particularly those in western Arizona, may actually have little relationship to the SDII and SDIII phases in southern California (Irwin-Williams 1979:34; McGuire and Schiffer 1982:169; Warren 1967:171).

Warren (1967) summarized problems with Rogers' definition of the San Dieguito phase:

> Malpais (San Dieguito I) is thus defined by a series of artifacts which show little stylistic patterning, have wide temporal and areal distribution, are from widely scattered sites which were often occupied or utilized by peoples of other cultures, and which are temporally placed on the basis of high degree of chemical alteration on the flake scars. These criteria hardly seem sufficient for the definition of a cultural unit [Warren 1967:170].

Problems with Rogers' assumptions regarding the accumulation of desert varnish and the antiquity of desert pavement have been discussed in relation to Hayden's work. In addition, a reading of Rogers' survey notes reveals that he placed an inordinate emphasis on particular topographic associations in the assignmnet of materials to the SDI phase. Artifacts on upper bajada desert pavements seem to have been automatically assigned to the phase regardless of possible associations with later sites. Phase assignments reflected Rogers' belief that the San Dieguito occupation occurred during a wetter, more hospitable period. Thus sites far from modern water sources were assigned to the SDI phase.

Finally, Rogers did not consider functional interpretations of San Dieguito assemblages. He did not address the possibility that SDI assemblages represented a particular set of activities rather than a group of early hunters camping "in their scattered manner" (Rogers n.d.). The wide areal and temporal distribution and the lack of stylistic patterning noted by Warren indicate that the choppers, scrapers, and crude bifaces of SDI may represent a basic, multi-purpose tool kit that could be quickly produced from local raw materials. McGuire and Schiffer (1982:178) suggested that the predominance of steep-angled unifacial tools was consistent with a woodworking tool kit.

In summary, the extent and nature of Pleistocene and early post-Pleistocene occupation of the study area is unknown, particularly given the uncertain status of the San Dieguito I concept. Ancient occupations are suggested by desert pavements containing embedded lithics with heavily patinated flake scars. Such areas include the margins of the Harquahala Valley and the area at the northern base of the Eagletail Mountains, designated by Rogers as the "Great Malpais area" (Rogers n.d.). However, it is difficult to assign these surface lithic scatters to a particular culture or time period, since they may well represent quarrying or expedient tool manufacturing areas used repeatedly over centuries or even thousands of years.

During the Paleoindian period of probable low population densities, west central Arizona may have been a marginal zone rarely occupied or used by aboriginal groups. The region lacked important resources available in adjacent regions prior to 8000 B.C.: herds of large mammals in the southeastern Arizona grasslands and lacustrine resources associated with the pluvial lakes of southern California. Given the absence of pluvial lakes (Meinzer 1922) and a less lush environment than southeastern Arizona, the study area was probably perpheral to major areas of Paleoindian settlement.

ARCHAIC OCCUPATIONS

The retreat of the continental glaciers at the end of the Pleistocene initiated a trend of increasing temperatures and aridity resulting in vegetation shifts and the dessication of pluvial lakes in the Great Basin and California. Many large mammal species became extinct in response to either climatic changes or overhunting (Martin 1967). In western Arizona, there appears to have been a synchronous and rapid retreat of the juniper woodlands at about 6000 B.C. (Van Devender and Spaulding 1979:707).

In the western United States, these environmental changes are generally acknowledged to have been accompanied by shifts in human subsistence strategies. The subsistence base apparently became more diversified, incorporating a broad range of plants and fauna with less emphasis on the hunting of large game. Following excavations at Danger Cave in the Great Basin (Jennings 1957), Jennings and Norbeck (1955) introduced the Desert Culture concept to represent this foraging lifeway. As originally defined, the Desert Culture was a widespread cultural pattern distinguished by seasonal mobility, a reliance on wild grasses and small game, and the conspicuous presence of grinding implements and basketry. It was ancestral to later farming traditions but persisted to historic times in portions of the Great Basin.

The Desert Culture concept has been criticized for its neglect of spatial and temporal variation in subsistence and settlement strategies (Bettinger 1978; Madsen and Berry 1975). In actuality, the original definition did allow for regional variants, and Jennings (1968) later linked the Desert Culture to the concept of a continent-wide Archaic developmental stage characterized by technological versatility and the efficient exploitation of a wide variety of wild, seasonally available resources (Willey and Phillips 1955). In the North American deserts, the Archaic stage incorporated numerous regional variants linked by the challenge of survival in an arid environment.

For the Archaic stage in the Southwest, Irwin-Williams (1967) defined an "elementary culture" designated as the Picosa, an acronym for the Pinto Basin, Cochise, and San Jose regional variants. These western, southern, and northern variants shared a number of general traits including grinding implements, simple circular brush shelters, and intensive exploitation of a range of resources. Dates were given as 3000 B.C. to A.D.1. The western variant in southwestern Arizona and southeastern California was characterized by core and flake tools, heavy planes and choppers, shallow basin grinding slabs, and stemmed, indented base and leaf-shaped projectile points. Map 6-1 shows selected Archaic site locations in the Southwest and Great Basin.

Two Archaic traditions are relevant to the prehistory of west central Arizona. The Amargosa tradition was originally defined in the California desert. The Cochise culture is considered to be the dominant Archaic manifestation in southeastern and central Arizona.

Amargosa

Rogers (1939) defined the Amargosa tradition from studies of sites located near playas, stream channels, and highland springs in southern California. He believed that an Amargosan incursion resulted in the displacement or absorption of San Dieguito groups in western Arizona (Rogers 1958, 1966). He first defined a sequence of Pinto-Gypsum, Amargosa I, and Amargosa II phases (Rogers 1939). A later revision of the sequence was presented in the Ventana Cave report (Haury 1950:534). The later version added an additional, earlier phase designated as Amargosa I. The Pinto-Gypsum phase became Amargosa II. The initial Amargosa I phase became Amargosa III, and the last phase of the initial sequence was defined as a Basketmaker phenomenon. The following discussion is based on the 1950 phase revision. Table 6-1 correlates Archaic phase designations for southwestern Arizona. Archaeologists in the southern Great Basin have retained the Pinto designation to refer to a tradition preceeding Amargosa and dating from approximately 5000 to 2000 B.C. (Bettinger and Taylor 1975; Wallace 1962; Weide 1976).

In general, the Amargosa tradition witnessed the addition of grinding implements and various projectile point types to a percussion-flaked lithic assemblage reminiscent of San Dieguito I. The latter included flake scrapers, scraper planes, and thick cobble and flake choppers (Irwin-Williams 1979:38; Rogers 1939). Points of the Amargosa I phase were crude with basally notched stems (Haury 1950:290). Grinding implements were rare and consisted of thin, flat schist slabs (Rogers 1939:52). Features included the ubiquitous cleared circles, rock alignments, trails, and intaglios.

Metates and mortars appeared during the Amargosa II phase (Rogers 1958:6). Metates consisted of shallow basins used with cobble manos. New projectile point types included Pinto types with shallow notches and expanding, concave-based stems which were often wider than the blades (Haury 1950:278,286). Other points, commonly known as Gypsum points, had narrow, sharply contracting stems with convex bases (Haury 1950:281).

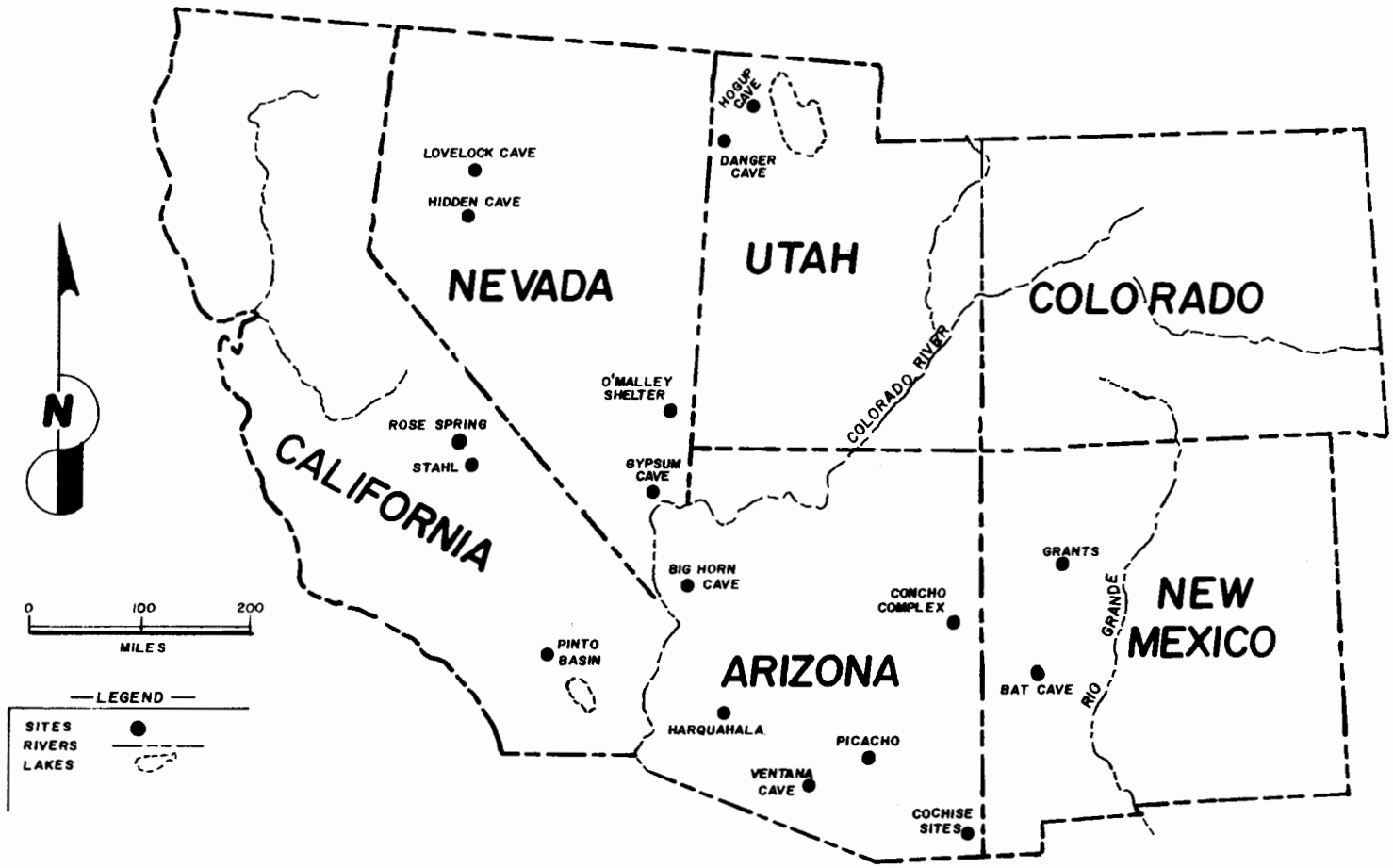
There was an increase and elaboration of bifacially flaked implements during the Amargosa III phase (Irwin-Williams 1979:39). Projectile points were long and corner-notched with triangular blades (Rogers 1939:Pl. 16). Hayden (1967:339) claimed that plain brownware ceramics were associated with late Amargosa artifacts in southern Arizona.

As with the San Dieguito complex, the relative chronology of the Amargosa tradition is based largely on surface remains. Haury (1950) recovered Amargosa I and II artifacts from the lower levels of Ventana Cave. In California, the stratified Stahl site yielded a variety of artifacts and features but no radiocarbon dates (Harrington 1957). At no site have all three phases been found in stratigraphic context. Rogers, of course, relied heavily on geographic location, artifact weathering, and the presence of grinding implements as indicators of Amargosa affiliation and relative age. The possibility remains that the Amargosa and San Dieguito traditions reflect functional rather than cultural or temporal distinctions.

Given the paucity of chronometric evidence, absolute dates are uncertain. Haury (1950:530-539) correlated the Ventana deposits with then existing geochronological schemes and suggested dates of 3000 B.C. to A.D.1 for the Amargosa tradition. Irwin-Williams (1979:38) recently suggested an Amargosan time span from 3000 B.C. to 500 B.C. According to Rogers' final publication, Amargosa I began by 5000 B.C. (Rogers 1966).

Cochise

The Cochise culture was defined by Sayles and Antevs (1941) based on materials first recovered from arroyo banks in southeastern Arizona. They originally outlined



MAP 6-1: SELECTED ARCHAIC SITE LOCATION IN THE SOUTHWEST & GREAT BASIN

TABLE 6-1

ARCHAIC PHASE DESIGNATIONS FOR SOUTHWESTERN ARIZONA

Amargosa (Rogers 1939)	**Amargosa** (Haury 1950)	**Ventana Cave** (Haury 1950)	**Dates** (Bryan)	**Dates** (Antevs)	**Huckell** (1984)
Amargosa II	Basket Maker III	Hohokam	A.D. 200+	A.D. 200+	A.D. 300+
Amargosa I	Amargosa III	San Pedro	1000 B.C. - A.D. 200	3000 B.C.- A.D. 200	Late Archaic 1500 B.C. - A.D.300
Pinto-Gypsum	Amargosa II	Chiricahua-Amargosa II	2000 B.C.-1000 B.C.	7000 B.C.-3000 B.C.	Middle Archaic 4800-1500 B.C.

Playa	Amargosa I	Ventana-Amargosa I	3000 B.C.-2000 B.C.	8000 B.C.-7000 B.C.-	Early Archaic 8500-4800 B.C.

three phases: Sulphur Spring, Chiricahua, and San Pedro. An intermediate phase following Sulphur Spring, the Cazador, was later proposed by Sayles (1945). Whalen (1971) argued that the Cazador was part of the Sulphur Spring phase.

The Sulphur Spring phase incorporated a basic Cochise assemblage consisting of choppers, scrapers, planes, slab metates, and cobble manos (Sayles and Antevs 1941). The preponderence of grinding implements indicated that the exploitation of wild plant foods was an important activity. Sayles and Antevs noted a lack of projectile points, but later researchers found crude, leaf-shaped specimens (Ferg 1977:8). Antevs dated the archaeological deposits geologically and considered the phase to predate 8000 B.C. On the basis of nine radiocarbon dates, Whalen (1971:67,69) proposed a range of 7000 to 3500 B.C. The apparent association of extinct Pleistocene fauna with Sulphur Spring materials created controversy concerning the validity of the association and the relationship between Sulphur Spring and Clovis occupations (Haury 1960; Sayles and Antevs 1941; Whalen 1971). McGuire and Schiffer (1982:173) supported Haury's arguments favoring the validity of the association.

Basin metates and percussion flaked bifaces, along with bone and antler tools, appeared in the Chiricahua phase (Sayles and Antevs 1941). Pressure flaked projectile points, rare and first considered as intrusive, were short with expanding stems and concave bases (Haury 1950:298). Antevs suggested dates of 8000 to 3000 B.C., but Whalen (1971) revised this interval to 3500-1500 B.C.

San Pedro phase assemblages included a variety of pressure flaked lithic tools, deep basin metates, and mortars and pestles (Sayles and Antevs 1941). San Pedro points were pressure flaked, finely crafted specimens. These stemmed, elongated forms had slightly oblique notches and convex or straight bases (Haury 1950:288-289). The San Pedro type site, a base camp judging from its size and the presence of possible structures, contained hearth features and storage pits (Ferg 1977:8; Sayles and Antevs 1941). For this phase, Antevs gave dates from 3000 to 500 B.C., while Whalen (1971) revised these to 1500 to 200 B.C. Ceramics and evidence of agriculture have been found at late San Pedro phase sites (Huckell and Huckell 1985; Martin et al. 1949; Sayles 1945; Wilcox 1979:79).

Ventana Cave

Just as its earliest level yielded an apparent mixture of San Dieguito and Clovis materials, later deposits at Ventana Cave contained an apparent combination of Amargosa and Cochise remains. Haury (1950:531) suggested that the cave was a "meeting ground" for cultural traditions to the west and east. This status also reflected the meeting of minds of the three archaeologists who jointly interpreted the cultural remains: Haury, Hayden, and Rogers.

An erosional disconformity separated the earliest remains of the Ventana complex from later Archaic deposits (Haury 1950:534). The earliest level attributed to an Archaic occupation contained Amargosa I points and was labeled the "Ventana-Amargosa I" pattern. Haury (1950:532) suggested a western affiliation for these remains.

The "Chiricahua-Amargosa II" level was named for its mixture of characteristic materials. Notable among these were the "Pinto points" which closely resembled Chiricahua Cochise points in form. Haury (1950:296) regarded the Chiricahua points as variations of the Amargosa II (Pinto) point.

The succeeding level contained San Pedro Cochise points but a lack of Amargosa III traits (Haury 1950:533). In summary, the preceramic sequence showed a mixture of western (San Dieguito and Amargosa) and eastern (Clovis and Cochise) cultures, with an early predominance of the former gradually giving way to a preponderence of late Cochise traits. Haury suggested a late expansion of Cochise peoples. He attributed the cave's "meeting ground" nature to its marginal geographic position.

As McGuire and Schiffer (1982:177) noted, there are obvious similarities between the lithic assemblages and projectile point types of the Amargosa and Cochise traditions. Hayden (1970:88) argued for the existence of one overall complex, the Amargosa. Berry and Marmaduke (1982:118) suggested that "the two models, traditionally viewed as either competing or areally distinct, may be complimentary, two views of the same thing from opposite directions". Marmaduke (1984:88) further questioned the validity of the distinction between Amargosa and Cochise:

> Materially, neither seems strikingly different from the other, and the divergences that do exist can easily be laid to differing conditions of environment and preservation in the two halves of southern Arizona. It may well be that the Archaic of southern Arizona is basically unitary in most respects, with meaningful variation seen only where great distances intervene between data samples.

McGuire and Schiffer (1982:177) observed that similarities in the Archaic traditions reflected "the basic cultural dynamics of hunters and gatherers in arid environments". Differences were conditioned by local and regional environmental variation. They hypothesized that Cochise sites in the wetter southeastern part of Arizona should contain a relatively larger proportion of metates and projectile points, used for wild seed exploitation and the hunting of large game. These resources would have given way to tree legumes and small game in the more arid western desert, suggesting relatively fewer points and a higher proportion of mortars and multi-purpose grinding and crushing implements in the ground stone assemblage (McGuire and Schiffer 1982:178).

These unifying approaches to Archaic prehistory stress ecological rather than cultural factors as sources of variation. In the future, the utility of the Amargosa-Cochise distinction may decline as researchers focus on the definition and economic bases of regional variants. Huckell (1984:198) has taken an initial step in this direction by abandoning the cultural distinction in favor of a more general, three phase Archaic division characterized by different projectile point styles: an early Archaic period, from 8500 to 4800 B.C., by "tapering-stemmed" points; the middle Archaic period, from 4800 to 1500 B.C., by Pinto and Gypsum point styles; and the late Archaic, from 1500 B.C. to A.D. 300, by San Pedro and Elko Corner-notched types.

The Archaic Period in the West Central Desert

In western Arizona, Malcolm Rogers attributed the vast majority of Archaic sites to the Amargosa III and later phases (Rogers n.d.). He recorded large sites with quantities of grinding implements and few or no ceramics in the Kofa and Castle Dome mountain ranges. Structural remains included circular and rectangular cobble alignments. Each structure had at least one associated metate. According to Rogers, Amargosan basin metates were often patinated or decomposed, and later Yuman occupants favored slab forms. The Archaic sites contained roasting pits, as well as burned bones of deer and bighorn sheep.

In the study area, Rogers recorded Amargosa sites on the terraces of the Bill Williams River and the upper bajada of the southern Harquahala Valley. In the "Great Malpais" area north of the Eagletails, Rogers found Amargosa sites where large drainages emerged from the mountains (Rogers n.d.). He suggested that these drainages once contained water holes. These sites were designated as temporary camps and quarries, in contrast to the base camps located in the Kofa, Castle Dome, and Plomosa ranges.

Artifact scatters containing diagnostic Archaic projectile points have been found along Centennial Wash in the Harquahala Valley. Three concentrations of sites, incorporating at least 17 loci, have been documented between Lone Mountain and Saddle Mountain (Bostwick 1984, n.d.; Bostwick and Stone 1985; Brown and Stone 1982). Excavations revealed little depth, but the diverse artifact assemblages, diagnostic artifacts, formal tools, and a small number of radiocarbon dates indicated a late Archaic age post-dating 1500 B.C. Sherds, although not absent, were extremely rare at these sites. Several of the sites appear to have been base camps periodically reoccupied during seasons of locally available resources. Food resources accessible to the inhabitants probably included mesquite, amaranth, greens, and small game (Bostwick n.d.; Brown and Stone 1982). Numerous grinding implements were present.

Functional differentiation among sites is indicated by differences in the artifact assemblages of the Harquahala Valley Irrigation District sites (Bostwick 1984, n.d.) and those found further northwest along the Granite Reef Aqueduct (Brown and Stone 1982). The production and maintenance of lithic tools, particularly the final stages of biface manufacture, were major activities at the Granite Reef sites (Lewenstein and Brown 1982). In addition, grinding implements represented a much smaller proportion of the assemblage. Future research may illuminate the nature of these differences and their implications in terms of settlement and subsistence strategies.

Although San Pedro points dominated projectile point types at the Harquahala Valley sites, there was a mixture of types including "Chiricahua", Gypsum, and Elko styles. The apparent mixture of Amargosa and Cochise materials echoes the situation at Ventana Cave (Haury 1950). On the basis of conventional distributional maps (Irwin-Williams 1979), one would expect to find Amargosa rather than Cochise remains in the Harquahala Valley (Marmaduke 1984:88). These sites represent the most substantial San Pedro manifestation yet found to the northwest of Ventana Cave. This occupation may have resulted from the westward expansion of San Pedro peoples envisioned by Haury (1950:533). On the other hand, migration may not have been a factor in light of the questionable validity of the Amargosa-Cochise distinction (Berry and Marmaduke 1982:118; Marmaduke 1984:88; McGuire and Schiffer 1982:177). The Harquahala Valley sites may represent a regional variant of the southern Arizona Archaic, with an economy based on the use of desert resources, including those found along major but nonpermanent drainages.

THE CERAMIC PERIOD: PATAYAN, HAKATAYA, AND HOHOKAM

By definition, the Archaic period in the Southwest ended with the introduction of ceramics and the practice of agriculture. This transition took place over a long period of time, but events and processes are far from clear. Near the end of the Archaic period, increasing population densities and a decline in average effective precipitation may have reduced the efficiency of mobile hunting and gathering and favored the adoption of farming, a greater reliance on storage, and a settlement shift toward major rivers and streams (Wilcox 1979).

In western Arizona, Malcolm Rogers again devoted the greatest effort to the construction of a regional chronology, but not without controversy over its content and terminology. The history of changing cultural terms employed by archaeologists was reviewed in Chapter 5. "Patayan" is the favored term in this overview.

Patayan

Rogers (1945) based his chronology on the study of Lower Colorado Buffware ceramics, which were "produced and used along the Colorado River from the southern tip of Nevada to the Gulf of California, along the drainage of the lower Gila River, and in the peripheral deserts of western Arizona and southern California" (Waters 1982:275). Rogers was never able to publish his analyses in detail. In the 1970s, Michael Waters, then a University of Arizona graduate student, undertook an intensive reexamination of Rogers' notes and ceramic collections. He published a review of Patayan ceramic typology and chronology which supported Rogers' methods and conclusions (Waters 1982).

The absence of stratified sites led Rogers to adopt innovative techniques for dating pottery types (Waters 1982:276-277). He excavated trail shrines (mounds of sediment, cobbles, and artifacts) and employed "horizontal trail stratigraphy". He postulated that trails intersected by headcutting arroyos were older than adjacent, intact trail segments. If such trail segments yielded different types of pottery, the sherds along the abandoned trails were probably older. Some types were dated by virtue of their association with dated shorelines of freshwater Lake Cahuilla in the Salton Basin of California. Intrusive sherds, such as Hohokam types and the Salton sherds manufactured near Lake Cahuilla, linked absolute dates to the relative chronology.

In his chronological and distributional studies, Rogers emphasized differences in surface treatments and vessel and rim forms (Waters 1982:277). Schroeder (1952) later

redefined ceramic types on the basis of variations in temper and surface treatments. Waters (1982) defended and refined Rogers' approach. He argued that temper should be a secondary rather than the primary factor in classification, since distinct differences in paste and temper composition were often difficult to define.

Rogers proposed three periods of Patayan prehistory: Yuman I, II, and III. This document will replace "Yuman" with "Patayan", following McGuire and Schiffer (1982) and Waters (1982). Rogers (1945) dated the Patayan I period at A.D. 900 to 1050, and Waters (1982:281) revised this range to A.D. 700 to 1000. Waters' dates were based on associations with dated Hohokam intrusives at trail shrines and the Bouse site, radiocarbon dates from features near the Palo Verde nuclear plant site (Stein 1981), and the absence of Patayan I types at well dated sites of later periods. Patayan I sherds have been found associated with Colonial period Hohokam sherds in stratigraphic context (Harner 1958; Waters 1982). Characteristic traits include rim notching, lug and loop handles, the "Colorado shoulder", incised decoration, burnishing, and red clay slips (Waters 1982:282). According to Rogers' distributional maps (Waters 1982:286), Patayan I ceramics were confined to the southern portion of the lower Colorado River, below present-day Parker. Although they also occurred along the lower Gila River, they were rare beyond 30 miles (48 km) east of the Colorado-Gila confluence. Redwares were the dominant type at the Bouse site and along trails in western Arizona. According to Waters (1982:287), "ceramics found away from the river were transported there for use by the Lowland Patayan or were traded to non-pottery making people".

At the Bouse site, Harner (1958) defined the contemporaneous Bouse Phase I. Patayan materials were associated with intrusive Hohokam sherds and Hohokam 3/4 grooved axes.

Rogers (1945:196) postulated that the Patayan sequence began with immigration by either Hokan (Yuman) people from southern California or non-Hokan people from Papagueria or Sonora. Although he postulated a "Gila-Sonoran" interaction sphere, he denied a Hohokam derivation for Lower Colorado Buffware. Rogers (1945:186) attributed changes in ceramic traits at the end of Patayan I to new Hokan immigrants or internecine warfare along the lower Colorado River.

On the basis of his Colorado River survey and excavations at the Willow Beach site north of Needles, Schroeder (1952) challenged aspects of Rogers' reconstruction. He argued that Lower Colorado Buffware did not originate in the Colorado delta region. In this regard, it is interesting that linguistic historians believe Yuman languages were originally spoken in the circum-delta area of southwestern Arizona, northwestern Sonora, northern Baja California, and southern California (Hale and Harris 1979:174). If the Patayan were ancestral to the Yumans, this would tend to support Rogers' version of culture history.

Schroeder noted the similarity between red slipped Patayan ceramics and Hohokam redwares and argued that their development resulted from contact with the Hohokam after A.D. 1150. However, Harner's (1958) excavations at the Bouse site supported an early date for Patayan redwares, and Waters (1982) argued in favor of Rogers' conclusions.

Old ceramic traits were discarded and new ones introduced during the Patayan II period dating from A.D. 1000-1500 (Rogers 1945; Waters 1982). Discarded traits included the Colorado shoulder, red clay slips, burnishing, incised decorations, and certain vessel forms (Waters 1982:282). New forms were introduced, as were recurved rims and stucco finishes. Patayan II types were dated by virtue of associations with intrusive sherds, their absence in firmly placed sites of other periods, and geological association with the 12 meter shoreline of Lake Cahuilla (Waters 1982:289).

At the Bouse site, Harner (1958) defined Bouse Phase II. He noted a continuation of Phase I traits, and sherds were associated with intrusive Verde Black-on-grey pottery (Prescott Grayware).

The Patayan II period witnessed an expansion of Lower Colorado Buffware into the Mohave Desert, northward along the Colorado River, and east to Agua Caliente along the Gila River (Waters 1982:288). Rogers (1945:190) interpreted this range as evidence for the expansion of Patayan populations. In the California desert, Patayan groups inhabited the shore of Lake Cahuilla and exploited fish, shellfish, and aquatic avifauna (Weide 1976). In western Arizona, Patayan II types occur along trails, and Wasley and Johnson (1965) found intrusive Patayan sherds at Hohokam sites in the Gila Bend area. They postulated an increase in the level of interaction between the Patayan and the Gila Bend Hohokam.

The Patayan III period incorporated protohistoric and historic times following A.D. 1500. Ceramic continuity was the rule, with relatively few new types or traits (Waters 1982:291). Several types ceased to be made, and there were refinements in construction, symmetry, thinness, and painted decoration. Patayan III ceramics have been found in historic sites and on the Lake Cahuilla bottom. Several types were manufactured historically by the Mohave and other tribes (Kroeber and Harner 1955).

Patayan sherds have been found in the Papagueria and Sierra Pinacate (Ezell 1954; Waters 1982:291). They also occur in the Phoenix area, the White Tank Mountains, and the vicinity of Wickenburg (Rice and Dobbins 1981; Stone 1982). Stein (1981) reported on Lower Colorado Buffware found in the Palo Verde Hills. Occurrences in the vicinities of Phoenix, Wickenburg, and Gila Bend were probably associated with the migrations of the Gila River Yumans into the area (Spier 1933; Stone 1982:129-130). Wasley and Johnson (1965) argued in favor of a gradual replacement of Hohokam populations by Patayan groups after A.D. 1200 in the Gila Bend area.

Other population shifts may have occurred during the Patayan III period. The dessication of Lake Cahuilla, which began at approximately A.D. 1500 (Hubbs et al. 1965), may have prompted shoreline populations to migrate to the lower Colorado valley or the California coastal mountains (Rogers 1945; Weide 1976). Rogers (1945) postulated an expansion of Yuman groups, the ancestors of the Pai or upland Yumans, into western Arizona. The upland Yumans produced brownware pottery rather than Lower Colorado Buffware (Rogers 1936).

There is little archaeological evidence on which to base reconstructions of Patayan settlement, subsistence, and organizational patterns. Few investigations have been undertaken, and many sites near the Colorado River have probably been buried by silt deposition, inundated, or eroded by the lateral shifting of channels (Swarthout 1981). The lack of information from stratified sites has also obscured the relationship between prehistoric Patayan and historic Yuman populations. Although it is meager, evidence on material culture and settlement patterns indicates Patayan-Yuman continuity (Colton 1945; Huckell 1979).

Researchers have based models of settlement and subsistence on assumptions of continuity in land use patterns (Brown and Stone 1982:30; McGuire and Schiffer 1982:255; Swarthout 1981:65-67). Ethnographic analogy indicates reliance on river floodwater farming, fishing, gathering, and hunting. Swarthout (1981:66) suggested that winter base camps were located on the bajadas and lower slopes of mountains east of the Colorado River. Rogers (n.d.) stressed the economic significance of the desert to groups residing along the rivers. In his survey notes, he attributed desert Patayan materials to temporary camping and resource exploitation near desert trails linking reaches of the Colorado and Gila rivers; the exploitation of game, agave, and jojoba from seasonal mountain camps; and the gathering and processing of mesquite near major washes. Ethnographers were not able to observe such land use patterns.

Hakataya

Albert Schroeder (1957, 1979) proposed the Hakataya concept to encompass the indigenous descendants of Archaic groups in much of central and western Arizona. The Hakataya range was defined as the area south of the Grand Canyon and west of the Mogollon Rim, extending into southeastern and Baja California. This range incorporated that of the historic Yuman tribes as well as diverse prehistoric patterns including the river and upland Patayan, the Pioneer Hohokam, the Salado, and the Sinagua. In southern Arizona, Schroeder (1960:32) argued, the entry of the Hohokam into the Salt-Gila Basin affected surrounding Hakataya populations. The pattern of mobile, seasonal hunting and gathering was altered by the Colonial period diffusion of Hohokam traits after A.D. 700. Schroeder argued that environmental deterioration eventually led to the Hohokam abandonment of the region and the resumption of extensive hunting and gathering by the Hakataya. The Yavapai were seen as the descendants of the indigenous Hakatayan population.

A set of general traits was associated with the "rock-oriented" Hakataya. Hunting and gathering were important pursuits, although simple farming methods were practiced where environmental conditions were suitable. Artifacts and features included plain brown and gray ceramics produced by paddle and anvil, percussion-flaked choppers, slab metates used for both grinding and pounding, wooden and stone mortars, triangular projectile points, roasting pits, circular or oval brush shelters outlined by rocks, trail shrines, and thin trash deposits.

McGuire and Schiffer (1982:221) criticized the generality of the Hakataya concept:

> Schroeder has mapped the distribution of ethnographic Yuman speakers and included in the Hakataya root all the archaeological manifestations that occur in this range. The diversity incorporated by this concept is extreme, even exceeding the material culture variability of the ethnographic Yumans. Groups such as the Cerbat, Pioneer Hohokam, and Salado share few aspects of ceramic technology, architecture, settlement pattern, and subsistence. More importantly, each of these groups is more similar to other roots than to one another, i.e., Salado to Mogollon, Pioneer Hohokam to Hohokam or O'otam, and Cerbat to Patayan. In view of these patterns, the few traits Schroeder finds in common for these groups . . . appear inadequate to support a common culture across all of western Arizona.

The inclusiveness of the Hakataya concept undermines its interpretive value; substantive studies require a more narrow focus. However, the concept can serve as a perspective from which to generate hypotheses concerning economic and social changes. For example, it seems premature to discard the hypothesis that, in some portions of the Hakataya range, indigenous groups periodically modified subsistence patterns and eventually reverted to the extensive pattern of hunting and gathering practiced by the historic Yavapai.

There are two major approaches to the question of Yavapai origins. Schroeder (1960, 1981) argued for Hakataya-Yavapai continuity and suggested that similarities between prehistoric sites and historic lifeways supported this contention. Pilles (1981:172) described a variation of this hypothesis:

> A variation . . . suggests the Yavapai are descendants of other prehistoric groups such as the Prescott and Southern Sinagua. According to this concept, hunting and gathering was a basic way of life to the peoples of central Arizona. As these groups developed and came into contact with people from other areas, exchange relationships and a more complex organization were formed around a sedentary, agricultural life style. This experiment failed, however, perhaps due to a variety of reasons such as climatic change, shifts in regional centers of importance, disruption of elements in the exchange system, etc. The people then returned to a hunting and gathering life style and the cultural makeup typified by this adaptation; i.e., they became Yavapai.

Euler advocated Rogers' alternative hypothesis that the upland Yumans migrated into western Arizona after A.D. 1100 (Euler and Green 1978; Pilles 1981:175). As evidence, he cited the replacement of Cohonina ware by Tizon Brownware that apparently occurred after A.D. 1300. According to their origin myths, the Yavapai originally occupied the Verde Valley-Sedona region. They may not have migrated into the west central desert until the protohistoric period after A.D. 1500 (Mariella 1983).

The resolution of Yavapai origins is complicated by the problem of identifying Yavapai sites (Pilles 1981). Upland

Yuman material culture was meager, transportable, and perishable, and diagnostic artifacts are scarce. The lack of identification and investigation of Yavapai sites represents a significant regional data gap.

Hohokam

The easternmost portion of the study area approaches the core range of the Hohokam tradition, and Hohokam groups may have periodically ventured into the study area for purposes of travel or resource exploitation. In addition, the Hohokam participated in an extensive interaction sphere which may have incorporated Patayan groups in west central Arizona. One cannot discuss the prehistory of southwestern Arizona without considering the Hohokam, as this relatively complex society undoubtedly exerted a strong influence over outlying groups.

The Hohokam occupied large, sedentary villages along the Salt and Gila rivers. They constructed extensive canal networks and obtained much of their subsistence from irrigated crops. Wide-ranging trade networks, monumental architecture, and the maintenance and management of canal systems suggest organizational and political complexity exceeding that of historic Indian groups. An elaborate material culture included Red-on-buff ceramics and a high level of craftsmanship in the working of shell and bone (Gladwin et al. 1937; Haury 1976). Through diffusion of traits or colonization, the Hohokam cultural system extended its range into the Papagueria and away from the core area along major tributaries.

Numerous controversies and explanatory scenarios characterize Hohokam studies. McGuire and Schiffer (1982) provided a comprehensive summary of existing knowledge and the status of research. Other recent, comprehensive sources include Berry and Marmaduke's (1982) Class I overview of the middle Gila Basin and a volume of symposium papers (Doyel and Plog 1980). The reader is referred to these sources. Table 6-2 summarizes the culture history of the northern Sonoran Desert.

The Ceramic Period in West Central Arizona

Although ceramic sherds are not abundant in western Arizona, trails and other sites have yielded a variety of ceramic types and wares. These include Lower Colorado Buffware types, Hohokam plain and decorated types, and thin Tizon Brownware sherds tentatively linked to the upland Yumans (Dobyns 1974). Except perhaps for Lower Colorado Buffware, the plainwares can be very difficult to classify, and most have little value as chronological indicators (Stone 1982). However, the geographic distribution of ceramic types indicates the extent to which the Patayan, Hohokam, and Yavapai interacted and used natural resources and travel routes within the study area.

Lower Colorado Buffware, produced along the Colorado and lower Gila rivers, is the dominant ceramic ware in the region. It is found throughout the study area, with concentrations in the western mountain ranges, the Harquahala Valley, and the areas close to the Gila and Hassayampa rivers (Bostwick 1984; Stein 1981; Stone 1982). The western occurrences may represent desert resource use by Colorado River-based groups, or pottery may have been obtained through trade or the transport of goods between river and desert-based groups. The river and upland Yumans historically maintained a trade in subsistence commodities and manufactured goods, and the upland groups are said to have valued the technically and decoratively superior pottery produced by the river groups (Davis 1961; Dobyns 1974; Rogers 1936; White 1974). Trail breakage may have been associated with long distance travel. Numerous cross-country trails between the Colorado and Gila rivers were documented by Rogers (n.d.) and Schroeder (1961, 1979). One of these, the Halchidhoma Trail, followed Centennial and Bouse washes via Granite Wash Pass near Salome.

The eastern occurrences of Lower Colorado Buffware, in the vicinity of the Hassayampa River and the Palo Verde Hills, may indicate use of these areas by the ancestors of the lower Gila Yumans (Rice and Dobbins 1981; Stone 1982:129). Patayan sherds are sometimes found in association with Hohokam pottery, and use of the same sites may or may not have been contemporaneous (Rodgers 1976; Stein 1981). At Las Colinas, a Hohokam site in Phoenix, archeomagnetic dates for associated Patayan buffware sherds have fallen in the range of A.D. 1000 to 1150, indicating Hohokam-Patayan interaction (David Gregory, personal communication 1984). In the Gila Bend area, Wasley and Johnson (1965) found intrusive Lower Colorado Buffware sherds at Hohokam sites during the same period. In subsequent periods, the relative percentage of Patayan pottery increased, leading Wasley and Johnson to suggest a Patayan migration into the area after A.D. 1100. The presence of Lower Colorado Buffware in the Hohokam region apparently resulted from a long history of trade, interaction, migration, and possible co-residence.

Tizon Brownware and Prescott Grayware, pottery types associated with the upland Patayan, occur in the study area in small numbers (Stone 1982). Tizon sherds tend to be concentrated in the vicinity of the Harcuvar and Harquahala ranges, the traditional territory of the Wiltaikapaya band of Western Yavapai (Gifford 1936:250). They have also been found in the Harquahala Valley and the vicinity of the White Tank Mountains. Lower Colorado Buffware and Tizon Brownware sherds occasionally occur together at sites, indicating either interaction or reoccupation of the same sites by river and desert-based groups (Stone 1982:128). Prescott Grayware sherds have been reported from sites near Aguila. They may indicate seasonal use of desert resources by groups from the Skull Valley zone to the northeast.

Hohokam sherds have a restricted distribution in the study area. Gladwin and Gladwin (1930) noted an abrupt decline in Hohokam pottery west of the Hassayampa River. However, west of the Gila-Hassayampa confluence, Hohokam plain and decorated types occur in the Palo Verde Hills and Harquahala Valley (Carrico and Quillen 1982; Stein 1981; Stone 1982). In these areas, decorated Red-on-buff sherds date primarily to the Colonial and Sedentary periods between approximately A.D. 500 and 1150. Radiocarbon dates from sites near the Palo Verde Hills indicated occupation at about A.D. 900 (Stein 1981:38). Hohokam from Gila River villages may have ventured into the area, by way of Centennial Wash, in pursuit of supplementary food resources. The Palo Verde sites yielded evidence for mesquite processing and the hunting of large game (Stein 1981:38).

TABLE 6-2

SUMMARY OF CULTURE HISTORY OF THE NORTHERN SONORAN DESERT

PATAYAN		HOHOKAM	
Waters 1982	Schroeder 1979	Haury 1976	McGuire and Schiffer 1982
Patayan III A.D. 1500+	Yumans A.D. 1500+	Pima/Papago A.D. 1450+	Pima/Papago A.D. 1450+
Patayan II A.D. 1000-1500	Hakataya	Classic Period A.D. 1100-1450	Classic Period A.D. 1200-1450
Patayan I A.D. 700-1000	Hakataya	Sedentary Period A.D. 900-1100	Sedentary Period A.D. 1000-1200
		Colonial Period A.D. 550-900	Colonial Period A.D. 800-1000
			Pioneer Period A.D. 500-800
Basket Maker III A.D. 1-300 to A.D. 700		Pioneer Period 300 B.C.-A.D. 550	

Late Archaic: 1500 B.C. to A.D. 1-500

Middle Archaic: 4800 B.C.-1500 B.C.

Early Archaic: 8500-6000 B.C. to 4800 B.C.

Paleoindian, San Dieguito:
9500 B.C. to 8500-6000 B.C.

Isolated occurrences of decorated Hohokam sherds, in areas far from the major Hohokam settlements, may represent Patayan-Hohokam interaction. The presence of Hohokam sherds and other trade items, at the Bouse site and in the Parker area along the Colorado River, indicate contact between Hohokam and western Arizona populations (Gladwin and Gladwin 1930; Harner 1958; Schroeder 1952; Rogers n.d).

Patayan Settlement and Resource Use In the Arizona Outback

The distribution of Lower Colorado Buffware throughout the study area, as well as the existence of many overland trails (Rogers n.d.; Schroeder 1961), seem to support the view offered by Bean et al. (1978:27):

> The portion of northern Sonoran Desert lying between the Panya on the Colorado River and the Panya on the Gila was an integral part of Panya territory. It was not simply desert crossed by an occasional trader . . . It was the major upland resource area for riverine oasis-headquartered members of the same tribe.

The length of time that the Yavapai or their predecessors occupied the desert portion of this territory is unknown (Mariella 1983).

Concentrations of Lower Colorado Buffware sherds in the Harcuvar, Granite Wash, and Harquahala mountain ranges indicate some travel between the river and mountains, perhaps by groups normally resident along the Colorado River. The existence of sites so far from the river seems at odds with Driver's (1957) assertion that the river Yumans obtained over 90% of their food supply from the rich riparian environment of the Colorado River valley. Malcolm Rogers, however, stressed the importance of desert resource use based on the proliferation of Patayan hunting and gathering camps in the Kofa Mountains (Rogers n.d.). Castetter and Bell (1951:74) cited Rogers' contention that river groups routinely traveled over 50 miles (80 km) into the desert mountains "for the gathering of wild plant harvests and the taking of game". Trade, ritual activities, or the procurement of raw materials may have been additional inducements to travel.

In the desert, seasonal base camps may have been located near major washes, and hunting and gathering camps may have been satellites of those settlements. The Bouse site, with its water well, may have been a base settlement as well as a possible outpost on a major travel route between the Colorado and Gila rivers (Harner 1958; Rogers n.d.).

The highest desert ranges and the Colorado River can be characterized as oases separated by a vast area relatively deficient in resources. This viewpoint was expressed by Shreve (1936:15-7): "the plains and mountains which border the lower course of the Colorado River and the head of the Gulf of California have the smallest flora and the most scanty vegetation of any part of the North American Desert". This observation is borne out by a historical incident reported by Schroeder (1959:14-15). In the 1860s, Western Yavapai groups were confined to the Colorado River Agency near Parker. This confinement was not particularly strict; a "neutral line" was established about 50 miles (80 km) east of the river. If the Indians traveled across this line, they were regarded as hostile and were subject to attack. When spring food shortages occurred along the river, the Yavapai were permitted to forage within the neutral area. The Anglo agents eventually learned that the Indians frequently and routinely traveled further to the east. Schroeder (1959:15) quoted the comments of an agent:

> These Indians say that there is no game, and but little mescal, between the river and Granite Wash, and this statement has been corroborated by mineral prospectors who have thoroughly explored the whole country, and hence the necessity, as the Indians allege, of seeking a living where these articles of subsistence are to be found.

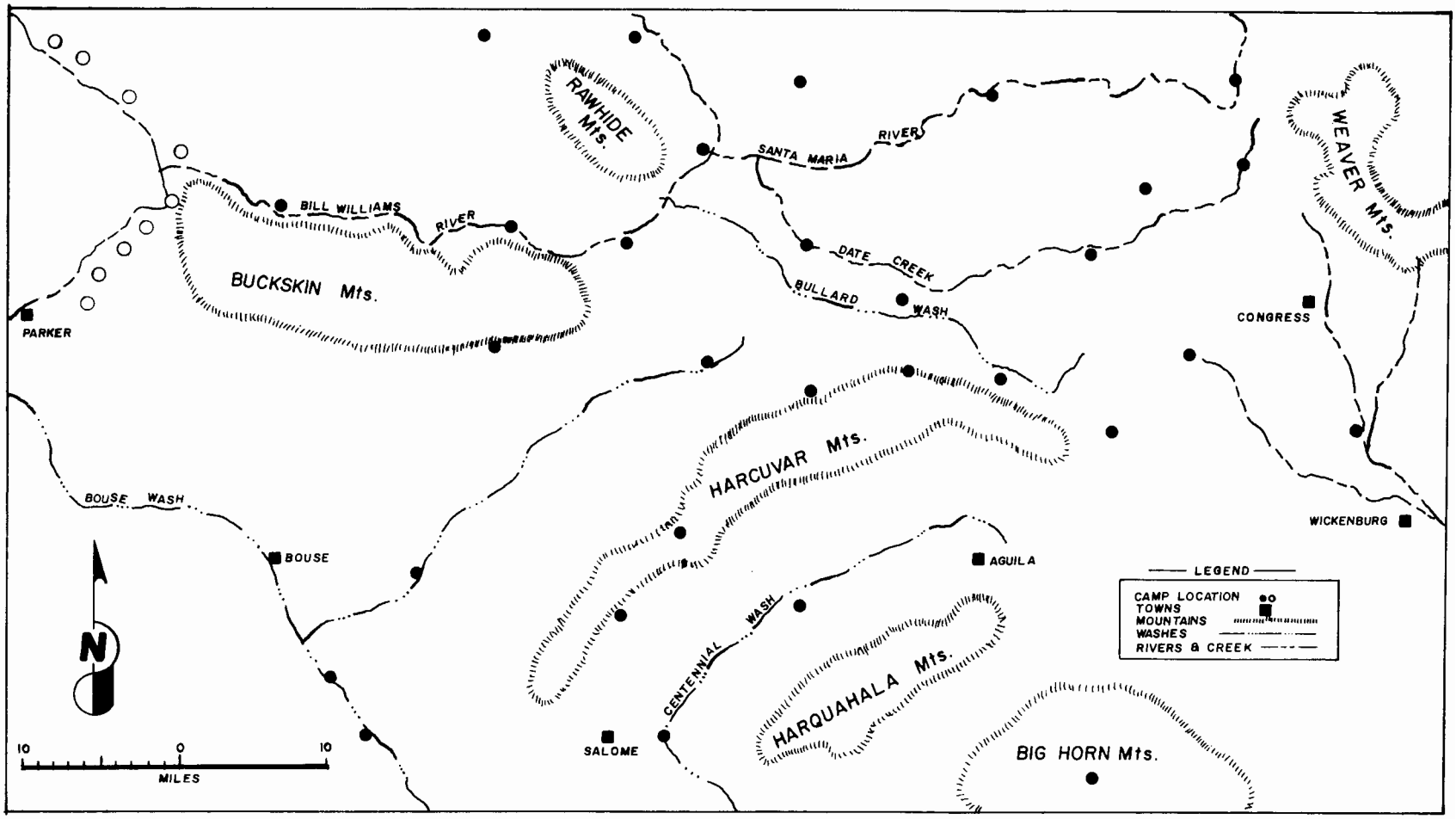
Food was to be found in the Harcuvar and Harquahala mountains. According to Mariella (1983), the Colorado Agency Yavapai were quite willing to be farmers, but the appropriation of farmland by Anglos, poor harvests, and Yavapai-Mohave conflicts over scarce resources induced the Yavapai to return to the mountains. It is likely that the prehistoric river Patayan ranged eastward in response to seasonal and periodic food shortages or internecine conflict.

Alfred Kroeber (1951) gave some consideration to the use of desert resources by the Yuman tribes and their ancestors. His detailed analysis of Mohave migration myths relates directly to the study area, and it provides insights into the nature of regional settlement patterns and social organization.

Between 1900 and 1905, Kroeber interviewed aged Mohave "dreamers" who specialized in the telling of migration myths. These long, detailed stories described the "ancient migrations of bands that lived off the land" (Kroeber 1951:71). These tales were "pseudohistorical" in content; they emphasized the legendary feats of cultural heroes and gave little attention to the supernatural. Kroeber focused on the wealth of geographic detail embodied in the stories. The Mohave had "an endless interest in topography, and a constant reflection of this in their myths and song cycles, which are almost invariably localized in detail" (Kroeber 1951:137).

This level of detail allowed Kroeber to produce tentative maps of camp locations and intervening travel routes (Map 6-2). These were reconstructed on the basis of known geographic locations and narrative information concerning the duration and direction of travel. The maps should be interpreted with caution, as they are essentially speculative. Many of the locations are approximate, and they figure in mythical events. However, Kroeber (1951:137) stressed that the imaginary events occurred within a real landscape: "while the plot is certainly invented, its geographical knowledge is actual". Mohave knowledge included regional maps compiled "from a sheer interest in place and orientation for its own sake, an interest further nourished by constantly fed information".

Many of the myths dealt with migrations and conflicts over land use rights along the Colorado River. Some of the tales took place within the study area, in the desert region bounded by the Bill Williams and Santa Maria rivers on



MAP 6-2 : KROEBER'S RECONSTRUCTION OF CAMP LOCATION IN THE WEST CENTRAL DESERT

the north, the Hassayampa River on the east, and a southern boundary linking Gila Bend and present-day Blythe (Kroeber 1951:137).

In one tale, Kroeber followed the travels of "Gambling Boy" through the desert. The main character cheated once too often and was banished from a village in the Mohave Valley. He traveled through historic Hualapai territory and reached the confluence of the Bill Williams and Santa Maria rivers, a place mentioned often in the tales. From there, he passed settlements along the northern flank of the Harcuvar Mountains, in areas where BLM archaeologists have since located camps with Lower Colorado Buffware. Gambling Boy avoided some of these places, as they were occupied by people not of his clan. At others, he shared deer meat and agave. For several years, he resided with clansmen at a site somewhere north of Wickenburg, near the Hassayampa River or one of the tributary creeks south of the Weaver Mountains. He eventually returned to the Mohave Valley and participated in a "war" which resulted in the migration of defeated groups to the Gila Bend area.

Another tale traced the wanderings of a Mohave group prior to their return to the Mohave Valley. Traveling along the Colorado River, this group turned east from the Blythe area. In the Ranegras Plain, they reached a settlement of 20 houses and several wells, a description suggestive of the Bouse site or a similar locus. This place was deserted save for one man, who escorted the travelers to a settlement near present-day Salome, where a high water table allowed Centennial Wash to sustain some flow. The description of life at this settlement is interesting. The people lived in brush huts, and references to melons and pumpkins indicate that they may have farmed. They subsisted primarily on deer, agave, rabbits, rats, and unidentified types of seeds. Many of these resources were obtained in the Harcuvar and Harquahala ranges. The travelers were allowed to remain, but their hosts warned that the land could support only a limited number of people: "we are scattered over the country; we have taken all the springs; everywhere our tribes have made monuments of trees or brush to claim the land" (Kroeber 1951:90). Indeed, food shortages engendered conflict, and after two years the travelers moved north to the Bill Williams River. They lived on seeds, cattail roots, fish, and beaver, periodically shifting settlements in response to the local depletion of resources. Abandoned hunting and gathering tracts were allowed to recuperate. The people eventually returned to the Colorado River, although conflicts resulted in the periodic reoccupation of settlements near the Bill Williams River. This account provides interesting insights into resource use, mobility, the possibility of marked territories for hunting and gathering, and the strong association of settlements with water sources. Archaeological sites are known or expected to occur in many of the locations mapped by Kroeber.

Kroeber (1951:119) suggested that the traditional distinction between riverine farmers and desert hunter-gatherers had been overemphasized. Instead, he believed that groups shifted subsistence strategies in response to environmental fluctuations and conflict. In economic and social organization, the river Yumans were "only a step removed from the more scattered, diffuse, and locality-bound gatherers like the Yavapai" (Kroeber 1951:119). Thus "the switching back and forth found in the tale between the two kinds of habitat and subsistence is by no means historically impossible or even improbable". A similar outlook was recently employed by Schrire (1980) in a study of changes in the economic "identities" of African hunter-gatherers in response to shifting environmental conditions. Kroeber's discussion indicates a plausible, dynamic model of Patayan settlement and subsistence.

CHAPTER 7
RESEARCH DOMAINS

Research issues guide archaeologists engaged in the design of field strategies and analytical studies. They can also contribute to the development of management plans by federal archaeologists and managers, since research objectives are crucial to the determination of "potential scientific use" of particular sites or categories of cultural remains. Knowledge of research issues can expedite the design of productive and efficient in-house field procedures and the evaluation of independent and institutional research proposals.

In the northern Sonoran Desert, certain data limitations may prove difficult to overcome. These include a predominance of surface relative to stratified sites and poor preservation of organic materials. These problems and a paucity of time-sensitive diagnostic artifacts complicate and inhibit the development of a regional chronology and the study of temporal changes. These limitations have undoubtedly discouraged extensive archaeological research in the region, and the problems may never be entirely resolved. However, certain avenues to their resolution have yet to be taken, and the development of new methodological approaches and techniques may generate productive research (McGuire and Schiffer 1982:406). The data limitations have an important implication for the resource manager: the rare sites containing organic remains, stratified deposits, or diagnostic artifacts must be protected through active preservation efforts or the application of strict guidelines for data recovery.

Despite the limitations of the data base, "the archaeological resources of southwestern Arizona are diverse and scientifically significant in many respects" (McGuire and Schiffer 1982:414). Most archaeological information has accumulated only in the past decade, and promising research directions as well as limitations have yet to be probed in detail. As Brown and Stone (1982:343) suggested, "rather than dismiss these minimal remains, along with whole periods of human prehistory, because they do not contain certain prerequisite classes of data, we must devise appropriate strategies for extracting the information they do contain and tailor our research questions accordingly".

Research issues in west central Arizona can be divided into five major problem domains which are basic elements common to most regional research designs. They are: (1) culture history, the definition of chronological sequences and cultural affiliations; (2) cultural ecology, the delineation of settlement and subsistence systems and land use patterns; (3) social interaction, the study of boundaries and frontiers and the spatial tracking of material items indicative of interaction and exchange; (4) patterns of lithic resource use; and (5) the description of environmental change and its relationship to temporal changes in other problem domains.

CULTURE HISTORY

The culture history domain was defined by McGuire and Schiffer (1982:155) as "the chronological ordering of archaeological materials, their classification as to ethnic or cultural origins, and the reconstructing of events—principally migrations—in the development of prehistory". Culture history involves chronology building and the determination of which groups occupied which areas during particular periods. This is a very important yet difficult research domain in the study area.

Difficulties lie in the predominance of surface sites, the poor preservation of datable organic materials, and the scarcity of diagnostic artifacts. Past researchers have employed dubious assumptions in the temporal and cultural assignment of archaeological sites. For example, the automatic equation of nonceramic with preceramic sites obscures possible functional differences and ignores the possibility that some ceramic period groups may have made relatively little use of pottery. "Typical" San Dieguito manifestations, such as rock rings, trails, intaglios, and simple core and flake tools, have a long history of use extending into the historic period.

In the Southwest, archaeological deposits are often crossdated by the presence of diagnostic artifact types found in dated stratigraphic contexts at other sites. Diagnostic artifacts consist primarily of stylistically distinctive projectile points and decorated pottery types. Desert assemblages are dominated by utilitarian stone tools and plainware pottery which appear to have undergone little change through centuries of occupation. However, diagnostic artifacts do occur, although they may be restricted to the sites which functioned as base camps and to trails. Amateur collecting is a factor contributing to a scarcity of distinctive artifact types. Malcolm Rogers (n.d.) reported the existence of several private collections in western Arizona. Archaeologists should attempt to view and ascertain the origins of such collections, if only to determine general patterns of occurrence and future survey areas.

It should be noted that the reliability of dating schemes based on diagnostic artifacts is far from secure. The diagnostic utility of some types has been questioned. For example, Chapman (1980) noted that Chiricahua and San Pedro points of the Cochise tradition, thought to be sequential, frequently occurred together in the same stratigraphic levels at Archaic sites. Archaeologists need to strengthen diagnostic sequences with chronometric data from geographically diverse localities.

One approach to the dating of lithic assemblages is based on the physical and chemical alteration of rock surfaces in the desert environment. Obsidian hydration and patination are cumulative processes resulting in variable thicknesses of surface alterations. Obsidian surfaces absorb atmospheric water, and differences in the depth of penetration can indicate relative dates for artifacts. Brown

(1982:233) reviewed scientific efforts to establish general hydration rates in order to obtain chronometric dates. It is difficult to control for variables affecting the hydration process, thus most hydration calibrations have been based on tool associations with datable radiocarbon samples or pottery types (Meighan 1976). However, recent studies have focused on the establishment of intrinsic hydration rates for the independent measurement of absolute age (Ambrose 1976). Hydration profiles might eventually be established for obsidian artifacts in western Arizona.

Thicknesses of desert varnish have been used as a relative dating tool, most notably by Julian Hayden in his research in the Sierra Pinacate of northern Mexico (Hayden 1967, 1976). In a statistical analysis of lithic collections from the Sierra Pinacate, Rosenthal (1979) defined four distinct patterns of tool manufacture. On the basis of differing degrees of patination, these patterns were correlated with Hayden's Malpais, San Dieguito, preceramic Amargosa, and ceramic Amargosa stages. McGuire and Schiffer (1982:450) applauded this effort to define cultural traditions on the basis of manufacturing techniques rather than gross tool morphology. However, they noted difficulties in controlling for functional and material factors, and they suggested that the conclusions were based more on subjective evaluations than replicable analyses. More controlled, comparative analyses, similar to the relative dating efforts of Hayden and Rosenthal, could be conducted in localized areas of western Arizona, such as the Eagletail or Big Horn ranges and their surrounding desert pavement bajadas. In such localized areas, artifacts would probably have been subjected to similar environmental conditions affecting the formation of desert varnish.

A new experimental chronometric method, cation-ratio dating of desert varnish, is based on differences in the rates at which minor chemical elements are leached out of rock varnish. Relevant measurements are taken by x-ray emission techniques. Dorn et al. (1986) recently developed a cation-leaching curve for the Mojave River basin in California, based on correlations of cation ratios with potassium argon dated basalt flows and radiocarbon dates for rock varnish, obtained by mass spectometry. Since desert varnish contains a very small amount of organic material, large areas of varnish are required to enable radiocarbon analysis. Thus radiocarbon dating is applied to landforms rather than artifacts. Dorn used the calibration to date a sample of artifacts taken from sites near calibration points. Problems with the method include the limited precision of recent potassium argon dates; analytical difficulties with radiocarbon dating of desert varnish; and a lag between the creation of a surface and the onset of varnishing. The reliability of the technique is limited to the region where a curve has been established (Dorn et al. 1986:831). Microenvironmental factors in varnish leaching can vary in different regions. The cation-ratio method holds promise for the dating of artifacts within surface scatters.

Ceramic wares have been successfully employed as indicators of cultural and temporal affiliation in the study area (Stein 1981; Stone 1982). Waters (1982) presented a useful summary of temporal variation in Lower Colorado Buffware, based on the analysis of Malcolm Rogers' survey collections. However, many of his dates were derived from intrusive Hohokam pottery and from radiocarbon dates and geologic associations in the Salton Basin of California. His sequence needs to be refined with chronometric data from western Arizona. The excavation of stratified sites near the Colorado River would be a major contribution, and chronometric dates would reduce the reliance on the disputed Hohokam chronology. Such dates have recently been obtained for Lower Colorado Buffware found at the Hohokam site of Las Colinas in Phoenix. These should contribute to Patayan chronology building (David Gregory, personal communication, 1984).

Certain site and feature types may prove useful in the separation of preceramic from ceramic period sites. Rock art design elements may be indicative of temporal and cultural affiliations (Teague 1981:71). Degrees of patination promise to be useful in the relative dating of petroglyphs and intaglios (Solari and Johnson 1982:427).

The most reliable regional chronologies are based on the excavation of stratified sites and the use of such standard chronometric techniques as radiocarbon and archaeomagnetic dating. Thus any sites with depth or datable remains (organic materials or fired clay) are significant scientific resources. Such sites are considered to be rare, but caves have been documented along the Colorado River (Swarthout 1981), and rockshelters or caves with stratified deposits may occur in the mountain ranges of the study area. Unpublished survey notes and site files indicate the existence of rockshelter sites in the Harquahala, Little Harquahala, Eagletail, and Big Horn ranges. Open sites are less likely to have subsurface deposits; yet the Bouse site and upper bajada sites in the Sonoran Desert have yielded subsurface remains (Brown 1977; Doelle 1980; Harner 1958; Rice and Dobbins 1981). Particular feature types, such as roasting pits, may yield datable materials. Unfortunately, the desert environment is not conducive to the preservation of organic substances, and prepared clay floors and hearths are rare in western Arizona (Larson 1980; Swarthout 1981:86-87). However, radiocarbon dates have been obtained at sites in the study area (Bostwick n.d.; Stein 1981). Researchers should focus on the refinement of techniques for the collection and preservation of samples from desert areas, particularly since techniques now exist for processing minute radiocarbon samples.

In conclusion, the development of more sophisticated techniques for relative and chronometric dating could illuminate basic questions concerning which groups occupied or used certain areas and when they did so. Only then will it be possible to address more specific issues, including: (1) the validity of ancient, pre-Paleoindian period remains; (2) the nature and origin of "San Dieguito I" assemblages; (3) Euler's (1975) notion of long-term continuity in the material culture of the upland Patayan; (4) the possible displacement of western-based Archaic populations by a late Cochise expansion; (5) problems relating to cultural origins and continuity: the transitions from San Dieguito to Archaic, Archaic to ceramic period, and prehistoric to historic Yavapai populations; and (6) the nature of changes through time in settlement-subsistence systems and social organization, and ultimately, understanding of the factors underlying those changes.

CULTURAL ECOLOGY

The domain of cultural ecology encompasses the interrelationships of human activities and organization within the natural environment. In his pioneering studies of Great Basin tribes, Steward (1938) demonstrated that the nature and distribution of economic resources within particular habitats had significant implications for human organization. Regional studies focus on the definition and analysis of patterns of settlement, resource use, travel, and communication in relation to the distribution of resources and social groups within a bounded area. Detailed intrasite analyses flesh out the regional framework by providing information on site function, subsistence practices, and activity organization. Both regional and intrasite studies should be important components of future research in the study area.

Previous researchers have emphasized the "marginal" nature of the region (Brown and Stone 1982; Carrico and Quillen 1982). Although marginality is a relative concept, it generally implies a deficiency of natural resources in comparison to surrounding areas. In its ruggedness and deficiency of water sources and arable land, the western desert was marginal to the river valleys which were primary zones of Hohokam and Patayan occupation. One would thus expect to find temporary or seasonally occupied sites rather than long-term, "permanent" habitation areas. Yet despite the marginality of this desert zone, it was repeatedly used and traversed over a very long period of time.

The implications of marginality for settlement studies have been reviewed by Reher (1977:21). One would expect to deal with partial rather than total settlement systems, as well as lower site densities relative to surrounding, less marginal areas. On the other hand, "it can be argued that the limited environmental tolerance of such an area will be mirrored by tighter correlations between cultural behavior and environmental parameters" (Reher 1977:21). Thus the development of predictive locational models may be a less complicated process than in "more favorable areas" where "predictive statements would have to incorporate larger factors of error" (Reher 1977:21). This quality indicates that such areas as western Arizona may serve as workshops for the refinement of methods used in the predictive modeling of settlement systems.

Researchers have constructed general, alternative settlement models incorporating the interior desert areas of western Arizona. For the western Papagueria, Doelle (1980) outlined models based on varying degrees of overall mobility and reliance on wild resources. These models incorporated: (1) year-round farming settlements along the rivers, with temporary or seasonal camps in the desert; (2) a series of seasonal camps, with an emphasis on the use of wild resources in the manner of the Western Yavapai; and (3) a highly mobile, "Sand Papago" system, with numerous temporary camps at locations of high wild resource productivity. According to Doelle (1980) and to Brown and Stone (1982), three major land use patterns should be expected in the desert: (1) temporary or seasonal use of natural resources by river-based groups, probably farmers; (2) occupation by mobile groups relying primarily or entirely on wild resources, such as Archaic or Yavapai groups; and (3) travel and associated transient resource use. These patterns need not have been mutually exclusive.

A major methodological problem is the difficulty of distinguishing among these patterns on the basis of archaeological evidence obtained primarily from surface artifact scatters. In a marginal environment, particular localities may have been used in a similar manner despite changes in the overall pattern of land use (Binford 1982:19), or the different patterns may have overlapped so that the same locations were frequently reused. Nevertheless, one would expect sites occupied by river-based groups to exhibit culturally diagnostic materials and to be situated in the productive resource zones most accessible to river settlements. The distribution of Lower Colorado Buffware along the Bill Williams River and in the Harcuvar and Harquahala mountains, and the occurrence of Patayan and Hohokam pottery in the Palo Verde Hills, may well represent this pattern of desert resource use by river-based groups.

Researchers have argued in favor of greater functional specialization in the sites and artifact assemblages of river-based farmers (Bayham 1982; Doelle 1980; Rice and Dobbins 1981). Presumably, these people undertook planned expeditions in pursuit of specific resources, and the use of highly efficient tool kits by special task groups offset the costs of travel from river villages. Investigations at the two Desert Gold sites, located in similar environmental situations, revealed differences indicative of such a pattern (Rice and Dobbins 1981:69-71). At the Archaic site, the assemblage incorporated a wider range of activity sets, including the production and maintenance of lithic tools, with separate activity areas dispersed around the site perimeter. At the ceramic period camp, the assemblage was less diverse, and activities were concentrated near a single roasting pit feature. Rice and Dobbins (1981:71) concluded that the Archaic site was a seasonal base camp and the later site a work camp used by a Patayan task group probably based at a Gila River village. Maricopa groups historically traveled to this area, just east of Wickenburg, to hunt deer and gather cholla cactus buds (Henry Harwell, personal communication 1984). Despite the interesting comparative study at the Desert Gold sites, it may be quite difficult to distinguish "specialized" sites or tool kits from those generated during a desert-based seasonal round. Archaic groups, as well as river-based groups, may have employed efficient, specialized tool kits for certain purposes.

Given the methodological difficulties of distinguishing among the different expected land use patterns, a more general approach to settlement analysis may be appropriate. The interrelationships between settlement patterns and environmental variables represent a regional research issue recently addressed by the Granite Reef Aqueduct study (Brown and Stone 1982). Problems with chronological control and a lack of paleoenvironmental data promoted an emphasis on the spatial distribution of archaeological sites in relation to environmental factors, with a qualified assumption of long-term environmental stability. It was assumed that portions of the regional environment would vary in their suitability for the efficient performance of generalized activity sets including wild resource exploitation, travel, farming, and initial stages of lithic manufacture. Environmental factors deemed relevant to the performance of particular activities were selected, mapped,

ranked in order of relative importance, and conbined to indicate increasingly favorable activity zones. Hypothetical models of prehistoric land use were expressed as maps generated by a computer-based cartographic analysis system called MAPS (Brown and Rubin 1982). These predictive maps indicated areas of high potential for natural resource exploitation and long distance travel (Map 7-1). Known site distributions appeared to correspond with the maps. However, the evaluation was subjectively done, and no correction was made for differences in the survey coverage of different environmental zones. Brown and Rubin (1982) advised that the predictive models be refined and used for the generation and testing of hypotheses in future settlement studies. Others have supported this recommendation (McGuire and Schiffer 1982:257; Teague 1984), and the results of more recent settlement analyses have conformed well with the Granite Reef models for west central Arizona (Carrico and Quillen 1982; Effland, Green, and Robinson 1982). The Granite Reef settlement models can thus serve as a starting point for further studies of prehistoric land use in the region.

In the marginal but heterogeneous environment of west central Arizona, one would expect differences in the nature and extent of aboriginal occupation of particular areas. Areas of frequent reuse, or those occupied for relatively long time periods or by larger groups, should occur where important food resources or raw materials were most abundant and predictable, if one assumes that the minimization of exploitation costs and risks was a key factor in aboriginal decision making (Dyson-Hudson and Smith 1978; Jochim 1981). Occupation should have been particularly intense where diverse resources were present simultaneously or where there was ready access to travel routes. In such areas, one would expect zones of repeated occupation or use, and base camps or multiple activity sites in addition to more specialized loci. The lowest occupational intensities should occur in areas deficient in both natural resource and travel potential. These general hypotheses can be elaborated and incorporated into regional settlement models.

An alternative but complementary approach to settlement system modeling involves a more detailed consideration of the exploitation costs, reliability, seasonal availability, and spatial distribution of particular resources. These resource properties influenced aboriginal decisions concerning seasonal scheduling, movements between resource areas, and the resolution of conflicting demands. Bostwick and Stone (1985) constructed a general model of Archaic settlement systems incorporating the information in Table 7-1. This information indicates probable seasonal movements focusing on the use of mountain resources in winter, upper bajada resources in the late spring and early fall, and basin drainage margins in the summer. Doelle (1976, 1980) and Goodyear (1975) constructed and tested resource-based models for the Sonoran Desert. Bruder (1982) provided an insightful discussion of the potentials and pitfalls involved in relating artifact and feature types to the exploitation of particular resources.

Faunal and paleobotanical remains are useful for determining the types, diversity, and relative importance of food resources and the season and duration of occupation of sites. Interpretations regarding prehistoric plant use are most reliable if based on a combination of macrobotanical, flotation, and pollen analyses. Even then, one must contend with a variety of natural, cultural, and data recovery factors contributing to the differential preservation of plant remains (Gasser 1982:217). Botanical remains of any size are rarely preserved in open desert sites; small, shallow roasting pits generally yield few specimens (Doelle 1980:149; Gasser 1982:216). Pollen counts also tend to be low (Brown and Stone 1982:79). However, luck or diligent recovery methods have yielded such remains (Stein 1981), and the collection of flotation and pollen samples should be undertaken at open sites where artifacts and features indicate extended camping or food processing activities. Botanical and faunal remains are most likely to occur in caves and rockshelters or in canyon and bajada sites with evidence of features or subsurface deposits. Small caves or rock alcoves with little evidence of domestic activities might have contained caches of food, traces of which could be preserved in sealed containers.

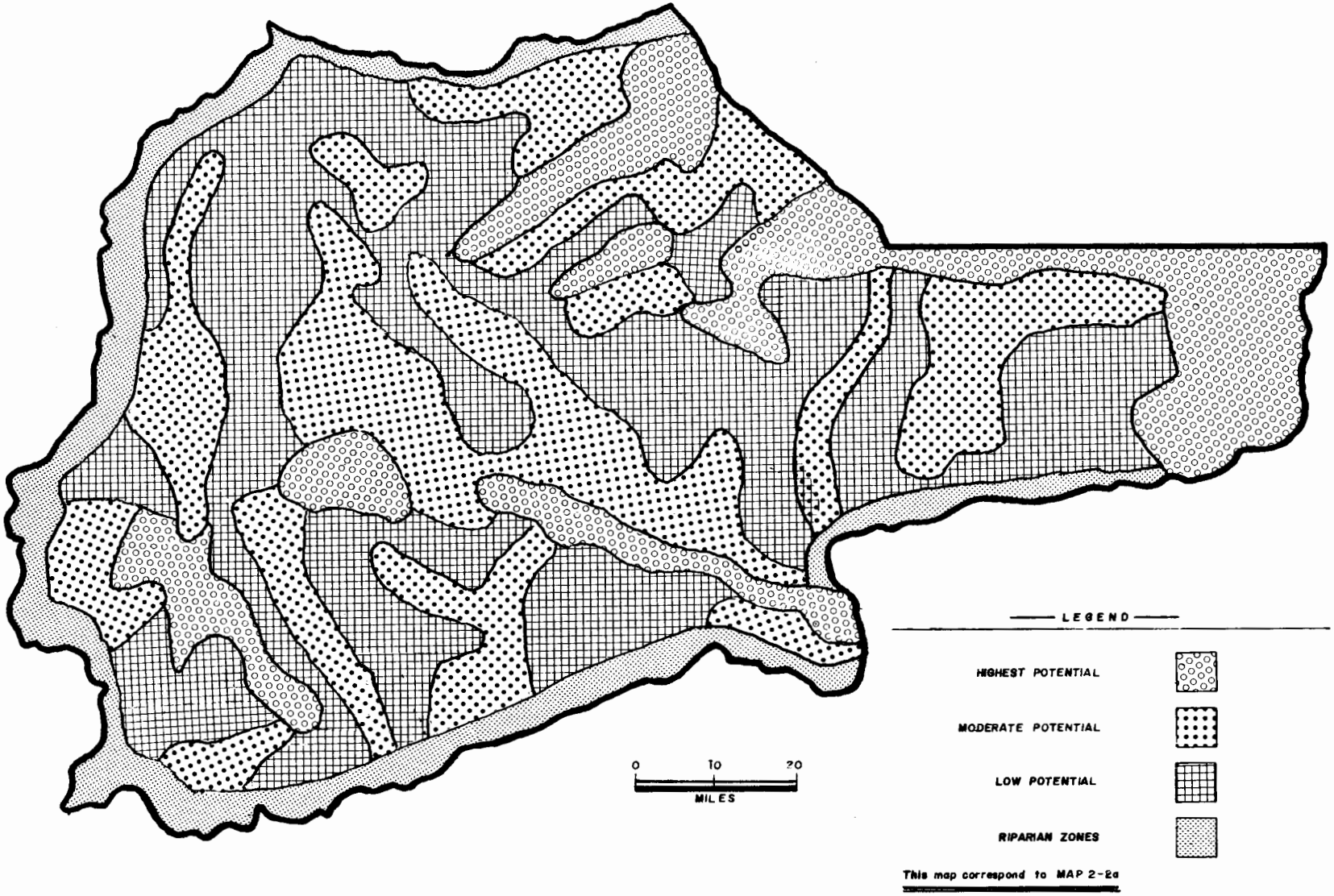
The spatial patterning of artifacts and features within sites can indicate the range, nature, and positioning of activities and the size and composition of social groups. However, the nature of desert sites once again complicates such analyses. It can be difficult to discern spatial patterning in areas which were repeatedly used or reoccupied over a long period of time. At AZ U:6:61 (ASU), an artifact scatter on a terrace of the Salt River, Brown and Rogge (1980:70) were unable to define discrete, meaningful clusters of artifacts. They concluded that "the apparent complexity of the distributional pattern resulted from the overlapping and superimposed remains of extensive lithic and food resource exploitation by many groups over a long period of time". Such "palimpsest" assemblages would be expected to occur at surface sites located on deflated surfaces or stable desert pavements.

Despite the limitations associated with intrasite analyses of open desert sites, recent studies have been successful in relating spatial and behavioral patterns. At Archaic sites in New Mexico, Chapman (1980:135) defined distinctive "hearth complexes" useful in distinguishing between base camps and limited activity sites. Intrasite analyses of artifact diversity and spatial clustering have also been used to distinguish among single event loci, residential sites, and limited activity areas of cyclical reoccupation (Ackerly 1982; Chapman 1980). Similar studies can be carried out at sites in west central Arizona.

SOCIAL INTERACTION

Regional studies of social interaction incorporate analyses of territories, boundaries, frontiers, and exchange. Boundaries are distinct, mutually acknowledged spatial demarcations between groups. Frontiers are sparsely occupied transitional zones and areas of cultural mixture or joint use (Wright 1974). The marginal environment of the study area, and its peripheral position in regard to the Cochise, Hohokam, and Prescott traditions, suggest a relatively low population density and the existence of frontier zones between different traditions.

The exploitation of wild food resources was an important form of regional land use, particularly critical to preceramic and Yavapai populations. Anthropologists have



MAP 7-1: THE GRANITE REEF MODEL: PREDICTED AREAS OF HIGH NATURAL RESOURCE POTENTIAL

TABLE 7-1

EDIBLE PLANT LOCATIONS AND SEASONAL AVAILABILITY IN THE SONORAN DESERT

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Jan.   Feb.   March   April   May   June   July   August   Sept.   Oct.   Nov.   Dec.
-------------------------------------------------------------------------------------

m - - - - - - - - - - - - - - - - - - - - - - - - - - - - Agave - - - - - - - - - - - - - - - - - - - - -
 w - - - - - - - - - - - - - - - - - Greens - - - -                w - - Greens - -
                          u- Sele' seeds -
                          u- - Cholla buds - -
                             w/u- Lycium berries -

    Primary Location                m- Berries -
    (Highest density)            w- - Seeds - -          w-Amaranth seeds
    w= Washes-Flats                 w- Chia seeds - -
    l= Lower bajada                   u/m- Saguaro -
    u= Upper bajada                         w- Mesquite - -
    m= Mountains                          w/u- PaloVerde - -
    h= Highest mountains                          w/u- Ironwood -
                                                u/m- - Prickly Pear -  - -
    Based on Bostwick
    and Stone (1985)          w/l- Gourds, Pods, etc. --

                                                      m- - - Jojoba - - -
                                                                u/m-Yucca - -
                                                               h- Acorns - -
                                                               h- Walnuts - -
                                                                     h- Pinyon -
```

recently devoted attention to the territorial organization of hunter-gatherers in arid environments (Fowler 1982; Myers 1982; Williams 1982). In these areas, small groups generally exploit dispersed, seasonally available resources with unpredictable and variable yields. Subsistence strategies tend to incorporate high mobility and the pooling of risk through widespread visiting and sharing of resources (Gould 1980; Wiessner 1982). Strict, defended territorial boundaries would restrict the ability to cope in such situations (Dyson-Hudson and Smith 1978). However, desert hunter-gatherers do not exist in a state of constant flux (Williams and Hunn 1982). In North America, Africa, and Australia, researchers have documented the existence of boundaries (Fowler 1982; Heinz 1972; Myers 1982; Williams 1982). These boundaries signify that certain local groups, or clusters of local groups, claim access rights to resources within particular areas. Outsiders must request access, which is usually granted in the interest of reciprocity, particularly when harvests are abundant. Conflict may result when outsiders fail to "check in" or when resources are scarce. Boundaries tend to coincide with natural features. In Australia, boundaries were marked by watershed divides, landforms, or shifts in slope (Williams 1982). Researchers argue that exclusion was not the main purpose of boundaries. Instead, their existence essentially structured social interaction by defining a geographic framework for widespread social networks based on resource sharing.

In the study area, Western Yavapai bands ranged over separate territories but often gained permission to forage in other areas (Gifford 1936:249-252). There is no known evidence of territorial disputes among these Yavapai groups. However, the Mohave migration myths recorded by Kroeber (1951) suggest that boundaries may have been more sharply defined prior to historic times. While traversing the northern portion of the study area, one protagonist avoided settlements not occupied by members of his clan. In another tale, travelers were permitted to live at a village after being informed that "we have taken all the springs: there is no place for you to stay . . . everywhere our tribes have made monuments of trees or brush to claim the land" (Kroeber 1951:90). Conflicts eventually forced the immigrants to leave the settlement. This story suggests that certain conspicuous archaeological features, such as rock alignments, cairns, or rock art, may have functioned as boundary markers. Other, perishable "monuments" would not have been preserved. Territorial markers would be expected to occur along trails, near drainage divides, or in areas peripheral to major resource concentrations. Distributional studies of features could involve the prediction of territorial marker locations.

Studies of social groups and their patterns of interaction generally focus on the analysis of stylistic and decorative variation in artifacts, as opposed to technological and functional differences. Obviously, it can be difficult to separate these categories of variation. Among highly mobile hunter-gatherers, particular artifact styles, such as Archaic projectile point types, may occur over vast areas. Large social networks promote information sharing, and "among those who pool risk, an effort is made to blend the individual into the greater population rather than to emphasize household or band identity" (Wiessner 1982:175). In addition, low density populations tend to incorporate numerous local groups into large, overlapping mating networks covering vast geographic areas (Wobst 1976).

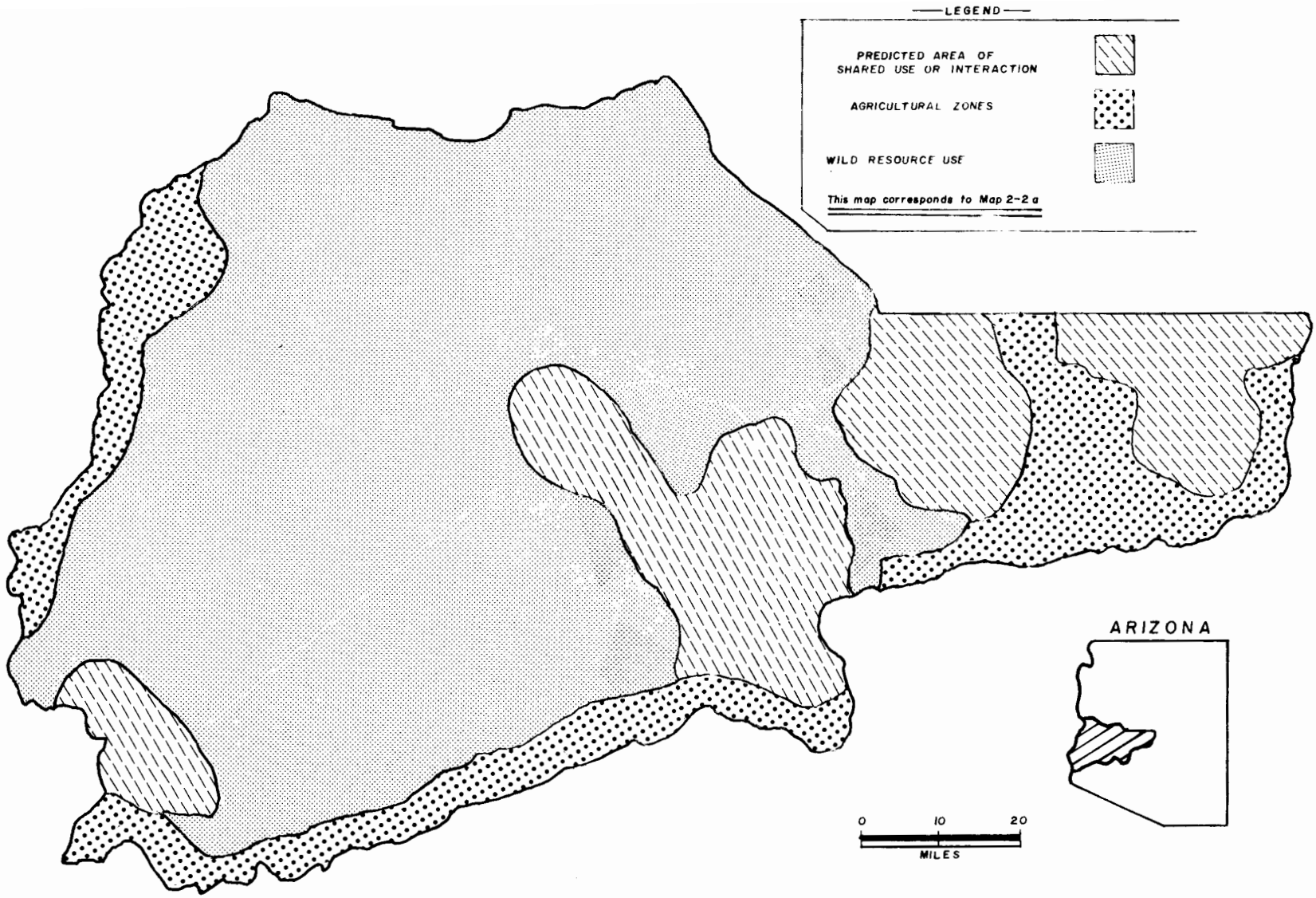
Increases in regional population density reduce the efficiency of information networks and mobile subsistence strategies (Lightfoot 1983; Moore 1981). Local groups tend to become more sedentary. Storage and formal commodity exchange tend to replace travel and resource sharing as means of reducing resource shortages (Wiessner 1982). Mating networks are reduced in size, and this closure may be reflected in increased material culture variation and the appearance of boundaries in the distribution of artifact types (Wiessner 1982; Wilcox 1979; Wobst 1976). Wilcox (1979:87-89) suggested that this process began during the late Archaic period and intensified through the Hohokam sequence. Thus it appears that the determination of boundaries and frontiers is more feasible for the ceramic period than for earlier times or for historic hunter-gatherers.

The Granite Reef Aqueduct study employed two major approaches to the analysis of cultural boundaries and frontiers. Computer simulation and modeling procedures were used to predict the location of frontier zones, and the geographic distribution of ceramic wares was mapped. The computer simulation reflected Wilcox's (1979) hypothesis that early farming villages depended on exchange relations with neighboring hunter-gatherers. In the simulation, interaction was expected to occur at the juxtaposition of potentially productive farming and wild resource zones. The resulting map predicted that the Wickenburg area, the Gila Bend Mountains, and the lower Centennial Wash area were possible frontier zones (Brown and Rubin 1982:304). The predicted frontier zones, based on the proximity of favorable wild resource and farming areas, could also represent desert areas used repeatedly by river-based groups (Map 7-2).

The Granite Reef ceramic study examined the geographic distribution of Lower Colorado Buffware, Tizon Brownware, and Hohokam area wares (Stone 1982). Lower Colorado types were produced along the Colorado and Gila rivers (Waters 1982), and Tizon ware was manufactured in west central Arizona by the upland Yumans and their predecessors (Euler 1982). Hohokam area types included Gila Plain, Wingfield Plain, and decorated Red-on-buff types.

Decorated types and the Lower Colorado Buffware series of types are relatively distinctive and easy to track. However, it can be very difficult to draw clear technological distinctions between the various upland Patayan and Hohokam plainwares (Stone 1982). It is tempting to define a simple, general category of "western Arizona brownware". Petrographic compositional analyses promise to be useful in determining the origin and distribution of ceramics. Rose and Fournier (1981) conducted studies of sherds from Gila Bend area sites and suggested that such analyses be combined with geomorphological surveys for the detection and comparison of raw material sources.

The definition of boundaries and interaction zones presumes that one can demonstrate the contemporaneity of different ceramic types or sites. At present, this is a difficult task in west central Arizona, given the long temporal



MAP 7-2: THE GRANITE REEF MODEL: PREDICTED RIVER—DESERT FRONTIER ZONES

spans associated with plainwares. The occurrence of different wares in the same geographic area could indicate a frontier zone, given contemporaneity. Alternatively, an intermixture of wares may have resulted from sequental occupation or use by different groups. The co-occurrence of different wares at single loci would constitute stronger evidence for interaction or trade. Intrasite stratigraphic or distributional analyses could indicate whether a site was occupied simultaneously or sequentially by different groups.

In west central Arizona, several zones of ceramic intermixture indicate either social interaction or the sequential or shared use of particular areas by different groups. Lower Colorado Buffware appears to be the dominant brand of pottery west of the divide between the Colorado and Gila watersheds (Carrico and Quillen 1982; Stone 1982). The Harcuvar, Harquahala, Little Harquahala, and Granite Wash ranges contain a mixture of Lower Colorado Buffware and brownware pottery probably manufactured by upland Patayan groups. These often occur together at the same site (Stone 1982:128). This intermixture of wares may have involved sequential occupation, shared use by river and desert-based groups, or trade involving the transfer of pottery. To the north of the study area, Dobyns (1974) interpreted the co-occurrence of buffware and brownware sherds as evidence of both shared land use and trade between river and upland Yuman groups. Ethnographic data were used to justify this interpretation. New and existing ceramic collections should be typed and dated according to Waters' (1982) criteria for the analysis of Lower Colorado Buffware, and compositional analyses might indicate the origin of Lower Colorado sherds.

The northeastern boundary of the study area, with a mixture of Tizon Brownware and Prescott Grayware, approximates a southern extension of the frontier between the prehistoric Cerbat and Prescott branches (Dobyns 1974; Euler and Dobyns 1962; Keller 1983; Powers, Granger, and Keller 1978). A variety of wares, including brownware, Lower Colorado Buffware, Prescott Grayware, Hohokam Red-on-buff types, and intrusive decorated types from northern Arizona, have been reported from an area incorporating Eagle Eye Peak near Aguila, the eastern end of the Harquahala Mountains, the southeastern portion of the Harcuvar range, and the Black Mountains. This was an area of relatively abundant water sources, and the sites include rockshelters and apparent base camps often associated with bedrock mortars. This may have been a zone of multiple frontiers, from which indigenous groups interacted with Hohokam and Prescott populations. On the other hand, the zone may have been periodically occupied by late prehistoric groups from surrounding areas. It is interesting that the area is located just west of a major aboriginal travel route. This trail branched away from the Hassayampa River at Jackrabbit Wash and continued past the eastern end of the Harcuvars to upper Date Creek and the north (Ezell and Ortiz 1962). The route thus linked the Hohokam and Prescott areas. This minimally investigated portion of the study area contains significant data of relevance to many research issues, and it should be one focus of future studies.

The Harquahala Valley and the Palo Verde Hills exhibit a mixture of Hohokam and Lower Colorado Buffware types (Bostwick 1984; Carrico and Quillen 1982; Stein 1981; Stone 1982). Decorated Hohokam types date at least as early as the Colonial Period, which may have begun as early as A.D. 500. A primary research issue is the contemporaneity of Hohokam and Patayan occupations; single sites in the Palo Verde Hills contain multiple wares, information relevant to the study of interaction or shared patterns of land use (Stein 1981). Data from the Hohokam site of Las Colinas in Phoenix, where Lower Colorado Buffware sherds occurred in an apparent Patayan "ghetto" area, should contribute to the dating and classification of Lower Colorado Buffware and the study of Hohokam-Patayan interaction (David Gregory, personal communication 1984). Data from the Gila Bend region are also applicable to this research issue (Teague 1981).

In summary, ceramic distributions indicate the existence of multiple frontiers within this study area, a zone defined as peripheral to several major prehistoric traditions. Future studies should further explore these apparent patterns. Factors underlying shared resource use, interaction, or sequential occupation could be illuminated through the correlation of frontier zones with natural travel routes, areas of high natural resource productivity or diversity, or sources of rare or highly valued resources.

Source and distributional studies of possible trade items are important to the examination of interaction and exchange. The movement of materials from source areas may have resulted from exchange or from direct procurement associated with long-distance expeditions or high residential mobility. It can be difficult to distinguish among these patterns on the basis of archaeological data. Trailside assemblages are likely to contain a variety of materials including trade items. Decorated Hohokam sherds are often associated with trails, travel routes, or nearby sites such as the Bouse site (Berry 1978; Brown and Stone 1982; Harner 1958). Their occurrence along the Colorado River, along with Hohokam ground axes and shell jewelry, indicates long-distance interaction between the Colorado and the Gila (Schroeder 1952; Stone 1979).

The analysis of lithic sources in the study area has focused on the characterization of the Vulture obsidian source (Brown 1982). Analyses of obsidian artifacts from sites in west central Arizona and the Salt River Valley indicated that although some of the Vulture obsidian nodules trickled into Hohokam sites, the dominant pattern of utilization was one of local procurement and distribution (Brown 1982:240). However, a cache of obsidian nodules from an unknown source was recently recovered from a Hohokam site near Gila Bend (Teague 1981:59). This discovery indicates that such nodules may have been a valued resource obtained through trade or travel to the source. In addition, obsidian from other sources has been found at Archaic sites in the Harquahala Valley (Bostwick n.d.). Shackley (1985) has conducted relevant sourcing studies, and distributional analyses are a promising area for future research.

LITHIC RESOURCE USE

Information from lithic assemblages in the study area can contribute to the study of lithic resource use as a major domain of prehistoric technology and a demonstrably ancient and recurrent form of regional land use. Patterns of stone tool use and manufacture, indicative of basic technological strategies for coping in the natural environment, can vary through space and time, possibly in response to temporal shifts in settlement and subsistence systems.

The numerous lithic scatters documented by the Granite Reef study differed in size, artifact density, internal structure, artifact types, physiographic setting, and relationship to raw material sources. These differences "helped to define a range of relevant research questions concerning raw material procurement or quarrying, stages of tool production, and patterns of tool use" (Lewenstein and Brown 1982:133).

The spatial distribution and quality of raw materials can affect the staging of subsequent manufacturing activities and the degree to which specific materials are selected for particular purposes. The distribution of raw materials in relation to other resources influences settlement patterns. Gould's (1980) studies of lithic resource use in Australia illustrate these points.

In the Australian desert, Gould drew a distinction between "localized" and "nonlocalized" quarries. The former were concentrated sources of raw material, outcrops rich enough to warrant special trips to the area. Aborigines would travel up to 20 miles from base camps to these relatively rare sources. Flakes and small cores were transported away for further reduction into tools which were eventually discarded at base camps.

Nonlocalized sources were defined by the occurrence of scattered nodules of raw material in terraces and other areas. These sources were associated with the on-site manufacture, use, and discard of "instant tools". This was the dominant pattern of lithic manufacture and tool use. Its remnants were low density artifact scatters dispersed over the landscape, often far from water sources. Nonlocalized lithic sources near water were used more intensively than localized quarries far from water, even when the former contained poorer quality material.

West central Arizona represents a similar situation. Lithic sources vary in extent and density, and outcrop quarries are rare in comparison to nonlocalized sources. Localized, high density quarries have been located along the Big Sandy and Bill Williams rivers near Alamo Lake and in the Eagletail Mountains and the Clanton Hills southwest of the Eagletails. These sites contain fine-grained rhyolite, jasper, and chert (Stone 1977). Nonlocalized lithic sources consist of scattered nodules on river terraces, pediments, and upper bajadas. Low density scatters and "chipping stations" occur in these areas (Brown and Stone 1982).

In the region between the Bill Williams and Gila rivers, the northeast-southwest trending chain of Tertiary volcanic ranges contains high quality, fine-grained raw materials. These ranges include the Vulture, Big Horn, and Eagletail mountains. Large portions of the study area contain few raw materials, or rock types of relatively poor chipping quality. These areas include the vast basins and lower bajadas and the predominantly metamorphic mountain ranges. Regional studies should map the disribution of raw materials in relation to the distribution of archaeological sites. One research question could focus on the use of poor quality local materials vs. imported, higher quality materials at sites remote from good lithic sources. The presence of the latter could indicate patterns of mobility or specialized tool production. Site records indicate that the ceramic period occupants of the Harcuvar and Harquahala ranges used locally available quartzite, but imported artifacts of Vulture obsidian also occur at these mountain sites (Brown 1982).

Raw materials for grinding implements are assumed to have been available in most of the mountain ranges. To the west of the study area, Rogers (n.d.) noted that quartzite deposits near New Water Spring were the source for manos found throughout the New Water and Kofa ranges. The study of mano and metate production areas could reveal implement manufacturing techniques and distributional patterns.

The Granite Reef investigations resulted in the definition of at least three major patterns of lithic resource use in the western desert (Brown and Stone 1982:346-347). These were: (1) the expedient manufacture and use of simple core and flake tools from local materials; (2) quarrying and the production of tool blanks which were transported elsewhere for finishing; and (3) specialized tool production.

The first pattern, characterized by isolated artifacts, chipping stations, and extensive lithic scatters of low density, was found at nonlocalized raw material sources. The presence of both chipping debris and utilized artifacts indicated the production, use, and discard of simple tools during the course of travel or resource exploitation. Binford (1980:9) proposed that such sites would lack internal structure due to a minimal reuse of particular loci. Concentrations of artifacts and rock ring features may represent temporary campsites within these areas.

Quarrying involved the systematic exploitation of localized raw material sources. Cores, flakes, and blanks taken from these sites were later shaped into tools which may have had specialized functions. At the Vulture source, AZ T:5:5 (ASU), there was evidence for the production of biface blanks.

Specialized tool production involved the manufacture of refined bifaces at Archaic sites in the Harquahala Valley. These sites contained finished bifaces as well as a preponderance of small tertiary flakes. They represented a later phase of the manufacturing process begun at quarries. According to Lewenstein and Brown (1982:202), "these tools and their debitage indicate that these people had considerable knowledge of the flaking properties of the raw materials they used, as well as skill in fashioning stone tools by means of hard and soft hammer percussion, bipolar reduction, and pressure flaking".

In his dissertation on sites in the western Papagueria, Doelle (1980) defined two patterns of lithic manufacture and use. His "generalized technological pattern" (GTP) corresponded to the expedient production and use of simple tools. "All purpose" tools were produced by hard hammer

percussion from a variety of local materials. The "specialized technological pattern" (STP) incorporated the production of specialized tools, such as thin bifaces, for specific tasks. These were produced from fine-grained raw materials by hard and soft hammer percussion, pressure flaking, and heat treating. In contrast to generalized tools, these implements were maintained and retouched rather than casually discarded. This pattern parallels the situation at the Harquahala Archaic sites along the Granite Reef Aqueduct.

Doelle hypothesized that these two patterns were associated with different activities, time periods, and settlement-subsistence systems. The multi-purpose tools of the GTP were associated with the use of a variety of plant and small game resources by highly mobile hunter-gatherers. Doelle linked this pattern to Archaic hunter-gatherers and their successors, such as the historic Sand Papago. The STP phenomenon was defined on the basis of investigations at hunting and butchering sites. Doelle suggested that this pattern represented big game hunting by task groups of specialized hunters from farming villages along the Gila River. He based this conclusion on the arguable assumption that big game hunting was not an important activity for Archaic hunter-gatherers. He also argued that the use of specialized tools by skilled hunters increased the efficiency of hunting and offset the costs of travel and transport between river villages and hunting grounds.

Doelle (1980) failed to acknowledge the potential contribution of big game hunting to the Archaic subsistence regime. Unless big game were scarce during Archaic times, a possibility that remains to be tested, there is little reason to assume that a broad spectrum subsistence pattern involved a minimal reliance on the hunting of large mammals. Rogers (n.d.) found quantities of burned deer and bighorn bones at Archaic sites in the Kofa and Castle Dome mountains. Deer hunting was a major activity among the Yavapai, although they also exploited a variety of small game animals (Gifford 1936). In the western Papagueria, the Sand Papago hunted antelope and bighorn sheep. Crosswhite (1981:55) argued that big game were as important as small animals in their proportional contribution to the total diet of the Sand Papago.

The "specialized technological pattern" aptly describes the lithic assemblages from Archaic sites in the Harquahala Valley (Lewenstein and Brown 1982:202). Doelle's type site, AZ Y:6:10 (ASM), yielded an Archaic point, although Desert Side-notched points and radiocarbon dates indicated that the major occupation was late (post-A.D. 1300). This site may represent an example of functional continuity despite changes in regional settlement systems. As Binford (1982:19) noted:

> Particular places may continue to be used in similar ways in spite of overall organizational change in the system (e.g., a good sheep-hunting camp in the mountains remains such regardless of changes in the role which sheep may play in the overall organization of the settlement subsistence system).

Doelle's hypotheses concerning big game hunting by river farmers are interesting and deserving of further scrutiny. Hunting specialists may well have been dispatched from river villages. The Eagletail Mountains were a historic Pima-Maricopa hunting ground for bighorn sheep (Ezell and Ortiz 1962). Nonetheless, there is little basis for attributing either the STP or big game hunting primarily to late prehistoric groups.

Neither is there justification for limiting the "generalized technological pattern" to broad spectrum hunter-gatherers. Hohokam lithic technology incorporated utilitarian core and flake tools in addition to a highly stylized stoneworking industry (G. Brown 1982:206). In general, it is unwise to "equate sophistication of tool production with complexity of economic organization, a relationship which does not necessarily hold for implements designated for subsistence tasks" (Lewenstein and Brown 1982:202). It seems likely that lithic assemblages from most time periods incorporated elements of both GTP and STP patterns. Differences may have occurred in the relative dominance of each pattern within particular time periods and settlement-subsistence systems. Patterns of tool manufacture, curation, maintenance, and use need to be considered in the context of settlement system analyses (Binford 1979).

Future researchers should strive to gain a better understanding of lithic technology and use behavior. Detailed technological studies, use wear analyses, and intersite comparisons should be undertaken. The Granite Reef report contains an abundance of analytical data that can be useful in the design of future research (Lewenstein and Brown 1982; Teague 1984).

ENVIRONMENTAL CHANGE

The accurate description of past environments and environmental changes is ultimately critical to the understanding of land use patterns and variability in the history of human activities and social organization. The best results are generally achieved when archaeologists enlist the aid of professional researchers from other fields. Interdisciplinary studies can contribute not only to the understanding of long-term environmental change but also to knowledge of the depositional histories of archaeological sites. This information contributes to the study of settlement and subsistence systems through time.

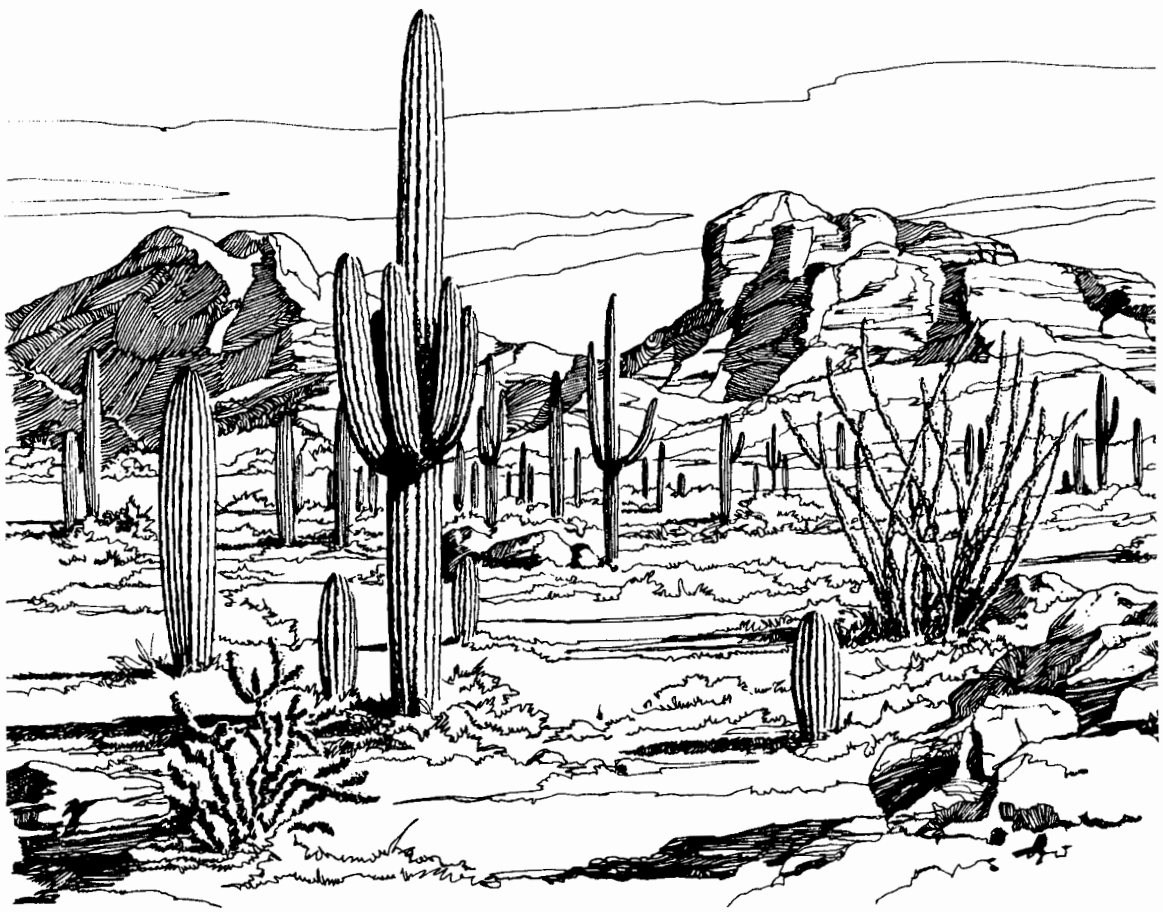
In the study area, contract projects have recently enlisted the aid of geologists, geochemists, and geomorphologists (Bostwick n.d.; Brown 1982; Water n.d.). These scientists have examined the geological context and composition of lithic raw materials and the depositional processes affecting Archaic sites. Other projects in the southwestern desert, too numerous to reference, have benefited from the cooperation of palynologists, hydrologists, zoologists, and others.

Geomorphological consultants are skillful in the determination of natural processes affecting the context and condition of sites. Their services should be viewed as essential at preceramic sites, those with subsurface deposits, multicomponent sites, and areas which may have been farmed by prehistoric inhabitants.

Packrat midden analyses should be encouraged as a means of paleoenvironmental reconstruction in the study area. Indeed, western Arizona was the original breeding ground for packrat nest studies (Cole and Van Devender 1984; King and Van Devender 1977; Van Devender and King 1971; Van Devender and Spaulding 1979). McGuire and Schiffer (1982:52) suggested that new studies would "require more detailed collection and analysis than that undertaken by previous packrat research in the area and more rigorous control of microenvironmental factors such as exposure". In addition, they noted that "the region's arid climate, plethora of protected locales for middens, and the ubiquitous population of packrats should provide a substantial mass of data for such an effort".

CONCLUSION

This chapter has discussed both the pitfalls and promising directions for archaeological research in the northern Sonoran Desert. Existing knowledge and models can provide a foundation for future studies. The generation of testable hypotheses and models should be a major goal, with continued attention to the definition of basic patterns of variation in material culture and settlement patterns. The former endeavor will serve to direct research, the latter to define new problems and refine existing models.



CHAPTER 8

HISTORY OF ARCHAEOLOGICAL RESEARCH IN THE PRESCOTT REGION

The Prescott region, including the Skull Valley study area southwest of the city, has received little attention by professional archaeologists. Amateur archaeologists, on the other hand, have been active researchers, and they have contributed much of the information in the regional site files. However, their published reports and unpublished manuscripts have tended to be cursory and narrowly focused on particular sites or research issues. Map 8-1 depicts the locations of archaeological sites investigated in the Prescott region.

The lack of institutional research has resulted in the existence of data "islands" rather than gaps (Gumerman, Thrift, and Miller 1973:16). Archaeological interpretations have been based on a small sample of sites from a small number of investigative efforts. It is difficult to explain the paucity of research. In comparison to the west central desert, the Prescott area is a lush environment, one of the first areas in the state settled by historic pioneers. However, the Prescott region was remote from the major institutions which conducted early archaeological studies in the state. When archaeologists did venture into this portion of central Arizona, they focused on the more spectacular sites in the Verde Valley. In more recent times, the area has not experienced the expansion of research associated with the advent of contract archaeology. There have been no major construction or development projects to privide funds for such efforts. Only one archaeological project, the Copper Basin study funded by Phelps Dodge Corporation, has involved an explicit research program for investigating a large number of sites (Jeter 1977). The Copper Basin report thus constitutes the major published reference on the prehistory of the Skull Valley area.

Archaeologists first ventured into the region in the early 1900s. Jesse Walter Fewkes conducted an extensive reconnaissance survey in central Arizona, focusing on the Verde Valley. He also visited sites in the vicinity of Prescott and concluded that ruins in the Hassayampa headwaters area were similar to those in the Chino Valley north of Prescott (Fewkes 1912). These included the hilltop masonry structures frequently referred to as "forts". Fewkes (1912:218) saw the Prescott area as a frontier zone occupied by pioneers from the Salt and Gila rivers.

The Gila Pueblo Foundation and Malcolm Rogers extended their regional surveys into the study area during the 1920s and 1930s. These surveys were unsystematic and were geared to the documentation of large habitation sites. The Gila Pueblo archaeologists were particularly interested in defining the geographic range of the Hohokam in central Arizona. Along Kirkland Creek and in Skull Valley and Peeples Valley, Gila Pueblo documented large pithouse villages with trash mounds. Hohokam Red-on-buff ceramics were present at many of these sites. They also yielded pottery designated as "Prescott Gray Ware" by Gladwin and Gladwin (1930). Tentative boundary corners for the distribution of this ware were Hualapai Peak to the northwest, Oak Creek to the northeast, New River to the southeast, and the Plomosa Mountains to the southwest.

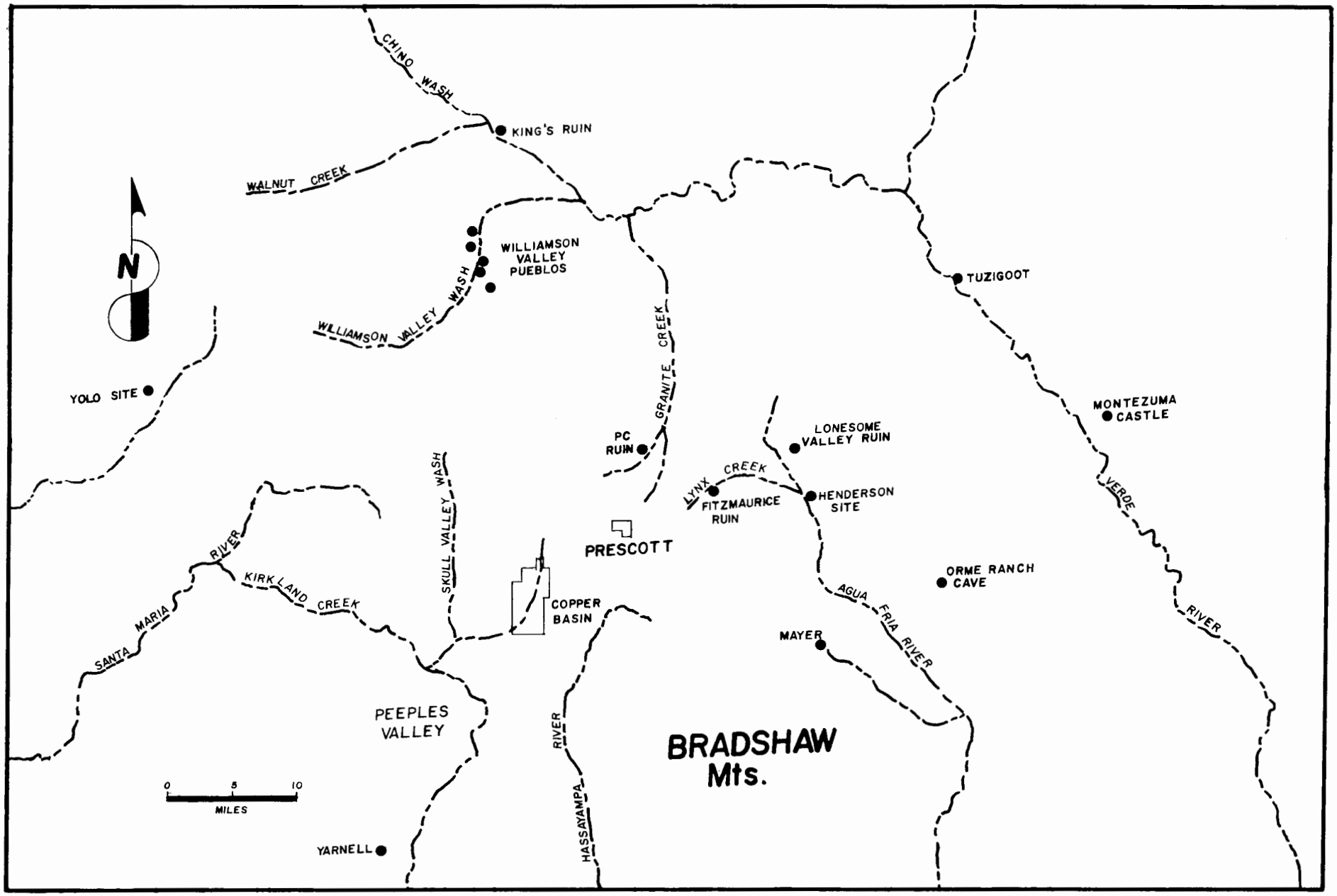
Malcolm Rogers (n.d.) recorded two sites in the vicinity of Congress. One site, near a tributary of the Hassayampa River, contained stone hearths, Prescott Gray sherds, and a few Hohokam sherds. Rogers called it an "early Yavapai" site. He also located a large stratified site near Sols Wash southwest of Congress. At least a meter of cultural deposits was exposed in the arroyo bank, and the surface was littered with manos, metates, finished stone tools, and worked pieces of antler. Rogers counted 104 metates and noted that pothunters had already carried away additional specimens. Both Prescott Gray and Hohokam ceramics were present.

In the 1930s, Spicer and Caywood (1936) reported on excavations at King's Ruin and Fitzmaurice Ruin, two pueblos located respectively in Chino Valley and near Lynx Creek southeast of Prescott. The results of these investigations were incorporated into Harold Colton's (1939) initial synthesis of prehistoric cultural units in northwestern Arizona. Colton and Lyndon Hargrave of the Museum of Northern Arizona had conducted a reconnaissance of archaeological sites west and southwest of Flagstaff. Their travels apparently brought them to the study area, as they defined a pottery type, Kirkland Gray, found at a site in Skull Valley.

In his synthesis, Colton (1939) defined the "Prescott Branch" of the "Patayan Root". The Prescott Branch was defined by the geographic distribution of Prescott Grayware pottery. Colton subdivided it into two phases, the "Prescott Focus" (A.D. 900-1000) and the "Chino Focus" (A.D. 1025-1200). The temporal ranges were based on tree ring-dates associated with nonlocal pottery types found at Prescott area sites. Shallow pithouses were characteristic of the first phase, and pueblo structures were occupied during the later Chino Focus.

Colton, operating from a northern perspective and a familiarity with materials from western Arizona, assigned the Prescott Branch to the Patayan Root on the basis of similarities between Prescott Grayware and Patayan wares. However, he stated that "the placing of this branch in the Patayan Root is mainly a convenience and cannot be justified by a study of the determinants" (Colton 1939:30). Gladwin et al. (1937), on the other hand, had noted similarities between Hohokam utility ware and Prescott area pottery. Thus the northern perspective stressed upland Patayan ties, while the southern perspective focused on Prescott Branch-Hohokam relationships. These themes have continued to dominate interpretations of regional prehistory.

In 1952, Richard Shutler excavated a pithouse and trash mound in Long Valley. This corridor north of the study area connects Skull Valley and Williamson Valley. Shutler's pithouse seemed to be characteristic of the Prescott Focus, but intrusive Wupatki Black-on-white ceramics indicated a later date than had previously been assigned to Prescott Branch pithouses (Gumerman, Thrift, and Miller 1973; Shutler 1952).



MAP 8-1: ARCHAEOLOGICAL SITES IN THE PRESCOTT REGION (Based on Jeter 1977: 15).

In the early 1950s, Albert Schroeder (1954) conducted a brief survey near Mayer, a small town east of Prescott. He suggested that artifactual remains indicated a blending of Hohokam and Patayan traits.

Euler and Dobyns (1962) attempted to define the western limits of the Prescott Branch through excavations at the Yolo site on Bozarth Mesa. They concluded that sites west of Bozarth Mesa could be attributed to the Cerbat Branch of the Patayan Root. The Yolo excavations revealed a westward decline in the amount of mica temper in Prescott Grayware. The investigations also indicated that the the Chino Focus included not only masonry pueblos but also shallow, rock-outlined, oval pithouses. These differed from older Prescott Focus pithouses which had no rock outlines.

In the early 1970s, most of the archaeological work in the Prescott region was carried out by nonprofessionals and by Prescott College. Franklin Barnett, an amateur archaeologist, conducted excavations north of Prescott in the Williamson Valley, at several small pueblos collectively known as the "Matli Ranch Ruins". He also conducted additional investigations at Fitzmaurice Ruin (Barnett 1970, 1973, 1974, 1975).

Ken Austin, an amateur archaeologist from Prescott, surveyed portions of the Prescott National Forest. He also recorded sites in the study area. His site records were filed at the Museum of Northern Arizona. In Austin's opinion, the "Mountain Patayans" were semi-nomadic people who engaged in the widespread trade of exotic items and the production of "remarkable petroglyph records" (Austin 1979). Residential sites were said to be located at the Santa Maria-Kirkland Creek confluence, in Kirkland and Peeples valleys, and in the vicinity of Congress Junction (Austin 1977:18).

Austin was primarily interested in the possibility that hilltop "forts" were linked into extensive line-of-sight communication networks. He defined six major and four minor "line-of-sight chains" in the Prescott region. These hypothetical systems consisted of lines interconnecting hilltop masonry structures. Two minor chains were defined in the study area. One of these linked buttes on opposite sides of Peeples Valley, and the other connected three hilltop sites bordering the Hassayampa River south of Wagoner (Austin 1977:9,17).

Investigators from Prescott College conducted informal, unpublished surveys in the study area. Robert Euler recorded Hohokam sites and ball courts in Peeples Valley. Albert Ward (1975) excavated Chino Focus structures at the PC Ruin near Prescott and noted similarities to Hohokam architecture.

In the 1960s and 1970s, researchers paid increasing attention to Hohokam manifestations in the Prescott region and the Verde Valley. Breternitz found evidence for Colonial period and later Hohokam activity in the middle Verde Valley. He suggested that the Agua Fria River was also a major route for Hohokam migration and trade (Breternitz 1960:27). Weed and Ward (1970) described Colonial Hohokam materials at the Henderson site on the upper Agua Fria near Prescott. Later investigations conducted by Southern Illinois University as part of the Central Arizona Ecotone Project confirmed the Hohokam affiliation of sites along the middle and upper Agua Fria River (Gumerman and Spoerl 1980; Gumerman, Weed, and Hanson 1976). The expansion of Hohokam influence may or may not have involved colonization (Weaver 1980). Hohokam traits in the Prescott area may have been associated with events and processes occurring to the southeast in the Agua Fria watershed. Although the Hohokam may have reached the study area by way of the Hassayampa River (Wood 1980), Hohokam use of the Hassayampa drainage apparently "never reached the level of permanent occupancy" (Weaver 1980:128).

During this period of intensive examination of the Agua Fria watershed, relatively little professional work was carried out southwest of Prescott. In conjunction with surveys of alternative transmission line corridors, the Museum of Northern Arizona surveyed 10 to 15 small plots along Kirkland Creek (Fish, Moberly, and Pilles 1975:25-26). These brief investigations recorded at least a dozen sites, but there was minimal information on which to base interpretations of areal prehistory.

The most significant archaeological investigations southwest of Prescott were conducted along Copper Basin Wash directly east of Skull Valley (Gumerman and others 1973; Jeter 1977). Much of the survey work and all of the more intensive investigations occurred on Prescott National Forest lands subject to exchange with the Phelps Dodge Corporation. However, the initial survey by archaeologists from Prescott College also incorporated some public lands within the study area (Gumerman, Thrift, and Miller 1973).

The Prescott College crew surveyed approximately 6000 acres of Prescott National Forest and 3000 acres of BLM land in Skull Valley. The survey was conducted at a relatively high level of intensity, and 13 sites were found in Skull Valley. These sites, which yielded Prescott Grayware pottery, included seven pithouse sites with artifact scatters, three sherd and lithic scatters, two ridgetop masonry structures, and an ash area. Forty additional sites, consisting primarily of artifact scatters and rock-outlined oval structures, were located on Forest Service lands. Although these sites were deemed to be "unspectacular", they were seen to have significant research potential, and excavations were recommended.

The research potential of the Copper Basin sites was realized in investigations conducted by Marvin Jeter of Arizona State University. Jeter's study, used as the basis of his doctoral dissertation, represents the only research-oriented work conducted in the vicinity of the Skull Valley area (1977). The investigations were limited to sites on Forest Service lands, since they were sponsored by Phelps Dodge Corporation to enable a proposed land exchange with the U.S. Forest Service. Unfortunately, the original survey maps and field notes became unavailable when Prescott College went bankrupt in 1975. There was little available information for assessing the accuracy of the original survey. An additional series of randomly selected, dispersed transects were surveyed, from which Jeter (1977:76) "obtained some asssurance that the original survey had indeed effectively characterized the distribution of sites in the project area". His crews then conducted surface collections and test excavations at most of the 40 sites originally located by Prescott College.

Data collection and analyses were based on a series of hypotheses regarding local settlement and subsistence patterns, regional exchange systems, and the agriculturally "marginal" nature of the area. Since the area was marginal in terms of its ruggedness, limited arable land, and short growing season, its occupation was suggested to be indicative of stress in surrounding areas of better agricultural potential (Jeter 1977:54). On the basis of radiocarbon dates and intrusive pottery, the occupation of Copper Basin was dated to A.D. 900 to 1200, with no evidence of occupation after A.D. 1300 (Jeter 1977:239). The Copper Basin study contributed to knowledge concerning variation in Prescott Branch artifact types and architecture through time. Settlement and subsistence data supported the construction of alternative settlement models at both local and regional scales.

Since the completion of the Copper Basin investigations, few additional studies have been conducted within the area southwest of Prescott. Near the western edge of the study area, the Museum of Northern Arizona recently surveyed the Mead-Phoenix transmission line route (Keller 1984). Sherd and lithic scatters were a major site type, and Tizon Brownware was the dominant ceramic ware. Several sites were found near the Santa Maria River.

The Museum of Northern Arizona also surveyed an area of 420 acres in Thompson Valley for a mineral lease application (Dosh 1984). This area was located near Yava in the northern portion of the study area. Intensive coverage at 20 meter intervals resulted in the documentation of 19 sites including 6 lithic quarries, 5 lithic scatters with tools, and other scatters incorporating a variety of sherds, chipped stone, and ground stone artifacts. Probable base camps were found near the heads of canyons leading into Kirkland Creek; these yielded brownware pottery. Several sites, including four probable habitation areas, were recommended for preservation or further investigation. Avoidance was suggested for other sites, and sampling was recommended for the investigation of large quarries (Dosh 1984:18).

The Bureau of Land Management, Phoenix District Office, has conducted limited surveys in connection with land exchanges and mining operations. The Skull Valley planning unit of the BLM contains relatively little federal land in comparison to the vast acreage of public lands in the western desert. In connection with the Peoples Canyon land exchange, Miller (1984) conducted a sample survey south of the Date Creek Mountains near Congress. Few cultural remains were found. Sites recently recorded on small clearance projects include sherd and lithic scatters along the Hassayampa River north of Wickenburg.

The BLM sponsored an archaeological overview of the Kirkland Creek watershed, with a partial draft report completed by J. Scott Wood. The author, a Forest Service archaeologist, summarized the archaeological record and presented an admittedly speculative interpretation of regional prehistory (Wood 1980). The unpublished manuscript is on file at the Phoenix District Office of the BLM. An earlier overview prepared for the entire Skull Valley planning unit emphasized the lack of available archaeological information (Andrews 1975). With the exception of the Copper Basin study, this situation has changed little in the past decade.

In summary, the study area remains one of the most poorly understood regions in southwestern prehistory. The state of knowledge is indeed one of islands rather than gaps. Published reports are rare, reflecting the scarcity of systematic surveys and intensive investigations. Although existing information suggests intriguing avenues for research, the data base can support only speculative summaries of regional prehistory. Problem-oriented research is desperately needed in order to bring the region into the mainstream of southwestern archaeology. As Jeter (1977:274) stated:

> The region has the potential to produce some truly excellent archaeological research. The sites and structures of the region are apparently fairly numerous, but generally only small to medium sized, so that judicious sampling programs should begin to produce insights without expenditure of great amounts of time.

CHAPTER 9

A SUMMARY PREHISTORY OF THE PRESCOTT REGION

The prehistory of the Prescott region has been interpreted from two basic perspectives. Early researchers suggested a western, upland Patayan affiliation for ceramic period archaeological sites (Colton 1939), while recent investigators have emphasized Hohokam influences from the southeast (Gumerman, Thrift, and Miller 1973; Jeter 1977; Ward 1975; Weed and Ward 1970; Wood 1980). The Prescott area represents a transitional zone between major cultural traditions: the Anasazi and Patayan to the north and west and the Hohokam to the south. The paucity of archaeological investigations and data from this area has contributed to a reliance on interpretive input from surrounding regions. At the same time, it is important to consider events in surrounding areas which likely affected the prehistoric inhabitants of the Prescott region. The following discussion will focus on the "Prescott Branch" and its ties to other cultural traditions.

The regional site files are dominated by sites assigned to the Prescott Branch, with little evidence for occupations prior to A.D. 800. No Paleoindian remains have been found, and Archaic sites are rare in the archaeological record. The small number of early sites may reflect a lack of discovery rather than a genuine absence. Intensive, systematic surveys have rarely been conducted, and researchers have concentrated their efforts on the discovery and investigation of later sites with structural remains. Archaic and earlier deposits, particularly sites near major drainages, have likely been buried.

Malcolm Rogers (n.d.) found Archaic materials one meter below the surface in the bank of Sols Wash south of Congress. These "Amargosa II or Chiricahuan" artifacts were associated with grinding implements. At Battle Flat in the Bradshaw Mountains, Wood (1978:32) found two Archaic points including one of the Pinto Basin or Amargosa II style. Chiricahua Cochise, Pinto Basin, and Amargosa II represent smimlar Archaic projectile point styles (Berry and Marmaduke 1982; Haury 1950; McGuire and Schiffer 1982). Several San Pedro Cochise points were found at one of the Desert Gold sites along Trilby Wash east of Wickenburg (Rice and Dobbins 1981:33). To the east of the study area, Archaic sites have been reported in the middle Agua Fria drainage (Gumerman, Weed, and Hanson 1976:39) and the middle Verde Valley (Breternitz 1960). The Dry Creek site in the Verde Valley was geologically dated to approximately 2000 B.C. (Shutler 1950).

Little can be said in regard to the Archaic occupation of the Prescott region. Hunter-gatherers are believed to have occupied the region between approximately 2000 B.C. and A.D. 1 (Jeter 1977:39; Shutler 1950; Wood 1978:33). Rice and Dobbins (1981) concluded that the Desert Gold site was a base camp from which a small community exploited rabbits, wild seeds, and cactus fruits. These were processed in a large, communal roasting pit. The Desert Gold investigations represent the only excavation of an Archaic site with subsurface remains in the vicinity of the study area.

The region appears to exhibit the blending of Amargosa and Cochise traditions found in other portions of west central and southern Arizona (Berry and Marmaduke 1982; Brown and Stone 1982; Bostwick 1984; Haury 1950; McGuire and Schiffer 1982; Wood 1978). The meaning of this overlap is far from clear, and some researchers have argued that the distinction is largely artificial (Marmaduke 1984:88) or overemphasized (McGuire and Schiffer 1982:177). Rice and Dobbins (1981:37) suggested the existence of a widespread interaction sphere incorporating much of Arizona and southern California.

There is little existing information on the transition between the Archaic and ceramic periods in the Prescott region. The distinctive architectural and artifactual remains of the Prescott Branch postdate A.D. 800. Wood (1980:38) suggested that the indigenous occupants of the region adopted pottery and farming, and that they inhabited small pithouse villages, between A.D. 1 and 800. These changes would have been consistent with contemporaneous changes in other areas of the Southwest, but there is little direct evidence for their occurrence in the study area. Excavations by Barnett (1970:85) at the Rattlesnake Ruin near Prescott provided some evidence for an early Prescott manifestation dated to A.D. 620 to 950 on the basis of intrusive sherds. This site included several shallow pithouses and trash mounds.

The Prescott Branch is the dominant ceramic period manifestation in the region. The designation was originally introduced by Colton (1939) as a division of the Patayan Root. Although this affiliation has generated controversy, the term will be retained in this discussion.

Colton (1939) incorporated much of western Arizona into the Patayan Root and defined three major "branches" in northwestern and west central Arizona. The Cerbat Branch was defined by the distribution of Tizon Brownware pottery in western Arizona. The Cohonina of the Flagstaff region manufactured San Francisco Mountain Grayware. Prescott Grayware pottery was associated with the Prescott Branch. The Prescott Branch seems to have been incorporated into the Patayan Root largely as a matter of convenience (Colton 1939:30). Recent investigators have noted a continuum of technological variability in central Arizona plainwares which throws doubt on simple associations between prehistoric "branches" and ceramic wares (Stone 1982). Breternitz (1960) argued that all were local varieties of a single, basic central Arizona utility ware.

Colton (1939) attempted to establish an early link between the Prescott and Cohonina branches in the Prescott area. He defined a pottery type, Kirkland Gray, apparently found to underlie Prescott Grayware at a site in Skull Valley. Kirkland Gray, a type which appears to be intermediate in a technological continuum between Prescott and San Francisco Mountain graywares, was defined as a Cohonina type. However, no evidence has been offered to support either an early intrusion form the north or the status of Kirkland Gray as a type ancestral to Prescott and Cohonina graywares.

Investigations in the Prescott region have yielded little evidence for strong ties between the Prescott Branch and Patayan groups to the west. Lower Colorado Buffware is

rare or non-existent at Prescott Branch sites. Intrusive ceramics are dominated by Hohokam pottery and decorated types from the Flagstaff and Hopi regions (Jeter 1977).

Colton (1939) summarized existing information on the Prescott Branch, based on a handful of surveys and excavations (Fewkes 1912; Gladwin and Gladwin 1930a,b; Spicer and Caywood 1936). His definition of Prescott Grayware, the indigenous pottery, incorporated six types including gray, brown, and orange variants sometimes decorated with painted black designs. Euler and Dobyns (1962:77) later attributed color variations to the practice of firing in an uncontrolled atmosphere, and they advocated a simple distinction between plain and painted types. They further noted that sherds in the eastern portion of the geographic range tended to be gray and to contain greater amounts of mica.

Two phases were dated on the basis of tree-ring dates assigned to intrusive pottery types. The "Prescott Focus" dated from A.D. 900 to 1000. Structures consisted of shallow, rectangular pithouses with rounded corners, and artifacts included trough and basin metates, choppers, pottery anvils, and full grooved axes. Methods of disposal of the dead were unknown.

The "Chino Focus" dated from A.D. 1025 to 1200. Architectural remains included masonry pueblos and hilltop "forts". The pueblo structures lacked kivas. Artifacts included open trough metates, triangular concave-based projectile points, 3/4 grooved axes, and such exotic materials as Hohokam turquoise mosaics and carved shell. Extended inhumation was the method of corpse disposal.

Subsequent investigations led to chronological revisions and a better understanding of Prescott Branch subsistence, architecture, and material culture. Gumerman, Thrift, and Miller (1973) incorporated revised tree-ring dates (Bannister et al. 1966) into an expanded chronological range: A.D. 850 to 1025 for the Prescott phase, and A.D. 1025 to 1310 for the Chino phase. Jeter's (1977) work in Copper Basin confirmed the basic temporal range (A.D. 900 to 1200) of the Prescott Branch, but it did not result in an overall revision of the regional chronology. He was able to obtain only five radiocarbon dates, and chronological interpretation was hampered by this small sample and the large standard deviations associated with the dates. Jeter (1977:239-240) stressed the promising potential for dendrochronology and archaeomagnetic dating in the Prescott region.

The two phases of the Prescott Branch were defined primarily on the basis of architectural differences. The Copper Basin investigations contributed to the study of architectural variation through time. Shallow pithouses were the rule prior to A.D. 1000, although one of the early structures at Copper Basin exceeded a meter in depth (Jeter 1977:250). A variety of structures were in use between A.D. 1000 and 1200. Single-roomed shelters included shallow pithouses, some of which were masonry-walled. Ovoid to rectangular rock alignments, the most common structural type at Copper Basin, apparently employed different types of roof support arrangements (Jeter 1977:250). In these structures, occupational surfaces were generally found between 15 and 35 cm below the surface (Euler and Dobyns 1962; Jeter 1977). Multi-roomed masonry pueblos appeared around A.D. 1100. Jeter (1977:252) noted a concurrent decline in single-roomed houses. However, the Yolo site contained 16 oval rock outlines in addition to a 12 room pueblo (Euler and Dobyns 1962). Few hilltop masonry structures or "forts" have been dated, but these are generally assigned to the Chino phase.

Jeter (1977:252) suggested that changes in architecture and ceramic decorative designs indicated significant shifts in social organization or subsistence practices between A.D. 1100 and 1200. He suggested that some single-roomed structures may have been agricultural field houses occupied during the growing season only. He also reviewed Ward's (1975:160) hypothesis that communities were of two types: small, scattered hamlets such as the Copper Basin sites and larger communities residing in masonry pueblos such as Fitzmaurice Ruin (Barnett 1974, 1975; Spicer and Caywood 1936).

The Copper Basin sites contained faunal and macrobotanical evidence for the exploitation of deer, rabbits, pinyon nuts, walnuts, corn, beans, and amaranth. Sites in the upper basin appeared to be hunting and gathering camps associated with the use of chaparral resources, while lower basin habitation sites were associated with small patches of arable land. Extending his settlement analysis into a regional study, Jeter (1977:231-233) found that the major Prescott Branch habitation sites were located in proximity to cultivable Lynx soils, a rare and spatially concentrated resource. In the Prescott region, the major concentration of Lynx soils occurs in the Chino Valley and its larger tributaries. Chino Phase pueblos are clustered in those areas. Secondary concentrations of Lynx soils exist to the east of Prescott around the headwaters of the Agua Fria River and to its southwest in the Peeples Valley-Kirkland Creek area (Jeter 1977:228).

Intrusive ceramics at Prescott area sites indicate that local inhabitants maintained contact with northern Arizona and Hohokam groups. Hohokam sherds of the Colonial and Sedentary periods occur at many Prescott Branch sites, and the regional site files include descriptions of large "Hohokam" pithouse villages in Skull, Peeples, and Kirkland valleys. In those areas, Gila Pueblo recorded large sites with numerous trash mounds, turquoise and shell objects, and "Red-on-buff usually present". Two Hohokam ball courts were found in the northern part of Skull Valley (Wilcox and Sternberg 1983:125). According to the site files, Euler recorded three additional ball courts in Peeples Valley.

Recent researchers have addressed the possible connections between the Prescott Branch and the Hohokam tradition (Jeter 1977; Ward 1975; Wood 1980). Fewkes (1912:218) originally saw the Prescott area as a frontier occupied by pioneers from the Salt-Gila basin. Others suggested that the Prescott Branch was a peripheral manifestation of the Colonial period expansion of Hohokam traits along the major tributaries of the Salt and Gila rivers (Weed and Ward 1970). This phenomenon may or may not have involved the migration of Hohokam pioneers (Weaver 1980). In Jeter's (1977:253) opinion:

> The documentation of Hohokam-like structures, a small canal, and Santa Cruz, Gila Butte and

> Snaketown Red-on-buff ceramics at the Henderson site (Weed and Ward 1970) makes it highly plausible that expansion of agriculturalists from the south was a major factor in the rise of the "Prescott Branch".

On the other hand, indigenous populations may have adopted certain Hohokam subsistence practices and elements of material culture. According to Schroeder (1980:177):

> Weaver implies that the Hohokam frontier expanded north, that these people adapted to the new environments, and that these frontiersmen maintained their major economic ties with the core area. However, he does not explain the presence of contemporary non-Hohokam sites within his expanded frontier into which the Hohokam moved. They did not enter an uninhabited land nor did they replace the indigenous occupants.

Schroeder suggested that outlying Hohokam sites, such as ball courts, were "colonies" which functioned as trade centers.

Wood (1980:20) hypothesized that the Prescott Branch developed from Hohokam colonization and the acculturation of local populations. Hohokam sites and ball courts in the Peeples, Kirkland, and Skull valleys were interpreted as colonies occupied prior to A.D. 1000. Their presence stimulated the local adoption of Hohokam subsistence practices and architectural forms. Wood (1980:25) argued that the Hassayampa River was the most likely travel corridor between the Kirkland Creek watershed and the Hohokam core area along the Gila River. The upland valleys of the Kirkland watershed provided the best concentrations of arable land on the northwestern periphery of the Hohokam.

David Wilcox (1979, 1980) addressed these issues in discussions concerning the "Hohokam regional system". He recently presented a model of the regional system based on a comprehensive analysis of ball court data (Wilcox and Sternberg 1983). These large features are concentrated in the Hohokam heartland, although they occur in areas as distant as the Flagstaff region. Their distribution defines the geographic extent of the regional system, an area within which the Hohokam resided or interacted with surrounding populations.

Wilcox and Sternberg found that most ball courts were located along the Salt and Gila rivers and their major tributaries. Based on the types and distribution of courts, they defined a Hohokam "core area" and three peripheral zones (Wilcox and Sternberg 1983:219-220). The core area, centered on the Salt, Gila, and lower Verde rivers, included almost half of the ball courts as well as sites with multiple courts. In the core area, there existed large villages with extensive canal irrigation systems. An "inner periphery" incorporated the middle Agua Fria River among other areas. This was seen to be a frontier zone occupied by Hohokam pioneers who utilized small scale irrigation systems. An "intermediate periphery" incorporated the upper Agua Fria River and the middle Verde River. These areas maintained close relations with the Hohokam core, and the occupants may have been either Hohokam migrants or indigenous groups who had adopted Hohokam traits and who participated in trade with the core population. A "far periphery" included Skull and Peeples valleys and the Flagstaff region. The Skull Valley ball courts were viewed as "isolates". Their significance was unclear, but they were "somehow incorporated into the Hohokam regional system" (Wilcox and Sternberg 1983:220). Indigenous Prescott area populations may have participated in wide-ranging Hohokam trade networks. Jeter (1977:194) listed azurite, malachite, hematite, and quartz crystals as possible trade items from the Prescott region. Argillite, a known trade commodity, occurred in the upper Chino Valley (Fish, Pilles, and Fish 1980). By A.D. 1125, Hohokam-related groups in the middle Verde Valley were displaced or absorbed by a Sinagua intrusion from the Flagstaff region, indicating changes in the structure or areal extent of the Hohokam regional system (Breternitz 1960).

The late Chino phase was apparently a time of population aggregation (Jeter 1977:257; Wood 1980:44). The people inhabited multi-roomed pueblos rather than dispersed hamlets, although the latter did not entirely disappear (Ward 1975:160). Most known Chino phase sites were located in the Chino and Williamson valleys, and the Kirkland watershed may have been largely abandoned by A.D. 1200. Jeter (1977:249) found little evidence for an occupation of Copper Basin after that date.

Jeter (1977:269-270) hypothesized that stress related to environmental deterioration or population growth resulted in the eventual aggregation of the population within those zones most suitable for agriculture (the Chino and Williamson valleys to the north of the study area). The occupation of such an agriculturally marginal area as Copper Basin may have been indicative of deteriorating conditions in Peeples, Skull, and Kirkland valleys. Wood (1980:48) suggested that soils of decomposed granite were subject to depletion of nutrients and that soils of the Kirkland drainage had been exhausted after centuries of farming.

Similar shifts in settlement patterns occurred in upland zones east of the Prescott area during this period. For example, small hilltop masonry structures or "forts" are common late prehistoric features in the mountains of central Arizona (Bruder 1982; Spoerl 1979; Spoerl and Ravesloot 1981; Weaver 1980). Various site functions have been proposed, including defense, agriculture, habitation, and ceremonial activities (Dove 1970; Page 1970; Rodgers 1977; Spoerl). Fewkes (1912:207), Holiday (1974) and Austin (1977) argued that such sites may have been linked into communication systems, perhaps for defensive purposes. Spoerl (1979) argued in favor of a defensive function. She hypothesized that environmental instability or population growth led to competition and conflict over scarce resources during the late prehistoric period. Bruder (1982) similarly argued that poor agricultural harvests promoted conflict and raiding in the Cave Creek area. These conditions appear to have caused the abandonment of less agriculturally productive zones and subsequent aggregation into larger settlements within more restricted areas. Alternatively, there may have been shifts to less intensive subsistence strategies based on a greater degree of hunting

and gathering. Events in the Prescott region may have paralleled those in the uplands of the Agua Fria and Verde watersheds.

By A.D. 1300 in the Prescott region, most Chino phase sites had been abandoned, and "the Prescott Branch seems to have almost ceased to exist as a recognizable entity" (Jeter 1977:42). From the mid-1300s to the late 1500s, there is a hiatus in the archaeological record.

There are two basic hypotheses concerning this period. Yavapai immigrants may have moved into the region from the north or west after its abandonment by Prescott Branch groups (Pilles 1981:175-176). The alternative hypothesis, that the Yavapai were Prescott Branch descendents, involves reference to Schroeder's Hakataya concept (Pilles 1981:172). Briefly, Schroeder would consider the region to have been continuously occupied by an indigenous Hakataya population which shifted settlement and subsistence strategies in response to processes of environmental change and external contact. The Yavapai would thus represent Prescott Branch groups who reverted to a subsistence pattern focused on hunting and gathering.

Both hypotheses are plausible, and the issue remains unresolved due to a lack of evidence from protohistoric sites (Pilles 1981). The Yavapai were more mobile than the folk of the Prescott Branch. They made less use of pottery, and their structures were less substantial in general (Jeter 1977:255). However, oval rock ring structures at Prescott Branch sites in Copper Basin resembled Gifford's (1936) description of Yavapai huts. Jeter (1977:255) stressed differences in subsistence patterns between the Prescott Branch and the Yavapai, focusing specifically on the reliance on farming by the former. However, this distinction may have been overemphasized. Mariella (1983) argued that the Yavapai reliance on farming was greater than that recognized by Gifford (1936), since agriculture was probably the first subsistence practice to have been severely disrupted by Anglo settlement. In the study area, patches of arable land in the upland valleys were among the first areas settled by Anglos, and pioneer settlement patterns seem to have been very similar to those of Indian groups (Wood 1980:88). The Prescott Branch to Yavapai transition may well have involved a shift in settlement patterns rather than populations. As Jeter (1977:254) conceded, the Yavapai pattern may have been derived "from a remnant portion of the 'Prescott Branch' population".

Known Yavapai sites are rare in the study area. This lack of sites is probably attributable to their poor archaeological visibility (Pilles 1981). Jeter (1977:77) found sherds of Orme Ranch Plain, a probable Yavapai pottery type, at one of the sites in Copper Basin. According to Schroeder (1959), Yavapai camps were located in Skull and Peeples valleys, along lower Kirkland Creek, and in the Congress area south of the Date Creek Mountains. Small reservations are now located near Prescott and Clarkdale.

RESEARCH ISSUES

Due to the limited research in this region of data "islands", the first priority is obvious: to obtain basic information on variability in settlement patterns and material culture throughout the region. Such information can then serve as the basis for generating and testing behavioral models as well as hypotheses focusing on temporal changes and social or economic links to surrounding regions. The results of the Copper Basin study (Jeter 1977) can contribute to future research designs. Both Jeter and Wood (1980) have suggested research directions.

Wood (1980:102) suggested that information on site characteristics and spatial distributions should be applied initially to three baseline goals: (1) the identification of the range of site types; (2) chronology building and the identification of different cultural traditions and their origins; and (3) the identification of settlement patterns, with an initial focus on impinging environmental factors. As Wood (1980:105) noted, it is difficult to develop either testable models or detailed management recommendations until baseline goals are met.

More specific research goals can be expressed as a series of questions or problems relevant to three major research domains: culture history; settlement-subsistence systems; and community and regional interaction systems. There are many gaps in the temporal record, especially for the preceramic, early ceramic, and post-Prescott Branch periods. The origins of the Prescott Branch are particularly unclear. When did people settle into villages, adopt pottery, and devote a greater degree of effort to farming? Where were the earliest Prescott Branch sites? Were they located in the Kirkland, Skull, and Peeples valleys as suggested by Wood? Were these developments stimulated by population growth, environmental changes, Hohokam colonization, participation in trade, or more indirect influences from the Hohokam or other areas? How did such factors act in combination? What was the nature and significance of "Hohokam" sites, including ball courts, in the region? How did Prescott Branch material culture, architecture, and settlement patterns change through time, and what were the social and economic conditions underlying the changes? What was the nature of ties to the Cohonina, Cerbat, and Sinagua traditions? How do late prehistoric developments relate to the Salado or "Western Pueblo" phenomenon centered in the mountains of eastern Arizona? The Prescott region represents the northwestern periphery of this mountainous zone as well as a northwestern extension of the Hohokam regional system. Are late prehistoric similarities rooted primarily in similar ecological adjustments or in widespread interaction systems? Finally, there are many questions concerning Prescott Branch "abandonment" and Yavapai origins. Should Schroeder's Hakataya concept be discarded or can it be revised and reapplied to the problem of "abandonment"?

The Prescott region is likely to contain many stratified sites valuable for controlled excavation and chronological studies. These may well include preceramic deposits. Both Jeter and Wood stressed the importance of finding and testing early pithouse sites. Jeter (1977:239-246) discussed the range and techniques of dating methods applicable to the region. He advocated a lesser degree of reliance on dates associated with intrusive ceramics. Archaeomagnetic dating should be profitable due to an apparent abundance of well-fired clay-lined hearths (Jeter 1977:240). It is also important to establish a regional dendrochronological sequence. Datable wood specimens, such as ponderosa pine

and fir, have been recovered from sites. Tree-ring data can also contribute to studies of prehistoric climatic conditions and their changing effects on farming and subsistence strategies. Finally, Jeter (1977:244) suggested that Prescott Grayware ceramics, which frequently contain large mica particles, could be useful for experiments in alpha-recoil track dating.

Jeter (1977) proposed alternative settlement-subsistence models for Copper Basin and the greater Prescott region. These models can be used to guide further studies. Data bearing on locational strategies and subsistence changes are important to the assessment of different models. The degree of reliance on farming should be indicated by a strong association between habitation sites and Lynx loam soils. Research should also focus on the discovery and characterization of canal systems or other water control facilities, if they exist in the region. However, Jeter (1977:234) acknowledged that the "Lynx model" should be broadened to include the consideration of non-agricultural resources:

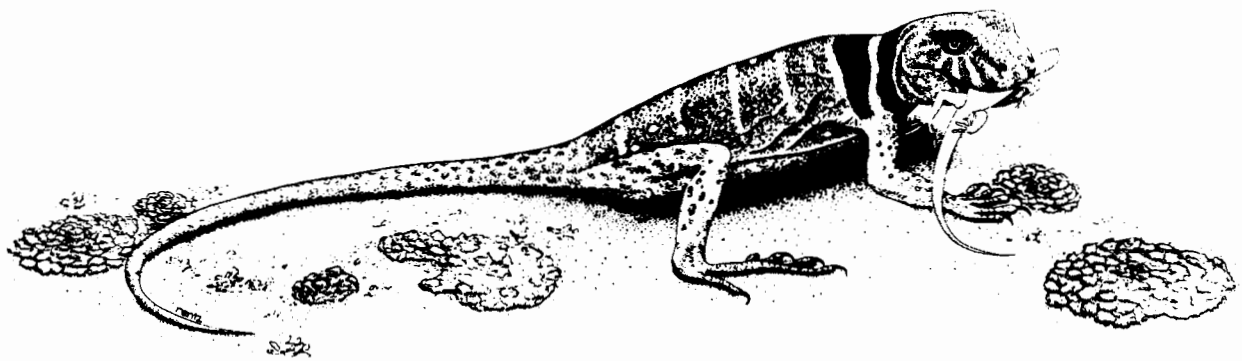
> Plog (1977:5ff) has suggested that SARG researchers move away from analyses based on specific single resources, and toward analyses based on 'environmental patterning' or 'the distribution of resources in relation to one another in the environment'. This type of predictive modeling could also be attempted in the Prescott region, taking the 'Lynx model' as a beginning point, and using knowledge about probable plant food, game animals, and other resource concentrations to suggest the major modifications which may be necessary.

Jeter suggested that important non-agricultural resources might include concentrations of deer browse species in the chaparral, ecotonal situations, and pinyon concentrations in the higher elevations. He also suggested more detailed studies of amaranth utilization and chaparral resources. The southern portion of the study area could yield additional information on the use of such desert resources as mesquite and cacti. The Skull Valley zone may well incorporate a range of site types representing nearly complete settlement systems.

Subsistence resources are obviously not the only factor likely to affect the distribution of sites. The distribution of "fort" sites may be related to other factors such as line-of-sight visibility or suitability for defense. Alternative functional hypotheses should be tested with data from these sites. Tests could incorporate not only site-specific analyses but also the detection of locational settings held in common. An interesting study would involve experimental tests of Austin's (1977) proposed communication networks.

Settlement studies should also focus on sites as components of communities and regional social networks. Wood (1980:89) suggested that population units could be "arranged and combined to form organizational patterns and hierarchies in multi-site communities". There seems to have been a dichotomy of large, possibly permanent villages in the major valleys and smaller, transient homesteads, hamlets and field houses in the tributary drainages containing more marginal agricultural resources (Wood 1980:95). Organizational "centers" may have been located in the Chino or Williamson valleys or other zones north and east of the study area. These in turn may have been linked to sites in the Verde Valley. Relevant issues include the role of Hohokam ball courts in intercommunity interaction systems as well as trade networks of a larger geographic scale. Finally, it would be interesting to examine relationships of habitation sites to Austin's (1977) proposed "fort" communication networks. Different communities might be associated with particular networks.

Future research efforts could ultimately relate the Prescott region to processes of change occurring in successively larger regions of the Southwest. There is much truth to Jeter's (1977:274) statement that the region offers a great potential for future archaeological research.



CHAPTER 10

SITE CHARACTERISTICS: TYPES, VALUES, AND MANAGEMENT RECOMMENDATIONS

There is obviously no single, correct approach to the definition of site types. In general, different systems of classification are appropriate for different purposes. For the most part, archaeologists continue to classify discrete sites and bounded areas in terms of descriptive or functional characteristics.

The early surveyors of the region, the Gila Pueblo archaeologists and Malcolm Rogers, defined most sites as "villages" or "camps". The former were more interested in the regional distribution of ceramic types than in the activities carried out at particular sites. Rogers was more attuned to economic issues. However, although his notes suggest that camps differed in size, density, and artifact types, information is inadequate to assess distinctive patterns of variation (Rogers n.d.). The early surveyors employed a subjective approach to the classification of sites. Thus the logic underlying their assignment of site types is unclear, and it is difficult to compare such sites or to incorporate them into regional syntheses (Brown and Stone 1982:54; Swarthout 1981:61). Recent surveyors have directed their efforts toward a more objective description of sites.

Although it is difficult to avoid making functional inferences, the use of descriptive terms minimizes the premature classification of sites on the basis of function. Descriptive classifications impart basic information on such variables as site size, overall density of remains, classes of artifacts or features, and the presence of structures or natural shelters. Examples of descriptive types would include caves, trails, rock rings, petroglyph sites, dense sherd and lithic scatters, and low density lithic scatters.

Descriptive classifications are particularly appropriate for use in preliminary studies, surveys, and the initial phase of multiple stage investigations. Descriptive types are useful for the initial presentation and assessment of survey data, prior to the design of more detailed functional studies, data recovery procedures, or management plans. They can also be employed to organize and simplify the presentation of data in reports and regional summaries. This was done in the Granite Reef Aqueduct report, where 46 sites were grouped into 5 categories based primarily on the relative size and spatial continuity of artifact and feature groupings (Brown and Stone 1982:64). The categories included large artifact scatters exceeding one hectare (100 x 100 m); small artifact scatters; large "discontinuous" sites with numerous but relatively isolated features and artifact clusters; trails; and miscellaneous sites such as petroglyphs. Functional variability within each category was treated in greater detail in the analytical chapters of the report.

Functional classifications are based on inferences concerning the nature and diversity of activities carried out at sites. They can also incorporate information on the season and duration of use as well as the composition of social groups. At a higher level of analysis, they relate sites to regional economic systems and social networks. Functional types are most appropriately applied following the analysis of data recovered from mapping, detailed recording, surface collection, or excavation. Interpretations should be based on adequate supporting data.

Approaches to functional classification vary according to research objectives. For example, lithic analysts might attempt to distinguish "long trajectory" from "short trajectory" production sites (Raab, Cande, and Stahle 1979). Other researchers might define site types on the basis of theoretical models of settlement and subsistence systems (Binford 1980; Holmer 1981). The determination of site function is based on the expectation of some correspondence among material remains, the "economic potential" of a place, and the activities conducted there during an occupation (Binford 1982:18). Site characteristics which figure in the definition of function include site size, artifact density, types and numbers of artifacts and features, relative diversity of material remains, relative preponderance of particular artifact or feature types, composition of non-artifactual remains, the nature of intrasite patterning, and the environmental context. The most secure determinations would be based on a broad range of the above characteristics. The use of environmental context alone, for example, could involve circular reasoning. A site need not be a saguaro gathering camp simply by virtue of its location near a saguaro stand. However, one can predict the types of artifacts and features that would be associated with saguaro processing. In southwestern Arizona, Doelle (1976, 1980) and Goodyear (1975) have defined "material correlates" for particular activities, based on ethnographic and ethnoarchaeological information as well as logical arguments linking tool and resource use. Goodyear (1975) predicted and tested associations between particular assemblage types and resource zones. This approach is useful, as long as one bears in mind that there is no simple correspondence between particular tool types and specific resources. Particular tools may have served a variety of functions, and certain resources may have been harvested and processed by alternative procedures.

Differences among sites might be related not only to the nature of activities but also to differences in the following variables: (1) the size of the group during any given occupation; (2) the duration of single occupational episodes; and (3) the number of reoccupations through time (Chapman 1980:73). The interpretation of these variables is complex and difficult, particularly for surface scatters. Button (1980:4) expressed this difficulty in simple terms:

> I do not think that archeologists will ever be able to specify precisely the particular prehistoric 'events' which created many kinds of artifact clusters. Does a given cluster represent a single two-day shindig by 500 folks celebrating a successful rabbit or antelope drive, or a season's camp of a much smaller group, or a prehistoric KOA Kampground where single family bands periodically spent the night over the course of a hundred years?

Archaeologists have begun to deal with this complexity through the development of sophisticated methods of quantitative spatial analysis and increased attention to the physical processes affecting "site formation" (Ackerly 1982; Button 1980; Chapman 1980:138-141; Doelle 1980; Schiffer 1983:685). For example, Ackerly (1982) employed statistical techniques to examine differences in intrasite spatial structure, artifact density, and artifact diversity among sites recorded during a sample survey. On the basis of this analysis, he defined three basic site types: base camps, single episode limited activity camps, and limited activity areas of repeated use.

Ackerly's trichotomy of site types evokes Button's (1980:4) contention that "we are able to distinguish locations of repeated 'foraging events' from the various kinds of 'campsites'". The distinction between base camps and limited activity sites is a common analytical device (Chapman 1980:118). Base camps are "residential loci where individuals process food resources gathered or hunted in the vicinity of the camp, cook, eat, sleep, and, perhaps, engage in repair and manufacture of clothing, hunting equipment, containers and the like" (Chapman 1980:118). At limited activity or "special use" sites, specific resource procurement or processing activities take place away from the base camp "in the field" (Chapman 1982:119).

Ethnoarchaeological research among hunter-gatherers, and the subsequent development of new approaches to settlement analysis, have led to criticism of the base camp-limited activity site distinction (Binford 1980, 1982; Chapman 1980). These criticisms have focused on certain assumptions which have characterized its application: (1) that it is applicable to most settlement systems; (2) that a clear distinction can usually be drawn between the two; and (3) that obvious functional differences exist among limited activity sites. Binford (1980, 1982) recently developed a new approach to understanding intersite variability in settlement systems, particularly those of hunter-gatherers. He proposed a continuum of settlement and subsistence strategies based primarily on the degree of mobility of groups. At one end of the continuum are "foragers", at the other "collectors". Foragers are characterized by high mobility; they place relatively little emphasis on food storage and "map onto" available resources through numerous shifts among resource patches. Foragers tend to occupy tropical and subtropical regions with relatively dispersed resources and long growing seasons (Binford 1980:7). Collectors, at the other end of the continuum, rely on the accumulation and storage of surplus resources, and they make fewer residential moves. They instead send out task groups to specific locations to harvest and process resources for transport back to the main base camp. Binford (1980:15) argued that such "logistical" strategies typically operate at higher latitudes where resources are available simultaneously in different locations during a short growing season.

Binford (1980:12) argued that intersite functional variability would be more pronounced in collector settlement systems. In addition to residential camps, there should be a relatively greater number of limited activity sites including special purpose field camps, established observation stations, and various temporary activity loci. Any decrease in residential mobility, linked to higher population densities, sedentism, or greater reliance on storage, should lead to greater functional specialization among limited activity sites (Binford 1982:21).

Foragers "would be expected to leave an archaeological record comprised almost entirely of residential sites with the only evidence of 'in field' procurement being isolated occurrences of expended tools" (Chapman 1980:121). Variation in the size and composition of base camps, or residential sites, should reflect differences in the seasonal scheduling of activities or the duration of occupation (Binford 1980:9). Low density artifact scatters, the remains of isolated activity episodes, should be characteristic. This dual division of site types parallels that applied to Great Basin Archaic sites by Davis (1963), where "occupance areas" were reoccupied camps with relatively dense debris, and "use areas" consisted of low density scatters and isolated artifacts. According to Binford (1980:10), there should be few "functionally specific" sites. Chapman (1980:121) suggested that for hunter-gatherers in the arid Southwest, such sites would be limited to lithic quarries, hunting blinds, and sacred sites.

The environmental context and ethnographic record of the western Arizona desert indicate a probable dominance of foraging strategies. Site types appear to correspond to those predicted for forager settlement systems. They are dominated by temporary camps, low density scatters, and areas containing single event loci, such as lithic "chipping stations". Along the Granite Reef Aqueduct, temporary Hohokam sites east of the Hassayampa River were more discrete and functionally specific than those in the western desert (Brown and Stone 1982:345).

In accordance with the predictions for forager settlement systems, researchers have found a continuum of variation in attempting to distinguish among base camps, shorter term residential sites, and "limited activity" sites. The former are generally expected to contain a higher density and diversity of artifacts and features indicating "more frequent performance of more kinds of activities by greater numbers of people" (Chapman 1980:119). Many surface sites appear to have been temporary camps occupied or reoccupied for varying lengths of time. It can be difficult to distinguish these from loci used in the procurement and processing of specific food resources. In the San Cristobal Valley of western Papagueria, Doelle (1980) divided surface scatters into "campsites" and "possible campsites". The latter were smaller and contained fewer classes of artifact and feature types. The investigators of sites along the Palo Verde-Devers transmission line focused on a distinction between single and multiple activity loci (Carrico and Quillen 1982:138). "Single activity" sites were defined as "special use" areas for the procurement or processing of specific resources or for other purposes such as travel. They may have been repeatedly used, but assemblages were indicative of a single activity, such as lithic manufacture. "Multiple use temporary camps" were sites "where a range of different activities apparently occurred" (Carrico and Quillen 1982:148). They may have been occupied for periods as short as several days, and "by virtue of their variable functions, these sites possessed wide variation in location, size and frequently in artifact assemblage" (Carrico and Quillen 1982:137). The 152 prehistoric sites along the transmission line were classified according to the presence

or absence of 16 classes of artifact and feature types (Carrico and Quillen 1982:140-145). "Multiple use" sites contained an average of 4.3 classes and accounted for 31% of the 152 sites. The rest of the sites were "special use" areas with an average of 1.9 artifact and feature classes. These consisted almost entirely of lithic production areas, isolated rock rings, and trails.

One factor complicating functional interpretations is the ready availability of lithic raw material in many (but not all) areas of the western Arizona desert. There may be cases where "sites with similar debitage characteristics are greatly different in terms of the intensity of occupation and the range of on-site tasks" (Butler and Lopinot 1982:12). Schilz, Carrico, and Thesken (1984:149) argued that "the expedient use of locally abundant raw material masks certain characteristics in lithic reduction technologies which might otherwise allow for the clear-cut determinations of site types". They considered the case of AZ X:4:1 (ACS), a possible base camp with numerous rock rings and a relatively high proportion of formal tools. It was difficult to assign this site to a defined range of types: it "is either a base camp at which quarrying also took place, or stands in a position intermediate between a special purpose camp and a full-fledged base camp" (Schilz, Carrico, and Thesken 1984:149). They concluded that "the availability of raw materials must be considered before making determinations of site types or drawing conclusions about the kinds of activities undertaken at such sites".

In west central Arizona, analyses of intersite variability along surveyed transects have focused on the separation of single from multiple activity sites and the study of functional and technological variation among lithic scatters (Berry 1978; Brown and Stone 1982; Carrico and Quillen 1982). A small number of additional studies have specifically addressed the range of economic activities performed at different sites (Bostwick n.d.; Giorgi and Bayer 1981; Linford 1979; Rice and Dobbins 1981; Stein 1981).

While conducting investigations near the Cyprus-Bagdad copper mine north of the study area, Linford (1979:124-126) proposed criteria for distinguishing among five major site functions. These are summarized below in abbreviated form.

(1) Procurement and initial reduction of chippable stone: local raw material; predominance of chipped stone, with a large proportion of cores, primary flakes, and shatter; low incidence of tools (both utilized and retouched pieces); hammerstones.

(2) Preparation of chipped stone tools: predominance of chipped stone; hammerstones; cores; lower proportion of primary flakes, and higher proportion of secondary, tertiary, and thinning flakes than in (1); low incidence of tools. Evidence for later stages of manufacture.

(3) Extended habitation: a diversified artifact assemblage, with no overwhelming predominance of a particular artifact type; relatively high incidence of retouched and utilized artifacts; high frequency of broken tools; grinding implements; features, particularly shelters; pottery (if not preceramic).

(4) Plant food gathering and preparation: predominance of grinding implements; limited amount of chipped stone; pottery (if not preceramic); features related to food preparation or storage.

(5) Hunting (staging and processing): relatively high number of projectile points.

This approach largely relies on interassemblage comparisons of the relative diversity and predominance of artifact and feature types. Particular sites need not have been limited to a specific function as defined above. Using this interpretive framework, Linford (1979:127-147) compared and evaluated seven sites. Statistical comparisons generally supported hypothesized site functions. For example, Chi-square tests showed significant differences (p .05) between the relative frequencies of cores, primary flakes, and shatter at lithic quarries and other sites (Linford 1979:132). According to Linford, the sites included base camps as well as specialized plant processing areas, lithic quarries, and lithic tool production areas. Habitation sites included one "short-term camp" with a low volume of debris but a relatively high diversity of artifact and ceramic types. Two other base camps were more substantial in size and artifact density. Their assemblages were most diverse in terms of total number of artifact types and number of types represented by over five items (Linford 1979:129). Linford noted a close correlation between diversity and sample size (see Kintigh 1984). Nevertheless, the base camp designations were strengthened by the presence of features, including a structure. One base camp had been interpreted initially as a lithic production site, but a closer examination revealed a diverse range of lithic artifact types including diagnostic projectile points. This site was reinterpreted as an Archaic base camp with a strong lithic production component.

Linford's Chi-square analyses can be criticized for the "lumping" of data from different sites with presumably different functions. However, his functional definitions appear to be reasonable. In his opinion, site functions were "clarified" rather than "affirmed" (Linford 1979:147).

The definition of site types is obviously a complex procedure. Researchers should keep aware of new approaches and techniques and their applicability to different types of data sets. It is generally preferable to employ quantitative rather than purely qualitative analyses.

DESERT SITE TYPES

The following list incorporates prehistoric site types which either have been documented, or might be found, in the Sonoran Desert of west central Arizona. These site types are basically descriptive, although some functional distinctions, such as "quarries", are recognized. They are listed roughly in order of relative frequencies as indicated by data in the site files. Those listed first are most common, and rare or yet unknown types are near the bottom of the list. These site types need not be mutually exclusive: many consist of features or phenomena which often occur in combination at a single location.

I. Artifact Scatters: These may or may not have depth or associated features. Several approaches can be taken to the definition of subtypes:

A. Distinctions based on artifact classes: presence of sherds, groundstone, or chipped stone alone or in combination. Other artifact classes are rare.

B. Distinctions based on the relative diversity of assemblages: multiple activity vs. limited activity or specialized sites. See the Palo Verde-Devers report for an example of this approach applied to survey data (Carrico and Quillen 1982).

C. Distinctions based on site size and artifact density. It is difficult to propose absolute values to employ in making such distinctions. They could be derived from a statistical analysis of sizes and average densities of sites in the regional files. Gallegos (1980:82) proposed cutoff points for distinguishing between "small" and "large" sites, and those of "high" and "low" density, in the eastern California desert. Fifty square meters was the cutoff point for site size. This seems much too small; in western Arizona, most sites would exceed this size. A prevalence of large, low density scatters led Brown and Stone (1982:64) to establish a division at 10,000 square meters (100 x 100 m). Another reasonable figure would be 2500 square meters (50 x 50 m). The 152 Palo Verde-Devers sites included 27 exceeding 10,000 square meters and 40 over 2500 square meters in size (Carrico and Quillen 1982:140-145). As for average artifact density, Gallegos (1980:82) recommended a cutoff of 30 artifacts per 10 square meters. The figure is admittedly arbitrary, but it appears to be a reasonable guideline. Since many sites in the region have low artifact densities, it makes little sense to compare them in terms of densities per square meter. Size and density combinations yield at least four alternative types of artifact scatters: (1) large and dense; (2) large and light; (3) small and dense; and (4) small and light.

D. Distinctions based on the degree of clustering or spatial concentration of artifacts. Average density values offer no information on the spatial distribution of artifacts over a site. Artifacts might be clustered in a central location or "core area", with a surrounding sparse scatter. They could be distributed fairly uniformly, or the site could incorporate discrete clusters or loci separated by low density areas. Carr (1984) provides an extensive review of spatial analysis techniques. Ackerly (1982) developed a simple coefficient for comparing the degree of clustering within sites of different overall artifact densities. Combinations of size, average artifact density, and distributional classes yield several alternative types of artifact scatters:

(1) Large, dense, and relatively uniform. This category might include localized quarries.

(2) Large, dense, with clustering or variable density. This category might include base camps with separate activity areas.

(3) Large, light, and relatively uniform. This category could incorporate foraging areas or "offsite" areas of isolated artifacts. It brings up the question of how to establish the lower threshold in distinguishing between low density "sites" and areas of isolated artifacts. There is no easy answer; relative densities must be monitored and evaluated in the field. Ackerly (1982) suggested that low density scatters be defined on the basis of relatively continuous distributions of isolated artifacts, rather than overall densities. Thus low density sites would be separated by areas devoid or nearly devoid of artifacts. A similar approach to site definition was employed along the Granite Reef Aqueduct (Brown and Stone 1982). It may be important to distinguish between low density areas and virtually "empty" or unused areas in regional studies.

(4) Large, light, and clustered. This category might include areas with a series of single event loci, such as lithic "chipping stations" or other types of artifact or feature concentrations.

(5) Small sites. These could vary in the density and distribution of artifacts. They might include single event loci, small limited activity sites, or small residential camps with separate activity areas.

The above distinctions focus on intersite comparisons based on relative rather than absolute values. Site formation processes might obscure aspects of size, density, or internal patterning. In addition, archaeologists can take different approaches to the mapping of artifact scatters. Site type definitions are influenced by the use of different strategies for drawing site boundaries. For example, a site of type (4) above could also be divided into several discrete loci or small sites. The rationale for drawing boundaries should be made explicit.

II. Rock Features: This class of features can be divided into three subtypes:

A. Rock rings.

B. Rock concentrations: hearths, roasting pits, scatters, middens, platforms, cairns or "shrines", etc.

C. Rock alignments (linear or complex configurations).

III. Trails.

IV. Rock Art: There are two subtypes:

A. Petroglyphs.

B. Pictographs.

V. Caves and Rockshelters.

VI. Stationary Grinding Features: bedrock mortars, metates, and slicks.

VII. Quarries: These are areas for the procurement and initial processing of localized raw material sources. Quarries are characterized by spatial concentrations of abundant raw materials. Manufacturing can also occur at "nonlocalized" sources (Gould 1980). Subtype distinctions can be based on the types of artifacts or substances produced from different raw materials:

A. Chipped stone quarries.

B. Ground stone quarries.

C. Quarries for clays, ceramic temper, minerals, etc.

VIII. Intaglios: These are ground figures created by scraping desert pavement from the surface.

IX. Cleared Circles: These are cleared, circular areas unbounded by rocks.

X. Prehistoric Wells.

XI. Burials and Cremations.

XII. Miscellaneous Types: This category includes site types or features not yet found in the study area but present in surrounding regions. Examples include prehistoric canals, platform mounds, and hilltop masonry "forts".

A GENERAL DISCUSSION OF THE SITE TYPES

In a general way, it is possible to summarize the following characteristics of different site types: their known range of variation in size, configuration, and function; their known geographic and environmental distributions; whether they appear to be rare or common in the area; to what extent they have been investigated by archaeologists; and their research values. Potential research contributions will be addressed in terms of the five major research issues presented in Chapter 7: (1) culture history and chronology; (2) settlement and land use patterns; (3) social interaction, boundaries, and frontiers; (4) lithic resource use; and (5) environmental reconstruction. Finally, it is possible to present general recommendations concerning procedures for data recording and recovery. Discussions regarding research values and investigative procedures are meant to serve as general guidelines to aid in the design of research and management plans. Specific sites need to be assessed individually in greater detail, with specific plans designed accordingly.

Artifact Scatters

Records indicate that artifact scatters, the most common type of site, exhibit considerable variation in size, artifact density, internal structure and diversity, extent of reoccupation, and function. They are also found in diverse geographic and environmental zones. Specific types may be more common in particular zones, but this question requires more rigorous study. Archaeologists have investigated many types of artifact scatters, particularly on basin flats and bajadas. Since these sites are common and exhibit a great range of variability, it is difficult to present specific summary points or recommendations in great detail. However, it is possible to make several general observations.

Site types range from probable base camps, to small temporary camps and limited use loci, to low density scatters of artifacts found in small clusters or in isolation. "Permanent" sites or "villages", occupied continuously for periods of at least several years, are unknown or unconfirmed. One would not expect such sites away from the permanent rivers, given the lack of abundant and predictable resources in conjunction with reliable water sources in the interior desert. Nevertheless, it is possible that some sites were occupied on a relatively long-term basis. One such site may have been the Bouse site, with its hand-dug well, near the confluence of Bouse and Cunningham washes (Harner 1958; Rogers n.d.). Other such sites may have been located in the few high water table zones, such as the Harrisburg Valley near Salome. Fairly large multicomponent sites and historic Maricopa villages are reported to occur along the lower reaches of Centennial Wash near its confluence with the Gila (Spier 1933). Stein (1981) argued that people may have practiced floodwater farming along major washes in this area. Finally, Kroeber (1951) indicated that settlements along the Bill Williams River were occupied for periods of two to three years. Settlement locations were shifted when labor costs were sufficiently increased by the depletion of local resources.

Grinding implements and ceramics, so common at the habitation sites of prehistoric Southwestern farmers, are relatively rare on the sites of the western desert. According to Malcolm Rogers (1945:196), there was "a weakness and possible absence of pottery-making in some eastern Yuman areas". It is likely that most pottery was manufactured at villages outside the study area and that some of this ware was transported or traded into the desert (Stone 1982). The paucity of ceramics may also reflect the use of such durable and lightweight containers as baskets and gourds. Pottery may have been curated. The historic Yumans mended pots with natural resins, and pots were preserved although other belongings were destroyed after their owners' deaths (Dobyns 1974:109; Van Camp 1979:54). In the study area, ceramics tend to occur in three major contexts: at probable base camps; near trails; and at resource processing sites in conjunction with grinding implements or roasting pits. A review of three major surveys in western Arizona allows a quick quantification of the proportion of sites with ceramics and grinding implements. Along the Palo Verde-Devers transmission line, between the Colorado River and the nuclear plant, 22% of the 152 sites yielded sherds and 18% had grinding implements (Carrico and Quillen 1982:Table 7-1). Of the 39 Granite Reef Aqueduct sites within the study area, 38% contained ceramics and 21% had grinding implements (Brown and Stone 1982:Appendix B). Finally, the preliminary analysis of BLM Class II inventory data, primarily from the Harcuvar planning unit, yielded higher percentages. Grinding implements were present at half of the sites, and 63% contained sherds (Giorgi and Bayer 1981). The relatively higher proportions probably reflect differences in settlement and land use patterns in the study area. The Harcuvar sites were located primarily on the pediment slopes and canyon bottoms of a relatively high, well-watered mountain range. The other survey projects recorded sites on the basin flats and bajadas yielding scarce water but abundant lithic resources.

Most surface scatters in this region, particularly those on desert pavements, have very little depth. However, a lack of depth should not be taken for granted. Apparent surface scatters tested by Brown (1977), Doelle (1980), and Rice and Dobbins (1981) yielded cultural deposits nearly a meter deep. During the BLM Class II inventory, probable midden deposits were recorded at several canyon sites. Residents near Bouse Wash have reported materials eroding from dunes.

The low density lithic scatter may well be the hallmark of archaeological sites in western Arizona. These sites probably represent the remains of numerous single episodes of the manufacture, use, and discard of expedient tools (Lewenstein and Brown 1982). This "offsite" pattern is said to be characteristic of mobile foragers (Binford 1980:9). In

western Arizona, these sites also represent the "quarrying" of nonlocalized lithic sources (see Gould 1980). Particularly near ranges shaped by recent volcanic activity, raw materials are scattered over desert pavements and along streambeds. Many low density scatters contain evidence of both manufacture and use of crude tools, supporting Binford's argument that tool production was often "embedded" as an incidental activity to subsistence pursuits (Binford 1979:260). Button (1980:1) argued that "such 'sites' are North America's most common archaeological manifestation and, perhaps, the most minimally studied by professional archaeologists". Researchers have recently devoted more attention to such areas (Brown and Stone 1982; Jones, Beck, and Grayson 1984).

Artifact scatters in west central Arizona vary greatly in terms of size, artifact density, and spatial structure. It is perhaps best to list specific examples of the alternative types of scatters discussed above.

Large, dense sites with a relatively uniform distribution of artifacts would include localized lithic quarries, discussed here as a separate site type. Some sites near Alamo Lake actually have depth on the surface, with piles of cores, flakes, and hammerstones (Stone 1977). Large and dense sites, with variable density or clustering of remains, include Field Locus 16 at AZ S:7:13(ASU) and the core of AZ T:5:5(ASU). Examples of large sites of low and relatively uniform density include AZ S:6:3(ASU) and AZ T:6:1(ASU). Large, low density sites with dispersed artifact clusters include AZ S:8:5(ASU) and AZ T:5:4(ASU). Examples of small sites include Field Locus 15 at AZ S:7:13(ASU), AZ S:6:6(ASU), and AZ T:5:3(ASU). These sites were all found along the Granite Reef Aqueduct (Brown and Stone 1982). Although these particular sites have been largely destroyed, they have been well documented and appear to be representative of the range of artifact scatters in the region.

Research Values. Obviously, the variable contents of artifact scatters will affect their contribution to the resolution of various research issues. The research potential of specific sites must ultimately be assessed on a case by case basis, in the context of well-defined research objectives. However, it is again possible to make some general observations.

It is likely that only a minority of artifact scatters will offer important contributions to the reconstruction of chronological sequences, patterns of interaction, boundaries and frontiers, and the prehistoric natural environment. Such sites would include those holding particular types of deposits or material remains including the following: subsurface cultural deposits or features; datable substances, such as charcoal or fired clay, in controlled contexts; patinated lithic artifacts; artifacts considered to be diagnostic of a particular time period or culture; lithic or ceramic artifacts of identifiable raw material sources; and such rare or "exotic" items as shell jewelry or polished stone axes.

Most surface scatters in the region can contribute to understanding patterns of lithic resource use, particularly in the context of detailed technological studies in conjunction with analyses of settlement patterns and raw material distributions. Through the interpretation of site functions and spatial distributions, all sites assume importance in studies of prehistoric land use and settlement patterns. Many small or low density sites may well be visually unimpressive, and they may be devoid of datable or diagnostic remains. However, together they reveal patterns of human behavior across a barren landscape through time. As Effland and Green (1982:6-5) noted, "The collective pattern of site characteristics and distribution in itself constitutes a significant research domain in this region of Arizona".

It is important to stress the research value of low density scatters, sometimes referred to as "nonsite" or "offsite" areas (Binford 1980; Thomas 1975). These areas do not simply represent the outlying remains of more substantial concentrations. They may represent the dominant archaeological manifestation in areas occupied by highly mobile hunter-gatherers or "foragers" (Binford 1980:9). As Thomas (1975:81) stated:

> Nonsite sampling will be more important to archaeologists dealing with nonsedentary peoples, who often leave only scanty, widely scattered evidence of their lifeway. In these cases, areas of hunting, seed collecting, quarrying, etc. may be of primary interest and yet not involve 'sites' in the conventional sense of the term.

Even where conventional "sites" are relatively common, low density scatters contain information important to the investigation of settlement patterns. They "reflect aspects of land use that probably differ from those at specific loci" (Jones, Beck, and Grayson 1984:2). It is possible to define and interpret differences among low density scatters in different environmental zones. For example, Button (1980) did a quantitative comparison of lithic scatters in the northern and southern portions of a Colorado valley. Differences in raw materials, amounts of fire-cracked rock, and the presence of Paleo-Indian vs. Archaic remains were linked to the occupation of different microenvironments. Quantitative analyses of survey data by Thomas (1973) and Goodyear (1975), among others, have demonstrated that the study of low density scatters is a productive research pursuit and an important contribution to regional studies.

Along the Granite Reef Aqueduct, Brown and Stone (1982) were able to define technological and functional differences among low density scatters. Future researchers should be alert to such variability. For example, low density scatters are known to occur in the area between the Palo Verde Hills and Centennial Wash (Berry 1978). These may have been associated with the occupation of preceramic and ceramic period base camps known to exist along the wash. The composition of these scatters may well differ from that of diffuse scatters located in areas of transit at a distance from any base camps or major drainages.

Investigative Procedures. Since the majority of artifact scatters probably have little depth, data recovery procedures will focus on surface collection, mapping, and testing. However, appropriate investigative strategies will vary from site to site. This does not mean that there is only one correct approach to the retrieval of information from any particular site. Investigative strategies should be based on well-reasoned judgments by qualified researchers.

Such strategies usually reflect several considerations: (1) specific research objectives; (2) the relative costs and efficiency of different techniques, in light of available resources (time, labor, and equipment); (3) the site's condition, or the detectable amount of previous disturbance; and (4) the type and expected degree of future disturbance. Ideally, the best investigative design would yield the most information per unit cost. This is more easily said than done, because it is difficult to evaluate these factors prior to the actual fieldwork. Flexibility is a key aspect of fieldwork; initial results often lead to the revision of methods. Land managers need to be aware of such contingencies. They also should realize that there is no "bargain basement" of archaeological techniques. However, some approaches may involve costs which are unwarranted in their yield of minimal additional information, relative to alternative procedures. Archaeologists whose investigations are supported by taxpayers have a responsibility to strive for efficiency in their work. If a site is to be severely impacted or destroyed by construction or other land use activities, they also have a responsibility to retrieve information relevant to a broad range of research issues.

Investigations of sites in the study area have enabled researchers to evaluate the efficiency and effectiveness of various strategies for data recovery (Brown and Stone 1982:341; Carrico and Quillen 1982:184). It is important to reiterate that research designs or mitigation plans should be developed and evaluated on a site-by-site basis.

Surface collection can be accomplished by point or grid provenience. In general, point proveniencing is relatively efficient at small sites and at large sites with extremely low artifact densities. At sites with a low density or small number of artifacts, there will be numerous grid units with low or empty counts. Thus it is efficient to focus on the exact distribution of specimens. However, "micro-mapping" or point proveniencing "can be time-consuming and costly at sites that contain vast numbers of artifacts distributed over large areas" (Carrico and Quillen 1982:184). Carrico and Quillen argued that the technique is most appropriate for small sites with identifiable activity areas. However, collection by grid provenience would be less time-consuming at small sites with high artifact densities. Schilz, Carrico, and Thesken (1984) used a mixed strategy at sites along the Yuma 500 Kv transmission line. Higher density areas were collected by grid provenience, with point collection of outlying small clusters and isolated artifacts.

Research objectives are an important consideration in choosing the method of surface collection. The choice of statistical methods for spatial analysis can determine the use of point vs. grid data (Carr 1984:139). Point provenience data are useful for the detailed study of activity areas and artifact associations, and such data are also important in ongoing studies of site formation processes. However, point proveniencing can be inefficient at sites with numerous, dispersed, and redundant loci such as lithic "chipping stations". Collection of such loci as single units, or by grid provenience, should suffice unless the researcher wishes to compare the details of core reduction or formation processes among different chipping areas. In reference to site formation processes, the horizontal displacement of artifacts can reduce the utility of point proveniencing. Grid unit collection may be more appropriate at sites where artifacts have been displaced by erosion, grazing, or other processes. In the study area, grid proveniencing has been justified by post-depositional displacement and by the successful fulfillment of research objectives with grid unit collections rather than detailed point provenience data (Brown and Stone 1982; Bostwick n.d.). Grid unit sizes are a matter of judgment. Along the Granite Reef Aqueduct, artifacts were collected by 1 x 1 m, 2 x 2m, and 5 x 5m provenience (Brown and Stone 1982).

Site mapping can take the form of point proveniencing or "micro-mapping" (Carrico and Quillen 1982). All maps should illustrate the locations and dimensions of archaeological features and artifact concentrations; their relationships to topographic features; and areas of disturbance. Needless to say, they should also serve as a spatial record of investigation procedures.

In addition to the method of provenience, surface collection involves a choice between "total" collection and sampling. The former strategy involves the collection of all visible artifacts by point or grid provenience. Redman (1975:149) defined three general types of sampling: haphazard (grab), purposeful (judgmental), and probabilistic. Grab sampling involves an unsystematic effort to obtain a representative sample by chance. However, it invariably incorporates biases. Judgmental sampling may also reflect the expectations or biases of the researcher, but this approach also allows for choices based on insight, past knowledge and experience, and informed reasoning. Probabilistic sampling, based on mathematical probability theory, provides explicit methods for estimating population values from sample values. Intuitive biases are minimized, since "theoretical limits of reliability have been calculated by statisticians to estimate how closely the values derived from the sampled units approximate the parameters of the entire population" (Redman 1975:149).

Archaeologists have generated a vast literature concerning how, when, and whether to employ various techniques of probabilistic sampling (Hole 1980; Mueller 1975; S. Plog 1978). A number of considerations are involved in the choice of a sampling strategy: (1) the specific research application; (2) prior knowledge of the structure of the target population; and (3) logistic concerns. Sampling is an efficient tool which has proven of value in the investigation of large lithic scatters in western Arizona (Brown and Stone 1982:341-342; Carrico and Quillen 1982; Schilz, Carrico, and Thesken 1984).

Along the Granite Reef Aqueduct, probabilistic sampling, "combined with sampling by judgement where appropriate, proved to be an efficient means of obtaining data for further analysis" (Brown and Stone 1982:341). Simplicity of design was the guiding principle; simple random sampling was most commonly employed. Sampling fractions varied, since the primary goal was to obtain an adequate number of sample units per site (see Cowgill 1975:263). At least 100 units were selected at most sampled sites, with a minimum of 30. There is little doubt that random sampling saved time and labor while yielding representative data on many large lithic scatters. The use of probabilistic techniques also enabled a statistical evaluation of predicted artifact frequencies for different sites (Lewenstein and

Brown 1982:134-137). The results of this evaluation were "equivocal", indicating that probabilistic sampling is not the most efficient means of obtaining information from some types of artifact scatters. In specific circumstances, other strategies should be considered.

Several factors impinge on the selection of total collection, probabilistic sampling, judgmental sampling, or a combination of these approaches. These include research objectives, the internal spatial structure of sites, and their relative sizes and artifact densities. Unless artifact densities are extremely high, total collection should be appropriate at small sites with definable boundaries (see the previous discussion of site size cutoff values). The costs of establishing and implementing a sampling design would probably outweigh any savings in effort, particularly considering the loss of information on intrasite spatial structure and artifact associations. If practical limitations are not extreme, "it would be better to investigate the entire population of items rather than a sample before making summary statements about them" (Redman 1975:153). For similar reasons, sites in the Harquahala Valley Irrigation District were totally collected (Bostwick n.d.; Marmaduke 1984:94).

Large scatters vary in artifact densities and internal configuration. Probabilistic sampling is an efficient technique for investigating large, dense scatters. This is particularly true for such sites as lithic quarries, where there is likely to be a minimal range of artifact diversity. However, important information could be lost in the sampling of base camps or specialized sites with a high diversity of artifact types or evidence of definable activity areas. Probability sampling "will not provide adequate data on configurational or associational patterns" (Redman 1975:153). If research objectives involve detailed intrasite distributional analyses, total collection is indicated. Otherwise, one must accept a reduction in the accuracy of spatial information. An additional cost-saving alternative would involve random sampling of collections in the lab rather than the field.

In general, the efficiency of probabilistic sampling decreases as artifact densities are reduced to extremely low levels. Along the Granite Reef Aqueduct, AZ T:6:1(ASU) and AZ S:6:3(ASU) were extensive, low density scatters. Each "could be interpreted only marginally as a coherent entity, or site" (Brown and Stone 1982:83). Nevertheless, surface collections were accomplished through simple random sampling. A 15% sample of AZ T:6:1(ASU) yielded 350 artifacts from 115 sample units, an average of 3 per 50 x 50m unit. At AZ S:6:3(ASU), 132 sample units, measuring 2 x 30m each, yielded only 114 artifacts. Clearly, the costs of locating and covering dispersed sample units were unwarranted in view of the meager return in artifacts. This is not to say that the sites lacked information. However, a more efficient approach would have involved the recording of isolated artifacts during the survey phase of investigations. An alternative technique would be the collection of artifacts from a long, narrow transect within such a scatter.

At sites of low but relatively higher density, simple random sampling was successful. Brown and Stone (1982:342) concluded that low sampling fractions, of less than 20%, are appropriate given a sufficiently high number of sample units. However, random sampling appears to be less efficient where artifacts are distributed in dispersed clusters or loci. Lewenstein and Brown (1982:134-137) statistically evaluated sample collections and found that estimates of overall artifact frequencies could be made only within very large confidence intervals. The largest confidence intervals were found at sites with dispersed clusters of artifacts. Confidence intervals were reduced, yielding more reliable estimates, where random samples could be stratified according to areas of variable density and where the spatial distribution of artifacts was relatively homogeneous. Brown and Stone (1982:342) concluded that for extensive sites with dispersed loci, where no identifiable patterns are apparent to structure the sample, "a probabilistic strategy may not necessarily yield more reliable results than one designed along other parameters". At sites with dispersed small loci, it is probably most efficient to focus on a judgmental sample of loci or to employ a combined strategy of judgmental and random sampling. Schilz, Carrico, and Thesken (1984:20-22) collected both random and judgmental sample units at three sites. Sixty random units yielded only seven artifacts, while 344 specimens were collected from 51 judgmental sample units of the same size. The judgmental sampling of artifact concentrations is an efficient means of investigating low density scatters.

Archaeologists should consider the use of mixed sampling strategies in appropriate situations. For example, where a site consists of a high density core area with a lower peripheral density of artifacts, total collection could be augmented by a random sample of the peripheral area (see Rice and Dobbins 1981). At the extensive area defined as site AZ S:7:13(ASU) along the Granite Reef Aqueduct, intervening low density areas were sampled at a lower intensity than the more dense artifact concentrations at "field loci" (Brown and Stone 1982:71-72). Along the Palo Verde-Devers line, proposed tower locations were examined intensively, while low density scatters were subjected to random sampling (Carrico and Quillen 1982). Above all, researchers should be flexible in their approach to sampling and investigative procedures. There are no easy answers or single, correct procedures applicable to all types of artifact scatters.

The results of surface collection can aid researchers in the design of subsurface testing strategies. Unfortunately, spatial relationships between surface and subsurface remains are poorly understood by archaeologists, although many are now researching these relationships. In west central Arizona, most tests have yielded very shallow if any subsurface remains. Thus there are few known clues for the detection of such rare phenomena.

There appears to be little justification for the testing of low density scatters or sites located on desert pavement (Brown and Stone 1982; Carrico and Quillen 1982:184; Hayden 1965). However, subsurface testing should not be written off entirely. For example, testing might yield insights into the formation processes of desert pavement. Testing is indicated for any site with evidence of post-occupational deposition. Test excavations should also occur in the following situations: (1) at possible base camps with a high diversity of artifacts; (2) at sites with numerous features

and associated artifacts; (3) at sites on alluvial surfaces; (4) where the color, texture, or composition of on-site soils differ from those of the surrounding area; (5) where features may yield organic or datable substances; and (6) to obtain geomorphological or subsurface pollen data.

Specific testing strategies should be based on the particular characteristics and environmental context of the site. Researchers often focus on areas of high artifact density or diversity as well as features or unusual soil deposits, such as diffuse charcoal scatters. It is probably best to diversify the test locations, through either random sampling or the judgmental selection of areas of different densities. Such a procedure will minimize subjective biases which may limit the discovery of unexpected spatial patterns. Subsurface features may well be located outside areas of relatively high artifact density.

Rock Rings

Rock rings are among the most common archaeological features in west central Arizona. Along the Granite Reef Aqueduct west of the Hassayampa River, the 83 recorded rings constituted 72% of all rock features. Stone and Dobbins (1982) summarized the results of studies conducted at these features. Their discussion also provides a detailed review of information on rock rings in the deserts of Arizona and California.

Rock rings vary in size and configuration, but their interior diameters appear to cluster within three ranges: 30-70 cm, with a mean value near 40 cm; 1-4 m, with most values between 2 and 3 m; and 5-7 m. The 83 Granite Reef features included 25 small rings, 53 medium-sized features, and 5 large ones (Stone and Dobbins 1982:253-254). Most are circular or semicircular, with some unusual configurations such as "keyhole" shapes or attached features. Rock rings are frequently isolated and devoid of other cultural remains. Over half of the Granite Reef features fit this description, and less than a third had any associated artifacts. Nevertheless, these features sometimes occur in clusters and are often associated with trails. Some may even represent base camps: possible examples include AZ S:8:6(ASU) along the Granite Reef Aqueduct and AZ X:4:1(ACS) along the Yuma 500 kV transmission line (Effland, Green, and Robinson 1982; Schilz, Carrico, and Thesken 1984). These sites consisted of groups of features associated with lithic debris, utilized artifacts, and formal tools. Ceramics are rare at such sites.

Rock rings appear to be most common on areas of desert pavement on upper bajadas, pediment slopes, and river terraces. This context may account for their lack of depth, although contained areas are often cleared and slightly depressed. Rock rings may also be associated with mountain passes and larger drainages. In the study area, they commonly occur on the higher portions of the Ranegras and Harquahala Plains, as well as the terraces near Alamo Lake (Brown and Stone 1982; Carrico and Quillen 1982; Stone 1977).

Functions have been inferred on the basis of ethnographic analogies. Small rings have been interpreted as supports for baskets or ceramic containers, used during gathering and other tasks (Goodyear 1975; Raab 1973). Most researchers interpret the larger features as foundations of temporary brush shelters or windbreaks (see Stone and Dobbins 1982:246-247). Rogers (1939) called them "sleeping circles". Some features may have served as hunting or observation blinds (Begole 1976; Stein 1981; Whalen 1976). Alternative functions remain to be tested.

Research Values. Keyser (1979:142) summarized the research potential of rock rings:

> Careful study of stone circles—their construction, morphology, associations, and site locations—can yield information concerning seasonal utilization, settlement pattern, and function. Minor attributes of construction and associated features might yield information relevant to temporal variation, cultural affiliation, . . . and cultural patterns of use if significant comparative data were available.

Investigations of rock rings will contribute primarily to research on settlement and land use patterns. The writings of Rogers (1939) and others (Begole 1976; Hayden 1976) have perpetuated the idea that these features are associated with early "Malpais" or San Dieguito occupations. The virtual absence of ceramics, the frequent presence of crude or patinated lithics, and an association with "ancient" landforms have been cited in support of this idea. However, such features are known to have anchored the structures of mobile hunter-gatherers in historic times. Indian shelters described by Spanish missionaries were felt by Rogers to be identical to the rock-rimmed clearings in the desert. He suggested that differences in weathering, environmental context, and associated artifacts could distinguish San Dieguito features from later ones (Rogers 1939:8). Rogers' criteria were colored by his subjective biases, such as the assumption that later "Yumans" shunned San Dieguito camping areas. Chronological and cultural assignments must be regarded as extremely tenuous. The features may well be very ancient. Relative and chronometric techniques for dating desert varnish may ultimately be applicable to the dating of interior surfaces and associated artifacts (Hayden 1976; Solari and Johnson 1982). Finally, Teague (1981:71) suggested that rock rings in the Gila Bend area were associated with petroglyphs of non-Hohokam, possibly Archaic origin.

Investigative Procedures. When surveyors encounter rock rings, they should be alert for the presence of associated features such as trails. Associated artifacts might be difficult to detect. They tend to be located outside rather than within rings. It can be difficult to recognize heavily patinated or weathered lithics camoflaged by the surrounding desert pavement. It is important to detect such specimens, as they might be of value in establishing the antiquity of these features.

Some rock features have been created as a result of modern military exercises. These include small rectangular features, rock lined bunkers, and rock rings. They are often associated with obvious recent trash, such as C-ration tins and tent posts. Interestingly, rock rings at AZ L:16:2(ASU), a military site near Osborne Wash, had interior diameters uncharacteristic of prehistoric features (Brown and Stone 1982:98,254).

Nearly half of the rock rings found along the Granite Reef Aqueduct were partially or totally excavated using alternative testing strategies (Stone and Dobbins 1982:249). Their depth rarely exceeded five cm. In general, "excavations of rock circles and cleared circles have consistently proven unproductive in southern California and western Arizona desert regions" (Carrico and Quillen 1982:184). Thus, data recovery should focus on mapping and surface collection. Accurate, detailed recording is essential, since most data will be left in the field rather than transported to the lab. In addition to maps and photographs, data should be recorded on constituent materials and environmental context. Comparative and settlement pattern studies will require information on locations and spatial distributions, morphology (size, shape, and composition), environmental context, and associated artifacts and features. Stone and Dobbins (1982:252) listed a series of variables appropriate for an attribute analysis of rock rings. Such an approach could be modified and applied to region-wide comparative studies, if all projects recorded data at a similar level of detail. Time and effort could be saved through field recording in the initial phase of survey.

Although testing has proven unproductive, it would be unwise to dispense completely with excavation. If we simply assume the lack of subsurface remains, we will never find those that might exist. Yet there is little reason for archaeologists to endure the agony of continuously negative results. Therefore, testing should be a highly selective procedure. Where large projects will impact many rock rings, a small sample of representative features should be tested. Tests should be conducted in features and intervening areas of the relatively rare sites with multiple rock rings and associated artifacts. Finally, tests should be conducted at rare features of unusual configuration. In the western Arizona desert, these include alignments of rectangular or oval-rectangular outline resembling features in the Prescott region (Jeter 1977). In the mountain ranges west of the study area, Rogers (n.d.) found such features and assigned them to the Amargosa occupation. Similar features were recorded during the BLM sample inventory of the study area.

Rock Concentrations

Rock clusters or scatters represent possible roasting pits, hearths, cairns, refuse deposits, or platforms. Cairns may have functioned as trail or boundary markers, observation blinds, or "shrines" built by the periodic addition of rocks or artifacts (see McGuire and Schiffer 1982: Fig. 2-3 and Appendix F). Scatters may represent the remains of heated stones dropped into containers for the purpose of cooking. Rock piles also appear to have functioned as agricultural features in southern Arizona; rock "mulches" may have promoted the retention of moisture (Fish et al. 1985).

In most areas of the United States, rock concentrations are among the most ubiquitous archaeological features (White 1980). In west central Arizona, they are frequently incorporated into other types of sites but are also found in isolation. At some sites, activities may have focused on the use of such features. Variations in size, shape, cultural context, associated artifacts, and subsurface contents may correlate with differences in function. Rock concentrations located in desert basins, where cobbles are scarce, often incorporate fragments of broken manos and metates (Bostwick n.d.; Brown and Stone 1982; Doelle 1980). "Shrines", some of which were constructed in pits, frequently contain sherds (Waters 1982).

Archaeologists have investigated many of these features. Rogers' (n.d.) excavations of shrines contributed to the development of a relative chronology of Patayan ceramics (Waters 1982). Tests of small clusters and diffuse scatters have yielded disappointing results. Due perhaps to limited use or poor preservation, desert "hearths" often contain few remains for faunal, flotation, or chronometric analyses (Bayham 1985; Doelle 1980; Larson 1980). However, several features have yielded more positive results (Bostwick n.d.; Brown 1977; Rice and Dobbins 1981; Stein 1981).

Relatively large "roasting pits" have not been investigated in the study area. The term refers to more substantial features with depth, containing burned rocks, gravel, ash, and charcoal. Such features appear to be restricted to mountainous zones and their pediment margins. The results of the BLM Class II sample survey indicated that roasting pits are common in the Harcuvar and Harquahala ranges but rare elsewhere. Rogers (n.d.) recorded substantial, apparently similar features in the Kofa, New Water, and Castle Dome mountains. Agave roasting is suggested by the proximity of agave stands and by the status of agave as a staple resource for historic Indians (Castetter, Bell, and Grove 1938; Gifford 1936). However, the features also may have served as ovens for roasting meat or other plant resources (Doelle 1980; Goodyear 1975; Rice and Dobbins 1981; Stein 1981). Rogers (n.d.) described quantities of burned deer and bighorn sheep bones. Chemical soil analyses from the Desert Gold sites indicated that pits were used to roast meat rather than plant foods (Rice and Dobbins 1981:54-60).

Castetter, Bell, and Grove (1938) published a comprehensive review of Indian agave utilization and the characteristics of roasting pits. They documented a great deal of variation in the size, structure, and constituents of features. Rogers (n.d.) drew a contrast between pits in western Arizona and southern California. He argued that Arizona features were larger and that they incorporated more dirt and gravel and fewer large rocks. These reused "community pits" were "not commonly scattered over the mescal bearing area as in California". Rocky slopes and canyons offered few suitable locations in which to dig roasting pits. In the study area, most features are located on the narrow, sandy benches adjacent to canyon drainages. In general, they resemble Rogers' descriptions of western Arizona features. Some incorporate gravel "rings" in excess of five meters in diameter.

There do appear to be similarities between features in western Arizona and those on the arid eastern face of the mountains bordering the Anza-Borrego desert in California (Christenson 1981). In both areas, many isolated features have few associated artifacts. Christenson (1981:178) suggested that plants were roasted, then transported to lower elevation camps for further processing and consumption.

Research Values. Variations in the structure, size, and contents of rock concentrations potentially can be linked to functional, temporal, or cultural differences. Although

preservation is a problem, these features are potential repositories for organic remains that can be radiocarbon dated or used to reconstruct subsistence practices. They can thus contribute to chronology building, the dating of associated artifact types, and the study of temporal shifts in patterns of settlement and subsistence. As previously noted, the study of stratified "shrines" can contribute to the relative dating of ceramic types (Waters 1982). However, relative sequences should be based on an adequate sample of such features, as rates of deposition are unknown.

As both isolated features and components of sites, rock concentrations can contribute to the study of settlement and subsistence strategies. As White (1980:69) noted, their investigation can result in the definition of utilized resources, economic activities, and site functions. The distribution of different types over the landscape is relevant to these questions as well as issues relating to social organization and demography. For example, does the large size of many western Arizona features indicate that "community" features were used by relatively large seasonal groups? Differences between Arizona and southern California features could be linked to differences in natural resource distributions, extent of reuse, or sizes of task or consumption groups. Systematic comparisons could yield interesting results. Finally, White (1980:70) suggested that different prehistoric groups could "be distinguished by the differences in the attributes of the rock clusters that they created and used". However, it would first be necesssary to rule out differences related to function or the availability of raw materials for feature construction.

Investigative Procedures. Like information on rock rings, data on rock concentrations are recorded primarily in the field: "unlike single artifacts which can be studied at leisure, a concentration of rocks cannot, under normal circumstances, be taken back to the laboratory and put aside for later examination" (White 1980:70). Careful mapping and field recording are thus essential. White (1980:67) suggested the recording of at least 12 variables, and he described ways to measure and interpret their values. The 12 variables included: (1) depth; (2) dimensions; (3) configuration or shape; (4) density; (5) number of rocks; (6) rock sizes; (7) percentage of thermally cracked rocks; (8) description of raw materials; (9) constituents or fill; (10) placement of different rock types or sizes; (11) associations; and (12) location within the site. Data should also include a description of the environmental context. Features should be tested or excavated for the determination of structure and depth. Samples should be collected for radiocarbon and archaeomagnetic dating (if feasible), faunal or macrobotanical identification, and flotation, pollen, and soil analyses.

Linear and Complex Rock Alignments

This discussion focuses on probable surface features of low height. The remains of compound walls or masonry structures are rare phenomena in the study area. Surface rock alignments vary in size and configuration. They can occur as relatively isolated features in low density sites, as features associated with rock rings or intaglios, or as portions of more complex systems. Two alternative functions can be tentatively assigned to surface alignments and systems. They may have served communicative or ceremonial purposes, with possible similarities to intaglio sites. Rock "ground figures" are sometimes associated with intaglios, as either outlines or as separate but proximate features (Hayden 1982). Trails may have been marked by cobble lines. Alternatively, linear alignments may represent such water/soil control features as check dams, terrace systems, or water diversion channels. These were used to enhance the capture of runoff and soil for farm plots in the prehistoric Southwest (Plog and Garrett 1972). They also may have promoted the growth of wild plant resources through the buildup of soil and consequent increase in water retention (Rodgers 1977:70).

Systems of linear alignments, probably used to increase the productivity of dry farming, are common in the nonriverine zones to the north, east, and south of the Hohokam core area (Doyel and Plog 1980; Fish and Fish 198?; McGuire and Schiffer 1982). These features, most of which appear to postdate A.D. 1100, are particularly common in the uplands of the northern periphery (Bruder 1982; Gumerman and Spoerl 1980; Rodgers 1977; Weaver 1980). Such systems appear to be relatively rare in the western desert. However, collections of linear alignments do exist, but few have been adequately documented. Brown (1977) recorded a terrace system on the upper bajada east of Wickenburg. Bureau of Land Management and avocational archaeologists have recorded plural rock alignments in several locations: the Palo Verde Hills (Jagow Well area); the Saddle Mountain periphery; the western bajada of the White Tank Mountains; the southeastern margin of the Harcuvar Mountains; and the western bajada of the Plomosa range. These sites usually have associated ceramics. The results of future surveys may well increase their known numbers and geographic range. As of now, with the exception of the Harcuvar case, these features have been found in the areas most accessible to Hohokam and Patayan populations along the major rivers.

The desert of west central Arizona, more arid than other zones peripheral to the Hohokam heartland, would appear to offer poor prospects for successful dry or floodwater farming. Nevertheless, researchers should be alert to the possible presence of check dams and artificial terraces on alluvial fans, hillsides, or canyon bottoms. Brown and Stone (1982:36) suggested that dry farming techniques may have been adapted to enhance the productivity of specific wild resources, particularly those offered in trade to farmers. High mobility, rather than "landscape modification", probably characterized a continued emphasis on wild resource use in the western desert (Brown and Stone 1982:35).

Research Values. One should first attempt to determine whether rock alignments served non-economic or economic purposes. If their function appears to have been symbolic or ceremonial, research values should be similar to those of intaglios. Features designed to enhance the capture or production of resources would offer important data on regional subsistence and settlement patterns. This specialized form of land use would indicate that prehistoric people were active managers as well as users of natural resources (see Williams and Hunn 1982). One would expect to find base camps near systems of rock alignments,

assuming that groups participated in their planned construction, maintenance, and sustained or repeated use. Such features may have been used seasonally. On the other hand, low labor inputs for construction and maintenance may have encouraged mobile groups to construct features in areas that were frequently revisited. In an experiment conducted by Brown's (1977) field crew, a hillside terrace system was constructed with a surprisingly small amount of effort. Further experimental studies could address aspects of maintenance and use as well as construction.

Investigative Procedures. Once again, comprehensive and accurate field recording is essential. Survey procedures should include mapping, plotting and recording of associated artifacts and features, and documentation of the environmental context. Low level aerial photos would be useful for defining and illustrating extensive systems. Data recovery procedures should include surface collection of artifacts and subsurface testing. Sediments within features may well differ from soils of the surrounding area. Soil, flotation, and pollen samples should be compared to control samples from natural, unmodified areas. Geomorphological or hydrological studies also could aid in the determination of function.

Trails

Most prehistoric trails are relatively straight, narrow (30-50 cm wide) paths indented on desert pavement surfaces. Larger rocks and cobbles have been cleared from these paths. Julian Hayden (1965:273) described the formation of trails on desert pavement:

> These pavements are, when unbroken, essentially imperishable and impenetrable by natural forces, but because of their nature are very readily imprinted or damaged by man and animals. The single layer of stone above the soft base may be impressed into the base by continued use of a trail either by man or beast, and this slight displacement of the protecting layer becomes permanent as any exposed silts are blown or washed away . . . the pavement will re-form quickly and retain a permanent record of the disturbance in the form of a paved depression.

In rocky areas and on slopes, trails may take the form of cleared paths with rock berms. Robertson (1983:2-7), writing of the prehistoric roads radiating from Chaco Canyon in New Mexico, drew a distinction between "roads" and "trails". "Roads" were defined as "true constructed surfaces" ranging from 3 to 15 meters wide. "Trails", less than 2 meters wide, resulted from "surface clearing, minor leveling or stabilizing".

In some cases, it may be difficult to distinguish human paths from game trails. Indeed, people may have used ancient game trails. At the complex of prehistoric features near Jagow Well in the Palo Verde Hills, modern animal trails link prehistoric sites and features. This indicates that they once functioned as Indian trails. Prehistoric human trails seem to be straighter, with varnished desert pavement and a lack of hoofprints (Carrico and Quillen 1982:94). They frequently exhibit associated artifacts and features.

Numerous trails have been documented on the desert pavements of west central Arizona. Malcolm Rogers (1941, n.d.) devoted much of his energy to the definition of extensive networks of trails, including at least three major trails between the Colorado and lower Gila rivers (see Waters 1982). He linked many of these paths to documented historic Indian routes (Kroeber 1951; Schroeder 1961; Spier 1933). Most of Rogers' trails were located to the southwest of the study area. Archaeological linear surveys have recorded many other trails in western Arizona (Brown and Stone 1982; Carrico and Quillen 1982). Many also have been found on the terraces of the Gila, Colorado, and Bill Williams rivers (Breternitz 1957; Schroeder 1952; Stone 1977; Vivian 1965). In the study area, known trails are most common on the desert pavements at the margins of the Ranegras and Harquahala plains (Brown and Stone 1982; Kemrer, Schultz, and Dodge 1972). Trails in the Palo Verde Hills, near the nuclear power plant, include hillside "streaks" (Stein 1981).

Features often associated with trails include rock rings, intaglios, and cairns (Brown and Stone 1982; Carrico and Quillen 1982; Rogers n.d.; Solari and Johnson 1982). The latter features, also known as "shrines", were formed from successive "sacrifices" of pottery, other artifacts, and stones (Waters 1982). Linear scatters of artifacts, primarily sherds, are often found along trails. These usually represent pots broken within three meters on either side of the trail (Breternitz 1957). In the western Papagueria, Ezell (1954:5) defined "trail sites" as "evidence of temporary halts along the trails". These small sites consisted of sherds, occasional stone flakes or hearths, and "boulders slightly used as metates". On the Harquahala Plain, Brown (1976) defined similar sites as probable temporary camps along a travel route following Tiger Wash.

Research Values. Trails are particularly relevant to the investigation of regional settlement patterns. They represent established links among sites, resource areas, and social groups. In both prehistoric and historic times, travel was a major type of land use in the western Arizona desert. As expressed by Brown and Stone (1982:348):

> Transitory movement was an integral part of all forms of settlement in the desert . . . The dispersed spacing of food and water resources made travel over long distances routine for hunting and gathering groups. Even sedentary groups established along the rivers were motivated to travel through the desert to maintain social and economic ties with their neighbors.

Trails are the physical manifestations of travel, and "patterns of travel flow have implications for the distribution of settlements and the intensity of resource use and interaction within the marginal desert region" (Brown and Stone 1982:347). Archaeologists should attempt to determine the relationships between the location and spatial structure of trail networks and the distribution of different site types and natural resources. Large trail systems may have been anchored to areas of relatively dense populations along the Colorado and Gila rivers. Rogers (1941, n.d.) proposed a basic hierarchical structure of main long-distance trails, minor long-distance lines, and subsidiary trails to particular settlements and resource areas. Along the Palo Verde-Devers transmission line, trails were most numerous and

dense on the Colorado River terraces. From there they converged on mountain passes, and main long-distance routes traversed the interior desert. Other trails branched off to minor passes and upland resource areas (Carrico and Quillen 1982). Trail networks can be studied at different spatial scales. An extensive regional perspective is exemplified by Rogers' (n.d.) maps of trails linking the Colorado and Gila rivers. Intensive studies of smaller geographic areas could focus on the linkages among trails and site types in local systems. For example, the system of trails near Jagow Well in the Palo Verde Hills may have connected temporary camps, areas of resource exploitation, and ceremonial loci (Carrico and Quillen 1982; Landon 1980; Stein 1981).

Predictive land use maps, generated during the Granite Reef studies, specifically addressed the locations of potential travel routes (Brown and Rubin 1982:287-292). The efficiency of long distance travel was assumed to reflect several environmental factors, including slope, water availability, temperature extremes, the proximity of food resources, and the presence of topographic corridors, barriers, and passes. Predicted travel routes coincided with the modern system of roads and highways (Brown and Rubin 1982:293). In California, modern roads often correspond to documented historic Indian trails (Davis 1961). There is a need to refine locational models and to test them against the spatial distribution of prehistoric trails. However, it is important to stress that processes of social interaction, as well as natural environmental factors, influenced destinations and the overall configuration of trail systems. One must also acknowledge the bias introduced by the differential preservation of trails on different landforms. Trails inevitably will be lost on alluvial basin soils.

An interesting research issue concerns the degree to which trails were purposefully established, reused, monitored, and maintained over long periods of time. Due to long distances between scarce and unpredictable water sources, aimless wandering would have been inefficient and potentially deadly. Established routes, with access to water and other resources, would have reduced the risks of desert travel. According to Robertson (1983:2-2), associated features indicated that "the trails in question were formalized and not expected to change".

Insights into the use of prehistoric trails can be found in ethnographic studies of travel in arid regions. Gould (1980) defined two basic patterns of movement for Australian aborigines. Foraging activities involving searching or the gathering of information, such as hunting or gathering from a base camp, were characterized by random patterns of movement. In contrast, planned and purposeful trips to known water sources and resource concentrations involved direct travel. The second pattern would be expected to result in the formation of trails.

Survival and successful use of desert resources demanded an intimate knowledge of the natural environment. For many groups, this knowledge incorporated mental "maps" of the regional geography (Fowler 1982; Gould 1980, 1982; Yellen 1985). In Australia, geographic knowledge was embedded in myth and ritual. Kroeber (1951:137) discovered a similar system of knowledge among the Mohave, "an endless interest in topography, and a constant reflection of this in their myths and song cycles, which are almost invariably localized in detail". Further,

> Most old and middle-aged Mohave I met around the first decade of the century seemed to be carrying in their heads a good equivalent—whether visual or kinaesthetic—of a map of a large area surrounding their valley; and to have done so largely from a sheer interest in place and orientation for its own sake, an interest further nourished by constantly fed information.

This information incorporated a large portion of western Arizona, including much of the study area. Kroeber used the information to map probable trails and associated settlements in west central Arizona. These reconstructions are difficult to evaluate, but in many cases they appear to correspond to the known distribution of archaeological sites.

Established trails may not only have promoted safe and efficient travel. They may also have played a role in communication and boundary maintenance among bands or social groups. The active defense of territorial boundaries is rare, perhaps impossible, among desert foragers. Permission to cross boundaries is usually granted, but failure to seek permission creates anger and disputes (Williams and Hunn 1982). Inadvertent trespasses and disputes may have been avoided through the use of formal trails. In addition, knowledge of the movements of other groups can enable hunter-gatherers to plan their own travels more efficiently (Moore 1981). The use of definite trails, as well as the characteristics of associated features, may have allowed groups to monitor the movements of other bands. Cairns or "shrines" may have contained relevant information, and they may also have served as signaling stations. The Australian aborigines, travelling by alternative routes, used smoke signals to indicate the presence or absence of water at particular sources (Gould 1980:70). The mapping of cairn locations could indicate their suitability as overlooks or signaling stations or their association with potential boundaries indicated by natural landmarks or artifact type distributions.

It is evident that trails offer the potential for interesting archaeological research. In addition to the above issues, the distribution of ceramic types and exotic trade items along trails can indicate boundaries, frontiers, or patterns of trade and social interaction. Rogers (n.d.) mapped the distribution of Lower Colorado Buffware types along major trails (Waters 1982). In some cases, these types were relatively dated through the excavation of cairns or the study of "horizontal trail stratigraphy" Hayden (1965:275) and Waters (1982:276).

Investigative Procedures. Surveyors must be careful to distinguish human trails from vehicle tracks or modern animal trails. They should record the locations and relative densities of artifacts and features along trails, with small provenienced collections of representative sherds for type identifications. Obviously, trails should be traced and mapped. Most can be easily followed at ground level on undisturbed desert pavement. Surveyors should note apparent line-of-sight orientations to prominent landmarks. A more costly but useful procedure is a helicopter

aerial reconnaissance followed by pedestrian ground truthing (Carrico and Quillen 1982). This procedure should be particularly useful in the documentation of localized trail networks. However, all trails might not be visible from the air. Remote sensing techniques were useful in the definition of the Chaco road system (Kincaid 1983), but their applicability to less substantial trails is untested.

Data recovery should include systematic collections of associated artifacts. Grid units can be used where specimens are distributed fairly continuously along a trail segment. At AZ S:1:5(ASU) along the Granite Reef Aqueduct, collection units of 10 x 10 m were bisected by the trail (Brown and Stone 1982:91). Along other trails, isolated clusters of artifacts were collected separately. Associated features, particularly cairns, should be tested or excavated. Carrico and Quillen (1982:65) conducted "trail tests" involving the removal of desert pavement and the comparison of cross-sectional profiles. The results were inconclusive. However, such tests could provide a measure of differences between trails that are "thin, short and apparently seldom used to those that are large, lengthy, and deeply rutted such as segments of the Cocomaricopa Trail" (Carrico and Quillen 1982:138).

Rock Art

Many rock art sites are recorded in the site files for west central Arizona, but none have been investigated systematically in detail. Wasley and Johnson (1965) conducted only minimal studies of the petroglyphs at Painted Rock Reservoir near Gila Bend. Further downstream, an initial mapping and assessment of a large petroglyph site has been carried out by BLM archaeologists, amateur archaeologists, and an archaeo-astronomer (Fran Miller, personal communication, 1985). For the Phoenix area, the best and most recent reference is Bruder's (1983) study of the Hedgpeth Hills site north of Phoenix.

Rock art sites in the Phoenix area exhibit a great range of variation in size, environmental contexts, internal variability, and associations with other types of sites. Bruder (1983:228) suggested the existence of two basic site types. "Public" sites were large sites with a wide variety of design motifs, probably visited by numerous people of diverse social groups. Smaller "private" sites with a limited number of motifs may have been used by members of a single social group.

The absence of large sedentary populations indicates that rock art sites in the western desert may be generally smaller and less variable than those in the Phoenix Basin. However, they are known to range from the large, conspicuous Eagletail petroglyph site to a few pictographs in an upland rockshelter. Rock art sites have been recorded in the Harcuvar, Harquahala, and Eagletail ranges, Saddle Mountain, the Palo Verde Hills, and on knolls on the Harquahala Plain. The most conspicuous site, visible from the highway, is located in Granite Wash Pass near Salome. Petroglyphs have been found near most springs. The majority of sites appear to be small, with less than 50 separate glyphs. The Eagletail site, located in a pass near a spring, may fit Bruder's definition of a "public" site. Recorded as AZ S:11:1 (ASM), it is located on public land in the Eagletail Mountains. It is a large site with a variety of design motifs, many of which are geometric rather than naturalistic in character.

Pictograph sites, unusual in western Arizona, have been found in canyon rockshelters of the Harcuvar, Eagletail, and Harquahala mountains. Others have been reported in the Alamo Lake area (Foreman 1941:222). In contrast to petroglyphs, designs pecked onto boulders using hammerstones, pictographs were painted with multi-colored natural pigments. Except in the Four Corners area and west Texas, petroglyphs are much more common than pictographs in the Southwest and Great Basin (Grant 1967:13). Pictograph paints consist of pulverized minerals mixed with animal or vegetable oils. According to Grant, the most common colors are red (hematite), black (manganese ore, charcoal, or graphite), and white (gypsum, kaolin, or chalky deposits). Green and blue pigments can be produced from minerals in copper ores, and yellow paints come from limonite, an iron oxide. In the mountains of the study area, the range of colors includes blue and green pictographs in the Harcuvar Mountains. Copper was mined there historically, and chunks of chrysacolla were found at a prehistoric upland camp. Rockshelters should be inspected for the presence of pictographs. In open areas, the paintings may have been less well preserved than petroglyphs.

Petroglyphs should be expected in the vicinity of springs, natural tanks, passes, trails, and topographic landmarks. Potential locations include heavily patinated areas of basalt and rhyolite boulders on mountain slopes and isolated knolls. However, petroglyphs need not be confined to such areas. Their presence on small isolated boulders led Bruder (1983:228) to suggest that their manufacture was "required" in certain situations despite a lack of suitable rock surfaces.

Research Values. These are perhaps the most challenging and provocative of archaeological sites. They may represent ceremonial, informational, or social functions served by few other types of sites. The determination of site functions, and of functional differentiation among rock art sites, is a major research issue. Rock art may have served the following general functions: (1) religious, ceremonial, or ritual use related to shamanistic practices, hunting magic, representation of myths, etc.; (2) insignia of personal identification or group membership; (3) mnemonic devices or records of events; (4) calendrical devices associated with recurrent astronomical events; (5) maps or markers of trails or territorial boundaries; and (6) prehistoric doodling or artistic expression. These alternatives need not have been mutually exclusive at a single site.

Functional interpretation is a complex process involving more than the subjective evaluation of design motifs. An example of this complexity is provided in Bruder's (1983:229-231) discussion of the Hedgpeth Hills site. Interpretations should not be based solely on meanings assigned to design elements. The geographic context, in terms of relationships to natural resources and to other sites, is an important interpretive factor. Efforts should be made to develop and test alternative hypotheses for particular sites. These could incorporate the analysis of associated artifacts and features. In some cases, these hypotheses could entail multiple uses. Regional analyses

involving intersite comparisons should contribute to functional determinations as well as comprehensive studies of regional settlement patterns, land use, and social interaction. Analyses should be based on rigorous, quantitative comparisons of the size, internal diversity, and environmental and archaeological contexts of sites. Recurrent patterns, such as the proposed distinction between "public" and "private" sites, should shed light on site functions and the operation of settlement systems. The distribution and co-occurrence of particular design elements, both within and among sites, ultimately might be linked to certain functions, social groups, or temporal periods.

Several methods have been employed in the relative and chronometric dating of rock art and in the assignment of cultural affiliations. At a single site, designs can be relatively dated by variable degrees of patination or weathering. In conjunction with these differences, consistencies in the superimposition of designs can indicate relative dates. If one assumes that associated, dated artifact types were contemporaneous with petroglyphs, tentative dates can be assigned to the designs. An example of such a study is Turner's (1963) analysis of ceramic types at Glen Canyon petroglyph sites. Temporal and cultural affiliations also can be assigned on the basis of designs used in other media, such as pottery or textiles. Bruder (1983:156) found that about 50% of the major design categories at the Hedgpeth Hills site corresponded to Hohokam ceramic design elements. However, attempts to temporally order design categories were complicated by the fact that "design motifs on Hohokam ceramics do not neatly occur during single time intervals and then disappear" (Bruder 1983:204). One must contend with temporal overlapping and the persistence of certain design elements.

Intersite consistencies in the relative dating of design elements can contribute to the definition of regional rock art "styles". The geographic distribution of such styles can be mapped. For example, in the Great Basin, the "curvilinear abstract" style is thought to be earlier than the "rectilinear abstract" style (Grant 1967:45). The former style appears at sites near Gila Bend (Grant 1967:124; Teague 1981). Schaafsma (1980) defined a "Gila Petroglyph Style" associated with the Hohokam, noting that there were differences between the Phoenix and Tucson basins. Much work remains to be accomplished in the spatial and temporal mapping of such "styles" and their correlation with social groups or interaction spheres. It might be possible to distinguish between Archaic and ceramic period sites or Hohokam and Patayan sites. A very preliminary assessment of the Eagletail site, based on designs and archaeological context, indicates that it may be an Archaic rock art area.

Several researchers have conducted experiments in the dating of rock art by physical and chemical means. Two experimental techniques used at the Hedgpeth Hills site were hydrogen profile analysis and cation-ratio analysis. The first technique was based on the absorption of atmospheric water by rock surfaces. It was proposed that "surfaces that have been modified at different times by incising will exhibit variability in the morphology of the hydrogen profile" (Taylor 1983:290). The results were unsuccessful. Taylor stressed the need to determine the mechanisms by which hydrogen profiles are actually produced in different types of rock.

Cation-ratio dating, based on the trace element analysis of desert varnish, is a new and promising technique (Dorn 1983). It focuses on minor elements believed to be relatively insensitive to microenvironmental factors. At Hedgpeth Hills, analytical results tended to support other indicators of relative age, including color differences (Bruder 1983:204). Related techniques for absolute dating are under development (Dorn 1983).

It should be evident that all rock art sites in the study area can contribute to the investigation of important research issues. The American Rock Art Research Association, an organization which sponsors a newsletter, published reports, and an annual meeting, represents a source for additional information on scientific research and documentation procedures for rock art sites.

Investigative Procedures. Rock art sites near water sources are likely to be discovered by Bureau of Land Management hydrologists and wildlife biologists engaged in spring and tank development. They should record site locations, photograph them if possible, and report them to a Bureau archaeologist. Sites recorded on topographic maps, for which descriptive information is inadequate or unavailable, should be field checked and photographed. Basic information recorded during field checks or surveys should include location; environmental context; photographs; sketches of representative design elements; rough counts of panels, individual designs, and design elements; site size; and descriptions of associated artifacts or features. Surveyors should check the area for water sources or trails.

Data recovery at rock art sites involves intensive fieldwork. It is important to record sites completely and accurately, since they remain uncollected. Sampling is not advised, since the spatial arrangements and interrelationships among design elements are important categories of information. Ideally, research goals should be outlined prior to data collection, then furthered through analysis. However, detailed descriptive data can be "banked" for future analysis. For example, the primary research goals at the Hedgpeth Hills site were descriptive inventory and preliminary analysis (Bruder 1983). These procedures involved computer coding and analysis of various attributes, as well as the production of computer-generated maps. This data base can support additional, more sophisticated studies.

For insurance and cross-checking, at least two recording techniques should be used. Photography, at various scales, should be a basic procedure. The resulting negatives should be examined to determine the need for rephotographing. Other techniques include scale drawings, rubbings, or the tracing of designs. Mapping techniques include the use of standard surveying instruments and photogrammetry. At the Hedgpeth Hills site, numerous techniques were used to record 758 panels and 1571 separate design elements. Each panel was photographed, drawn to scale, and traced on acetate. Selected individual designs were rubbed or traced. The site was mapped by tape and transit, photography at various scales, and photogrammetry. Separate forms were filled out on individual boulders, separate panels, and designs. Recorded information included assigned numbers keyed to maps, size, facing,

Munsell color codes, condition, and extent of superposition. Different techniques could vary in utility in response to the size and layout of sites. For example, photogrammetry is particularly useful where there are large panels, but it is less practical where a site consists of numerous small boulders. It is also more cost effective at larger, more complex sites (Bruder 1983:41; Turpin, Watson, Dennett, and Muessig 1979).

Managers should encourage experimental studies on the production, natural deterioration, and dating of rock art sites. The development of standardized recording procedures would facilitate comparative studies.

Caves and Rockshelters

Maps compiled by Brown and Stone (1982:61), as well as additional information in the site files, indicate that approximately 30 rockshelter sites have been documented in the study area. However, other undocumented sites have been reported by local inhabitants. Caves and rockshelters generally occur in remote, mountainous areas which have received little archaeological survey. They also are found on isolated buttes and knolls. Further explorations will likely reveal additional shelters occupied or used by humans.

Only one site, the Anderson Mine Rockshelter, has been tested. This site yielded a faunal assemblage consisting primarily of deer and bighorn sheep bones (Powers, Granger, and Keller 1978). Most known sites are small shelters probably used as temporary camps or as caches for food or artifacts. Possible ceremonial use is indicated by the presence of pictographs in the secluded canyons of the Harcuvar and Harquahala ranges. Larger sites may have been seasonal base camps. At present, there is no known equivalent to such major stratified sites as Ventana Cave or the well known Great Basin caves. Records on file at the Yuma District Office of the BLM indicate that such sites do occur in the mountains near the Colorado River. They may yet be discovered in the mountain ranges of the study area.

Research Values. Cave and rockshelter sites will probably vary in size, depth, occupational intensity, and function. All can contribute to the investigation of regional settlement and subsistence patterns. In this regard, small camps and cache sites are as important as more substantial habitation sites. However, for the resolution of these and other research issues, the importance of stratified sites cannot be overemphasized. In west central Arizona, rockshelters are likely to dominate the relatively few sites with depth or stratified deposits. They might also contain rare perishable materials. Perishable remains might include datable organic substances, faunal and botanical remains, burials, or artifacts produced from wood or natural fibers. These would yield data for radiocarbon dating, paleoenvironmental reconstruction, and diachronic studies of subsistence and technology. The investigation of a long-term occupational sequence would represent a breakthrough in the definition of regional culture history. Despite interpretive complexities, cave and rockshelter sites often serve as anchors for regional chronological sequences in the western United States. This has been particularly true for the Archaic period. Since the culture history of western Arizona is poorly understood, stratified caves and rockshelters are particularly important cultural resources.

The investigation of natural shelters can contribute to other, more specific research issues. One could focus on their economic role as storage centers and their apparent importance in the Yavapai settlement system. Information from these sites could contribute not only to the study of Yavapai settlement and subsistence, but also to the resolution of a late Yavapai entry vs. a continuous Hakatayan occupation of the western Arizona desert. Finally, natural shelters often contain fossilized packrat nests useful for paleoenvironmental reconstruction (Van Devender and King 1971). Even where cultural materials appear to be absent, such localities should be considered as important resources for the investigation of changing relationships between humans and their natural environment.

Investigative Procedures. Relative to investigations at other types of sites, data recovery and analytical procedures are likely to be time-consuming and costly. Such costs should be balanced by high yields in information. Few expenses should be spared in the investigation of repeatedly occupied sites containing deep cultural deposits. After all, true landmark sites are infrequently subjected to intensive study. State-of-the-art investigations should incorporate the following aspects: (1) an excavation strategy based on the results of preliminary testing; (2) excavation by natural stratigraphic levels where possible; thick natural levels could be removed in thin arbitrary layers; (3) the screening of deposits, using a standard mesh size to insure comparability of excavation units; (4) detailed mapping and profiling; (5) collection of a statistically adequate number of flotation samples of a standard size; (6) attention to the definition of formation processes; and (7) a multidisciplinary approach incorporating the services of natural scientists and archaeological specialists in the investigation of caves and rockshelters.

Stationary Grinding Features

In the study area, bedrock mortars, basins, and "slicks" are usually associated with artifact scatters or petroglyph sites. They occur in small clusters in canyons and mountain passes. Very large concentrations of these features have been documented in the Southwest and California, but substantial sites are yet unknown in west central Arizona. However, Rogers (n.d.) reported large bedrock mortar groups near the Bouse site. Schroeder (personal communication, 1984) commented on the absence of pestles and manos at bedrock grinding areas. Such implements may have been removed by later Indian occupants or artifact collectors. They might also have been curated and transported from camp to camp (Doelle 1980). According to Euler and Dobyns (1983), manos were curated by the Walapai; their use-life sometimes exceeded 50 years. No detailed investigations of stationary grinding features have been conducted in west central Arizona.

Research Values. The characteristics, environmental context, and spatial distribution of such sites can yield information on patterns of subsistence, settlement, and mobility within the region. The purposeful manufacture of such features indicates that sites were periodically revisited. They may thus have been located in strategic or productive resource zones. A large concentration of features could indicate a particularly productive resource zone or an

area of periodic population aggregation. It would be interesting to contrast the economic, demographic, and organizational factors underlying two systems for the production and use of grinding implements in the Arizona desert. These hypothetical systems apparently incorporated: (1) the periodic use of stationary grinding features by highly mobile groups in the arid western desert; and (2) the localized production of implements for trade to farmers along the rivers. People moved in the first system, while artifacts moved in the latter case. The second system seems to have operated in zones adjacent to the Salt, Gila, and Colorado rivers (Bruder 1983; Huckell 1985).

Efforts should focus on the determination of structural and functional variability among types of features. Differences in size, shape, depth, and wear patterns could be associated with the processing of different types of resources. Euler and Dobyns (1983) described functional variation among grinding tools used by the Hualapai. Experimental and ethnoarchaeological studies could yield data on the production, relative efficiency, and wear patterns of grinding implements used for different purposes.

Investigative Procedures. Surveyors should be aware of such features and should search for them on bedrock surfaces of mountain slopes and passes, canyon boulders, and streambeds. Data recovery should incorporate information on the number and spatial distribution of grinding features; their size, shape, and depth; types and degrees of use wear; rock types; and associated artifacts and features.

Quarries

Quarries are areas for the procurement of lithic raw materials. Various stages of production, particularly initial reduction, can occur at quarries. Variation exists among definitions for "quarries" and "workshops". The term "quarry" here refers to the use of a localized source of relatively concentrated, abundant raw materials. This definition follows Gould's (1980, 1985) distinction between localized and nonlocalized lithic sources. Nonlocalized sources, which can be quite extensive in area, consist of raw materials dispersed in relatively low densities over terraces, desert pavements, or streambeds. Gould argued that nonlocalized sources, used in an expedient manner, were rarely the destinations of special trips for resource procurement. Where nonlocalized sources were extensive, they may have been used more frequently and regularly than quarries (Gould 1985:128).

In the desert of west central Arizona, extensive nonlocalized lithic sources occur on river terraces and on the desert pavements surrounding volcanic buttes and mountain ranges. There is ample evidence for the use of such sources (Brown and Stone 1982). True quarries are relatively rare, although additional sites may yet be found. Known quarries include the following: several sites near Alamo Lake (Stone 1977); the higher density portions of AZ T:5:5(ASU) near Black Butte (Brown and Stone 1982); and sites recorded in the Eagletail Mountains and the Clanton Hills. All of these sites are littered with abundant debitage. They are focused on outcrops and volcanic flow remnants, as well as the terrace gravels near the Bill Williams River. Raw materials include fine-grained rhyolite at the latter two sites; rhyolite, chalcedony, and obsidian nodules near Black Butte; and chalcedony, chert, and jasper near Alamo Lake. Other quarries possibly occur in the Bouse Hills and Black Mountains (Brown and Stone 1982; Powers, Granger, and Keller 1978). Saddle Mountain, an agate collecting area for rockhounds, is another likely place. To the south, lithic sources and quarries might occur in the Gila Bend Mountains (Effland, Green, and Robinson 1982). In general, quarries should be expected in portions of mountain ranges formed by volcanic activity in the Mid-Tertiary period (Reynolds 1980). These ranges include the Vulture, Big Horn, and Eagletail mountains. Isolated chert outcrops might be found in other ranges.

At a broad regional level, the boundaries between localized and nonlocalized sources may often be arbitrary. Raw material densities will decrease when the former sources grade into the latter as a result of geomorphological processes. On the ground, many extensive, low density scatters are sufficiently distant from localized sources to be classified as separate site areas. However, quarries appear to consist of a high density core area surrounded by an extensive zone of chipping stations and low density scatters. The core areas sometimes have depth on the surface, consisting of piles of flakes. Initial reduction activities are evidenced by a predominance of cores and large primary and secondary flakes. Camping, later stage production, and incidental activities may have occurred in the surrounding lower density areas. All areas of activity need not have been directly related to tool production. These considerations should be incorporated into research designs for the investigation of quarries. In west central Arizona, only AZ T:5:5(ASU) has been investigated in any detail (Brown and Stone 1982). Although this investigation yielded valuable information on lithic resource use, it was confined to a long, narrow transmission line transect. Future studies could examine intrasite variation by focusing on larger areal blocks incorporating high density core areas and surrounding peripheral zones.

Research Values. Quarries are significantly relevant to the investigation of lithic resource use and regional settlement patterns. They offer the potential for technological studies of raw material characteristics and tool production. The localized abundance of high-quality raw materials may have facilitated specialized production strategies, such as the phased manufacture of biface blanks. It may be possible to define technological and functional differences between the use of nonlocalized and localized lithic sources (Gould 1980, 1985; Lewenstein and Brown 1982). This information could contribute not only to studies of prehistoric technology but also to the delineation of regional land use patterns.

The use of quarries may have been conditioned by their accessibility to base camps, travel routes, water, and other natural resources. Locational studies and geochemical source analyses could reveal links between quarries and other types of sites. Special trips to quarries may have been followed by the finishing of tools at specific base camps. Lithic sourcing and distributional analyses could indicate patterns of mobility or exchange, as well as the limits of social territories or ranges (Brown 1982; Goodyear 1979; Shackley 1985). Gould (1985:123) argued that the movement and transport of lithic materials followed wide-ranging social networks. However, he acknowledged the

difficulty of distinguishing long-distance exchange from "the distribution of lithic materials in the context of the normal range of foraging by highly mobile hunter-gatherers". The use of particular quarries ultimately should be related to the regional distribution of sites, other quarries, and other natural resources.

Single quarries may have been used by different groups over a long period of time. Differences in degrees of patination could provide a basis for diachronic studies of lithic technology (Rosenthal 1979). Such studies could also indicate the stable or changing role of quarry sites within different settlement systems.

Investigative Procedures. Most quarries are large sites with a high density but low diversity of materials. These conditions enhance the utility of random sampling for surface collection. Artifacts can be collected by grid provenience within sample units. Peripheral, lower density zones should be sampled in addition to core areas. One possible strategy would designate the two zones as separate sampling strata. Another strategy could incorporate long sample transects traversing both zones. These would allow for calculations of continuous changes in artifact and raw material densities. Other strategies, such as the random placement of transects along lines radiating from the core area, also could be appropriate.

Information on the types, density, and quality of raw materials is important in understanding the use of quarry sites. Ideally, surface collections of artifacts should be augmented by assessments of the quantities and distribution of unworked raw materials. This is more easily said than done, since there is a "gray area" consisting of shatter and tested cobbles. Within a subsample of transects or grid units, artifact collection could be followed by the counting or weighing of raw material chunks of different sizes. At AZ T:5:5 (ASU), estimates focused on the numbers of raw material pieces in three size classes (Brown and Stone 1982:82). Raw materials need only be collected for purposes of geochemical sourcing or experimental studies of tool production and use. Even if such analyses are not planned, a sample of raw materials should be collected for future studies.

If geochemical analyses are feasible for the type of raw material, quarry investigations should incorporate such analyses for compositional characterization and sourcing. Geological field studies can produce maps indicating the origin and distribution of raw materials, as well as relationships to other regional formations. A geological field study was useful in the interpretation of the Vulture obsidian source (Brown 1982).

Quarries in the study area are expected to have little depth. However, this expectation should be verified through limited testing, and associated features should be tested.

Ground Stone Quarries

Quarries related to the manufacture of ground stone implements, also known as "macroflake loci", are perhaps the newest addition to the inventory of site types in western Arizona. Earlier archaeologists may not have recognized such sites, which typically incorporate huge flakes, crude debitage, hammerstones, and blanks in various stages of production. Quarries for the production of metates, manos, and other implements have been recently documented in the New River area north of Phoenix (Bruder 1983) and on BLM lands near Bullhead City along the Colorado River (Huckell 1985; Johnson 1981). The BLM is currently funding investigations at the latter loci by archaeologists from the Arizona State Museum.

Only one site, a mano manufacturing area in the Kofa Mountains described by Rogers (n.d.), has been documented in the western Arizona desert away from the major rivers. Archaeologists may have failed to detect such sites. However, these sites may well have been rare in the interior desert. The Phoenix area and Bullhead City sites are believed to have been production areas for implements distributed to sedentary farmers along the major drainages. They also may have been distributed beyond local areas through trade. In the desert, a dominant settlement pattern of high mobility and temporary sites may have favored other, less intensive strategies of ground stone manufacture and use. Such strategies might incorporate the use of bedrock grinding features, portable tools, or cached implements (Spier 1933:129). At base camps, metates seem to have been used until they literally wore out; the fragments were then incorporated into features (Brown and Stone 1982; Doelle 1980). Cobbles and slabs obtained in desert washes could be used with relatively little modification (Bostwick 1984; Gifford 1936:280). The production of implements need not have been confined to localized quarries.

Ground stone quarries might nevertheless be found in areas closest to the rivers, where localized raw materials might have been exploited in response to village demands for implements. It is also possible that particularly good sources, such as the Kofa site described by Rogers, were worked to produce items for trade to riverine villages. The presence of substantial numbers of metates at sites in the Kofas also indicates that "macroflake" loci may yet be found in portions of the western desert.

Research Values. Ground stone quarries are important for the investigation of lithic technology, settlement patterns, and exchange systems. The preliminary research design for the Bullhead City macroflake site discusses a wide range of general and region-specific research problems (Huckell 1985). The technology of ground stone tool production is poorly understood. Questions concern: (1) techniques and tools used in production; (2) differences in the techniques and debitage associated with different end products; (3) special procedures used only in ground stone production; (4) the nature of reduction strategies; and (5) the determination of production failure rates (Huckell 1985:9). Reduction strategies can be compared to ethnographically documented sequences or to strategies employed at other sites in the Southwest. Differences could reflect factors involved in transport or the organization of production.

Settlement studies should focus on the density and distribution of quarry sites in relation to the distribution of raw materials and habitation sites. This information could indicate who used the sites, which raw materials were preferred, and how far finished tools were transported. Where such sites were readily accessible to camps or villages, they may have been sporadically used as needed. Those at a

greater distance may have been the focus of special purpose trips by task groups skilled in ground stone tool production.

It is difficult to date such sites. Huckell (1985:5) suggested that proximate but indirectly associated vessel breaks or trail shrines could be examined to establish tentative cultural/temporal assignments. Temporal frameworks would be useful for studies of change in technology, settlement patterns, trade, and social relations. The technological comparison of prehistoric and historic end products could indicate whether quarries were used in the production of historic building stones. Archival research could indicate the nature and intensity of historic use (Huckell 1985:4).

Finally, one can address the role of ground stone implements in regional exchange networks. Bruder (1983) suggested that implements manufactured in the Hedgpeth Hills area were traded south to large Hohokam sites near the Salt River. The Mohave or their ancestors also may have been involved in the distribution of trade items (Huckell 1985:7-8). Raw material sourcing and distributional studies could reveal patterns of spatial dispersion resulting from long-distance procurement or exchange. A related research issue involves the assessment of surplus production in excess of local needs. This rather complicated procedure would incorporate estimates of settlements and households in the local area, the use-life of implements, and the numbers produced over a period of time (Huckell 1985:6). Experimental, archival, and field data could contribute to these estimates.

Investigative Procedures. Huckell's (1985) research design includes a comprehensive summary of procedures for investigating the Bullhead City site. He suggests that on-site studies should incorporate the following tasks: (1) detailed recording of the composition and technological attributes of a sample of production loci; (2) mapping of these loci; (3) the total collection of a small number of loci; and (4) a search for temporally or culturally diagnostic artifacts in the vicinity of the site. In the laboratory, refitting analyses could contribute to the reconstruction of production sequences.

Both Huckell and Bruder stress the utility of ethnoarchaeological studies and experimental replication for technological analyses. The on-site experimental production of artifacts would enable comparative studies of prehistoric and experimental debitage, useful for reconstructing production techniques and stages. Replication would also offer insights into the labor expended in tool production and transport.

Thin section and trace element analyses should be used for the characterization of different raw material sources, since macroscopic differences may be negligible (Huckell 1985:6). The analysis of museum specimens from known locations could contribute to the distributional tracking of finished products from different quarries. Geological field studies could establish the areal limits of raw material occurrence, beyond which implements may have been transported through trade.

Other Types of Quarries

In addition to the use of quarries for lithic raw materials, Indians also may have exploited localized sources of clay or minerals. No aboriginal "mines" have been discovered in west central Arizona. One would expect to find mineral debris with hammerstones or blocky tools, perhaps in association with temporary camps or trails. Although quarries have not been found, natives are known to have exploited the area's mineral resources. Chrysacholla, found on an archaeological site in the Harcuvar Mountains, may have been one of several raw materials used in the production of rock art pigments. According to Bean and others (1978), the Mohave obtained "crystal" in the Eagletail Mountains. Rogers (n.d.) found that pyrophyllite from the north end of the Kofa Mountains was used in the manufacture of jewelry.

If such sites were found, their investigation could yield information on specialized aspects of prehistoric technology, such as jewelry production. If the raw materials could be sourced through trace element or other analyses, their geographic distribution could reveal patterns of mobility, trade, or long distance procurement.

Aboriginal mineral sources might well escape detection. The removal of quartz crystals, for example, may have generated little debris. Sources may have been exploited infrequently, or sites may have been destroyed by historic mining activity. Rockhounds could offer leads on the location of sites. Archaeologists should trace the distribution of rare minerals at other types of sites, particularly trails. If a mineral quarry is found, data recovery procedures could be based on techniques used in the investigation of prehistoric turquoise mines in the western United States.

Intaglios

These are large naturalistic, anthropomorphic, and geometric designs produced by scraping aside desert pavement to expose lighter colored underlying sediments. These truly mysterious sites have long fascinated the public, but there has been a lack of scientific research. Intaglios vary in size, style, artifact/feature associations, and environmental contexts. There is a wide range of hypothesized functions. Their creation has been attributed to nearly every aboriginal group believed to have occupied the western Arizona desert through time. Since the majority are located near the Colorado River, the most likely creators were the Colorado River Yumans or their ancestors. Horse representations indicate that at least some intaglios were produced during the protohistoric or historic periods. For further information on intaglios, the reader should consult the brief but comprehensive summary authored by Solari and Johnson (1982). This summary includes descriptive and distributional information, discussion of research issues, and management recommendations.

Most known intaglios are located along the lower Colorado River. They have also been found along the lower Gila River and in the desert of southeastern California. Solari and Johnson (1982) listed data on 64 known or reported sites in Arizona and California. These include 17 sites in Arizona, concentrated in the Yuma District of the BLM. Away from the rivers, intaglios are rare. Two have been recorded near the Bill Williams River in the vicinity of Alamo Lake (Rogers n.d.; Stone 1977). Amateur archaeologists recently recorded a site in the Plomosa Mountains, and Harner (1958) mentioned two intaglios near the Bouse

site. Landon (1980) recorded two features at the Jagow Wells complex in the Palo Verde Hills. Additional sites might be found on areas of desert pavement. Their likelihood of occurrence should increase as one approaches the major rivers. Archaeologists might also encounter modern military "intaglios" in areas surrounding World War II training bases. In most cases, configuration and context distinguish these features from prehistoric intaglios.

Research Values. According to Solari and Johnson (1982:417), "basic questions about the intaglios concerning their time of construction, purpose, and creators remain largely unanswered". Proposed functions fall into three categories: (1) trail or boundary markers; (2) ceremonial purposes; and (3) "pure" art.

If intaglios functioned as trail or boundary markers, they could be a significant factor in the investigation of regional land use patterns, travel routes, territorial ranges of social groups, and social interaction processes. Intaglios are frequently associated with trails and trade routes. However, some have no such associations, and it is difficult to assess the contemporaneity of intaglios and trails. It is tempting to interpret the recently discovered Plomosa intaglio as a boundary marker. This feature, located at the western edge of a mountain pass, represents a fisherman. Fish were an important food resource for the Colorado River Yumans, but desert dwellers tabooed their consumption. The location and content of this intaglio seem to support the idea of a territorial marker. Clearly, "additional work is needed to determine precisely how intaglios, habitation debris, and trails of various sorts are spatially associated" (Solari and Johnson 1982:426).

A ceremonial function is indicated by the large size, permanence, and subject matter of intaglios. Some are associated with "dance circles". Solari and Johnson (1982:426) suggested that their scarcity indicates an integrative function, possibly for use in periodic public ceremonies. They noted that although intaglios exhibit few associated artifacts, many sites tend to occur in nearby areas. Furthermore, "because larger groups are most likely to assemble in areas that can support population aggregations, ceremonially used intaglios could be expected to occur near important natural resources close to trails".

Site-specific and regional analyses are needed to test such hypotheses. In addition, archeologists should develop approaches to relative or chronometric dating, such as cation-ratio analysis, the study of formation processes, and the dating of associated ceramics (Solari and Johnson 1982:427).

Investigative Procedures. Archaeologists should view such sites in order to become familiar with their appearance. If an intaglio is found, the surrounding area should be searched for associated sites or trails. The intaglio, as well as associated features and artifacts, should be photographed and mapped in detail. If possible, low-level aerial photos should be taken. It is important to record the environmental context. These basic procedures should be followed at all intaglio sites, whether or not they are imminently threatened. Such sites are rare and easily damaged, and the recorded information can be used for regional and comparative studies. Surface collections, detailed artifact analyses, and experimental chronometric analyses could take place at a later time.

Other Site Types

Many types are very rare or are not expected to occur in the study area. Presently absent are canals, platform mounds, compound villages, ballcourts, and hilltop masonry "forts" generally associated with the Hohokam and Prescott cultures in adjacent regions. Such sites, located in areas where prehistoric populations were more dense and water more abundant, are not expected to occur in the western Arizona desert. However, they might be found in the vicinity of Buckeye or near the mouth of Centennial Wash. As such, they would probably represent the fringe of the Hohokam core area. Isolated or distant occurrences, analogous to the ballcourts southwest of Prescott (Wilcox and Sternberg 1983), should be regarded as especially significant.

Rare sites and features include cleared circles, human burials or cremations, and prehistoric wells. Cleared circles, located in desert pavement zones, are similar to rock rings ("sleeping circles") in size, environmental context, and probable function. In relation to rock rings, they are relatively rare in the study area. Their relative frequency appears to increase south of Bouse and Centennial washes (Effland and Green 1982; Rogers 1966:69; Stone and Dobbins 1982:246). Effland and Green suggested that rock rings and cleared circles may have been used by different ethnic groups, but Rogers attributed the distributional differences to variations in the area of desert pavement surfaces in southwestern Arizona.

Burials and cremations have rarely been reported from west central Arizona, although cremations were discovered at the Bouse site (Rogers n.d.). Cairn burials occur in the California desert, but none have been found in western Arizona. The rare sites with subsurface deposits, such as rockshelters, may yet yield human remains. If recovered, bones should be examined by a physical anthropologist. However, the lack of a large sample would limit the research contribution.

A walk-in well was excavated at the Bouse site (Harner 1958; Rogers n.d.). This well tapped the high water table near the confluence of Bouse and Cunningham washes, at the northern end of the Ranegras Plain. Inverted cone-shaped, walk-in wells were also found at Snaketown (Haury 1976:152). These wells, which were about three meters deep, tapped the high water table near the mouth of Queen Creek. Haury considered this to be a key factor in the location of Snaketown. Similar wells were constructed by the Cahuilla Indians of the California desert (Bean 1978). In the study area, other wells might be found in zones of high prehistoric water tables. They could yield significant information relating to settlement patterns, prehistoric technology, and the role of "oases" in subsistence, travel, and trade. When wells were abandoned, they were used as trash dumps. The excavation of stratified well deposits could thus contribute to the development of ceramic sequences and the reconstruction of culture history (Harner 1958).

CHAPTER 11

VALUES AND USE CATEGORIES OF CULTURAL RESOURCES

According to BLM Manual 8111 (Arizona Supplement), "specific statements of use", derived from one or more of seven "use categories", are to be developed for cultural resources. Such evaluations have two major purposes: the analysis of values associated with cultural resources; and the use of such values as a basis for making management decisions.

These references to "uses" and "values" reflect the literature of land use planning as well as the management directives underlying BLM policies. Values and uses provide the input for management decisions. Certain groups may value resources in different ways, and some types of values may be relatively intangible. Land use planners must consider a broad range of complementary and conflicting values (Lounsbury, Sommers, and Fernald 1981).

The American Heritage Dictionary defines a "value" as "a principle, standard, or quality considered worthwhile or desirable". The seven BLM use categories are based on several values commonly assigned to cultural resources. The following definitions, with guidelines for the development of site-specific statements, are taken from BLM Manual 8111.

Current Scientific Use. This means that "a cultural property is the subject of an ongoing scientific study or project at the time of evaluation". Specific statements of use are based on information, proposals, and data recovery plans obtained directly from professional researchers. Such statements should include the identification of research objectives, research personnel, recovery techniques, and time required to accomplish the work.

Potential Scientific Use. This signifies that "a cultural property is presently eligible for consideration as the subject of scientific or historical study utilizing research techniques currently available, including study which would result in its physical alteration, and it need not be conserved in the face of an appropriate research or mitigation proposal". Specific statements are to be based on the potential to yield information relevant to research issues and objectives discussed in "Class I" overviews or other background documents.

Conservation for Future Use. "Because of scarcity of similar cultural properties, a research potential that surpasses the current state of the art, singular historic importance or architectural interest, or comparable reasons, a cultural property is not presently eligible for consideration as the subject of scientific or historical study which would result in its physical alteration". Furthermore, "it is worthy of segregation from other land or resource uses which would threaten the maintenance of its present condition, and it will remain in this use category until specific provisions are met in the future". Specific statements are again based on evaluations of site types, research issues, and scientific goals discussed in overviews or other regional background documents.

Management Use. This signifies that "a cultural property is eligible for controlled experimental study which would result in its physical alteration, to be conducted for purposes of obtaining specific information leading to a better understanding of kinds and rates of natural or human-caused deterioration, effectiveness of protection measures and similar lines of inquiry which would ultimately aid in the management of cultural properties". Specific statements should identify the particular information requirements, procedures, and management objectives for such studies.

Socio-cultural Use. This "means that a cultural resource is perceived by a specified social or cultural group as having attributes which contribute to maintaining the heritage or existence of that group, and is to be managed in a way that takes those attributes into account". Specific statements require the assessment of socio-cultural values, based on several factors: (1) "the nature of the socio-cultural value which occasions the use"; (2) the identity of the relevant group; (3) "the nature of the use made of the property related to the value"; (4) "the percent of the group participating directly and/or indirectly in the use of the property"; (5) "the length of time the group has associated this value with the property"; (6) "the uniqueness of the property as a source of this value"; (7) the property's relationship to "the survival of the value or the group"; and (8) "the intensity of the emotional attachment of the group" to a particular site.

Public Use. This means that "a cultural property is eligible for consideration as an interpretive exhibit-in-place, a subject of supervised participation in scientific or historical study, or related educational and recreational uses by members of the general public". According to the guidelines, "public use is oriented toward cultural resource protection through improved public awareness", and specific statements are to identify measures for the enhancement of public use opportunities.

Discharged Use. A cultural property "no longer possesses the qualifying characteristics for that use or for assignment to an alternative use, or that records pertaining to it represent its only remaining importance, and therefore its location no longer presents a management constraint for competing land uses". Such sites might include those known to have been destroyed or those which have been adequately investigated scientifically. Specific statements should incorporate relevant information.

CURRENT SCIENTIFIC USE

The number of such sites will vary through time in response to the amount of fieldwork conducted by professional archaeologists. Most work will probably continue to be associated with large construction projects, such as the building of water delivery systems, roads, or transmission lines. Thus the number of sites assigned to this category

will increase drastically during certain periods, with intervening times of relative inactivity.

Management procedures should focus on two activities: assistance and monitoring. The Phoenix District Office of the BLM maintains a library of maps, site files, and published and unpublished references which together represent a centralized resource for archaeologists working in Arizona. These records should be updated and maintained, and BLM archaeologists should make this information available to researchers.

Monitoring tasks should incorporate visits to work in progress at sites. Such visits should establish that work is proceeding in a satisfactory manner, primarily since most work of this type is done under a cultural resource use permit. Such visits should also familiarize BLM archaeologists with the nature of the resource base and the effectiveness of new recovery procedures. Monitoring also incorporates the task of reviewing research designs, proposals, and reports, sometimes done in response to requests from archaeologists in other federal agencies. The Class I overview should be one tool used in such evaluations, but the range of targeted research problems need not be limited to those issues discussed in the overview. Many sites listed under current scientific use will later fit into the discharged use category.

POTENTIAL SCIENTIFIC USE

The primary value of most cultural resources rests in their existence as repositories of information for scientific archaeological research. In general, this value applies to nearly all site types and specific sites, unless they have been irretrievably damaged by natural or cultural processes. The category of potential scientific use thus incorporates more sites than any other use category.

Plog (1981:159) recommended that research values be defined in regional contexts with the aid of comprehensive overviews. He also suggested that specific evaluations of research importance be based on the nature of the research problem and the abundance of sites at which certain problems can be pursued. In west central Arizona, sites will vary in their relevance to a limited versus broad range of research problems. Five general research domains have been defined for west central Arizona: (1) culture history (chronology and cultural affiliations); (2) settlement patterns, land use, and subsistence (cultural ecology); (3) social interaction, frontiers, and boundaries; (4) lithic resource use; and (5) paleoenvironmental reconstruction. The vast majority of sites in the region can be expected to yield information relevant to the study of cultural ecology and lithic resource use. Fewer sites are likely to be relevant to the study of interaction and frontiers. Many lithic scatters and limited activity sites would not illuminate this research issue. Only a small proportion of sites is expected to yield information on culture history and paleoenvironments. Sites with information potential for all five research issues are likely to be rare and particularly important. This does not mean that all rare site types will contain data relevant to a broad range of research problems. Yet in general, rare site types will be quite valuable in view of their potential contribution to research problems that cannot be examined at many other sites.

The research values associated with particular site types are discussed in Chapter 10. Although nearly all possess research values, certain site types possess exceptional value by virtue of their unusual character, relevance to a broad range of research issues, or potential contribution to the resolution of particularly difficult problems such as chronological data gaps. Examples of particularly important site types are listed below:

1. Sites with subsurface deposits, especially stratified deposits or buried features. Caves and rockshelters with perishable remains.

2. Sites with the potential to yield organic or datable remains. Stratified sites, caves and rockshelters, sites with roasting pit or hearth features, fossilized packrat middens.

3. Sites with inorganic datable or diagnostic remains, including obsidian (potential hydration studies), diagnostic projectile points, decorated ceramics, or patinated lithics (cation ratio dating).

4. Preceramic (not just aceramic) sites: those with patinated lithics or diagnostic Paleoindian or Archaic artifacts.

5. Potential "base camps": multiple activity sites apparently occupied for more than a single, temporary stop; those with potential depth, a very high density or diversity of artifacts, or discrete activity areas.

6. Sites with a variety of ceramic types.

7. Sites with probable trade items, such as shell or Hohokam axes.

8. Sites with a variety of non-local lithic materials.

9. Trail networks in localized areas.

10. Large, localized quarries for chipped or ground stone.

11. Water/soil control features.

12. Intaglios.

13. Large petroglyph sites with evidence of long-term, repeated, or Archaic use.

14. Pictograph sites.

15. Prehistoric wells.

16. Prehistoric masonry structures.

17. Hohokam sites of the Pioneer period.

18. Protohistoric, historic aboriginal, or Yavapai sites, identified as such from diagnostic materials, chronometric dates, documentary sources, or native informants.

19. Very rare types which may be more abundant in adjacent regions, for example prehistoric canals, platform mounds, or ball courts. Special actions should be taken if these or other "new" site types are discovered in the study area. Appropriate protection measures, including the temporary curtailment of other land use activities, should be instituted. Such sites should be mapped and viewed in consultation with knowledgeable consultants or representatives of the State Historic Preservation Office. Their input can aid in the development of more specific plans for protection or data recovery.

Although more commmon site types such as low density lithic scatters, isolated rock rings, single trail segments, and artifact scatters with no diagnostic materials are not included in the above list, they are relevant to the resolution of many research issues addressing the nature of land use patterns and lithic resource use. Sites on the above list, such as stratified rockshelters, might contribute to the development of a regional chronology, but they still represent only a limited picture of settlement and subsistence systems operating in the region.

CONSERVATION FOR FUTURE USE

Sites assigned to this category might include rare properties from the list of "particularly important" types or those with "a research potential that surpasses the current state of the art". Relatively few sites would be assigned to this category, since it applies to rare sites and situations justifying active, direct protection measures.

The second criterion for assignment, that of research potential surpassing "the current state of the art", is difficult to assess. If one assumes that archaeological methods and techniques will continue to become more sophisticated, then this criterion could apply to all sites in theory. It is difficult to predict the course of future innovations in recovery methods or analytical techniques. However, past experience indicates the probable development or refinement of techniques for the dating and physical and chemical characterization of sediments, raw materials, and artifacts. Sites containing multiple classes of data, particularly large base camps or stratified sites with good preservation, are obvious candidates for this category of site use. Site types which justifiably could be assigned to "conservation for future use" include the following: (1) trail systems (future development of remote sensing techniques); (2) relatively undisturbed cave or open sites with stratified deposits (physical or chemical analyses of soils, features, or organic materials; use of remote sensing techniques; new techniques for the recovery of organic materials or the assessment of minute stratigraphic changes; (3) possible farming areas associated with sites (see (2)); and (4) intaglios, multicomponent petroglyph sites, and lithic scatters with artifacts exhibiting different degrees of patination (development of techniques for relative or chronometric dating of desert varnish, such as cation ratio dating).

"Conservation for future use" requires a management strategy of active protection. This special status, which could be reinforced through nomination to the *National Register of Historic Places*, can enhance the conservation of very important sites. However, managers must weigh the costs and benefits of preservation against an assignment to the category of "potential scientific use" where a site "need not be conserved in the face of an appropriate research or mitigation proposal". For example, it may be difficult or costly to protect a site that is remote yet known to be threatened by vandalism or erosion. Data recovery should be considered in such cases. It may be wise to conserve rare types of sites that have recently been investigated in adjacent regions. The results of such investigations could be used to formulate refined research goals or procedures expressed as special provisions to be met before the site could revert to another use category.

The Eagletail petroglyph site (AZ S:11:1 (ASM)) is a rare and important resource worthy of assignment to the conservation category (Stone 1986). Sites similar to the Bouse site, with stratified deposits, wells, and numerous trade items, would also be obvious candidates for this use category.

MANAGEMENT USE

Controlled experimental studies may be devised and implemented in order to determine the specific effects of land use activities or natural processes on the integrity of archaeological sites. Such studies could contribute to land use planning and the development of effective protection measures. They could also contribute to archaeological research on "site formation processes" and the evaluation of post-depositional impacts (Schiffer 1983; Wildesen 1982). Physical and spatial alterations through time can affect the validity of archaeological interpretations. It is helpful to understand such changes in order to reliably compare sites and to interpret the activities and processes resulting in their creation.

Management studies thus represent a valid use of archaeological sites. However, the number of cases should be minimized and well documented in order to avoid unwarranted destruction of sites. Emphasis should be placed on gaining information for both scientific studies and the development of protection strategies. Thus, management studies should incorporate the following general procedures: (1) the careful selection of sites assigned to this use category; (2) the development of clearly defined goals and procedures; and (3) the dissemination of results among land management agencies in order to avoid duplications of effort. Finally, managers should consider the use of experimental rather than real sites in such studies. Roney (1977) "constructed" a lithic scatter for an investigation on the effects of livestock trampling. His study was thus well controlled. In addition, he was able to locate his "site" in order to evaluate the worst case effects of heavy livestock use.

Sites assigned to this type of use should not include rare types or those listed as possessing particularly important research values. Appropriate types would include relatively abundant sites such as artifact scatters, low density lithic scatters, or rock features. Possible base camps, or multiple activity sites revisited over a long period, should not be assigned to this use category. Unsampled portions of previously investigated sites could be assigned to management use. An example would be AZ S:8:5(ASU), also known as AZ S:8:1(ASM). This extensive lithic scatter, located in the Harquahala Valley, was sampled and analyzed over the course of three different archaeological projects (Antieau 1976; Brown and Stone 1982; Carrico and Quillen 1982). Previously investigated trail segments could also be incorporated into management studies.

Examples of management studies include Roney's (1977) analysis of livestock trampling and a recent BLM study of the effects of reseeding equipment on an artifact scatter in

southern Arizona (Barger 1987). Studies should focus on the evaluation of specific impacts, with attempts to control for the effects of other variables. Specific impacts could include livestock trampling, ORV traffic, the use of mechanized equipment, vegetation removal, or sheetwash erosion. Plans should specify the particular areas and types of impacts; the information to be recorded; a schedule for short-term or long-term monitoring, depending on the nature of the study; and procedures for post-impact analysis. Pre-impact data recovery should include detailed mapping of artifacts and features, as well as on-site analysis of artifact types, sizes, and raw materials. Post-impact analyses should focus on the extent of horizontal and vertical movement of artifacts as well as damage to artifacts and features.

Alternative study designs could be employed. Changes in single plots could be monitored over time, with periodic mapping. Single plots or sites could also be subjected to short-term studies involving the use of particular types of mechanized equipment, with pre-impact and post-impact phases of analysis. An alternative design could incorporate the comparison of impact and control plots. One could compare protected (fenced) plots with plots subjected to varying degrees of impact. Such a design could be used for relatively long-term studies. Follow-up studies could be designed to test the effectiveness of specific protection measures.

SOCIO-CULTURAL USE

By definition, socio-cultural values contribute to maintaining the heritage or existence of a particular social or ethnic group. Such values, although relatively intangible, are an important component in land use planning and analysis (Lounsbury, Sommers, and Fernald 1981:79). Native Americans, the occupants of west central Arizona for thousands of years, regard the land, its resources, and its archaeological remains with great reverence (Bean et al. 1978).

For Native Americans, the significance of cultural resources can range from the continued use of specific areas for religious or economic purposes, to a more general desire to preserve the remains left by predecessors. Specific tribes which historically occupied the study area, such as the Yavapai, can be expected to have the most direct interest in the area. However, other Yuman and Piman groups, including the Mohave, Maricopa, Pima, and Papago, used and traversed west central Arizona. They too have an interest in its cultural resources. Archaeological sites need not be associated with direct tribal ancestors in order to hold significance for Native Americans. It is likely that many "ancestral" groups interacted and shared the use of particular trails or resource zones. They may have been bound together in large-scale systems of social and economic interaction. Thus it is a fallacy to argue that Yavapai should only be interested in Yavapai sites, with little regard for Hohokam or other remains. To many Native Americans, archaeological sites represent the contrast between modern society and the traditional Indian existence. This attitude was expressed in a letter sent to the BLM by a Papago man:

> We must leave something to remind us that other Tribe of People were inhabitants of this region with a different way of live (sic). Long after I am gone my generation will look upon the ruins of my ancestors and will ask, what will have been our way of live today if the inquisitive minds of men had not changed this form of environment.

Recent legislation has provided a legal basis for the consideration of Native American socio-cultural values in land management decisions. *The Archaeological Resources Protection Act of 1979* required the notification of interested tribes when permits are issued for archaeological work on Federal land.

Several site types and zones of spiritual or cultural significance have been documented by ethnographers. In conjunction with the planning of transmission lines, ethnographic studies of Native American values were conducted by Bean et al. (1978). Consultants interviewed urban and reservation Indians and solicited attitudes toward the western Arizona environment and the effects of construction projects. They cautioned that Indians may have been unwilling to reveal locational details for fear of jeopardizing sacred sites or religious secrets.

Native concerns about cultural and natural resources tended to be expressed in terms of environmental zones rather than specific sites. Bean et al. (1978:6-92) stressed that "land is the physical and symbolic context of the very existence of the Yavapai . . . profound religious meaning is indelibly attached to Yavapai land and its mountains, plants, and animals". To the Indians of southwestern Arizona, mountain ranges were particularly important areas. Mountains housed spirits and important game animals of sacred significance, such as the bighorn sheep. Yuman myths were grounded in networks of topographic features (Kroeber 1951; Spier 1933). Important peaks were connected by "strings" along which men traveled during the "dream experience". At each peak, spirits revealed the specific cures associated with that locality. For the Maricopa, these circuits incorporated mountains as far away as Prescott, Flagstaff, and Needles (Spier 1933:247).

Native Americans listed the following ranges as important areas: the Big Horn Mountains, the Eagletails, the Kofas, the Gila Bend Mountains, and the Palo Verde Hills. The studies did not incorporate areas further to the north. It is likely that additional ranges, such as the Harquahalas and Harcuvars once occupied by the Yavapai, were also significant zones. The Palo Verde Hills, Gila Bend Mountains, and Eagletail Mountains had pan-tribal significance, as they were mentioned by Yavapai, Maricopa, Papago, and Pima. Land claims records indicate that the Maricopa and Pima utilized these areas as supplemental resource zones and bighorn hunting ranges (Ezell and Ortiz 1962). The bighorn sheep was a sacred animal to the Maricopa (Spier 1933:69). Court House Rock in the Eagletails was mentioned as a sacred site.

Site types of special cultural significance included rock art, intaglios, caves and rockshelters, trails, trail shrines, cremations and burials, and mineral sources. To the Indians, "each and every rock art site" has religious value (Bean et al. 1978:7-14). Of the urban Phoenix Indians interviewed in

the Bean study, nearly half identified the Eagletail Mountains as a sensitive rock art zone.

The Palo Verde Hills complex of trails, petroglyphs, and other features (Landon 1980; Stein 1981; Trott 1974) was mentioned as a sacred area by Yavapai, Maricopa, and Papago. The trails were said to be links of spiritual power in a sacred network, with an intaglio symbolizing a spirit living in the Kofa Mountains (Bean et al. 1978:7-40). Other specific sacred areas included a mesa with petroglyphs near Arlington, the Tonopah hot springs north of the Palo Verde Hills, and the alluvial flat between the Palo Verde Hills and the Gila Bend Mountains.

Additional information on socio-cultural values is needed in order to best incorporate Native American concerns into the process of planning and land management. Attempts to obtain such information may be hampered by a lack of detailed knowledge by younger informants or by an understandable reluctance to discuss such matters with government officials. BLM Manual 8111 lists eight criteria for the development of specific statements of socio-cultural use; these have been listed at the beginning of this chapter. From the preceeding discussion, it is obvious that many of these criteria will be difficult to evaluate. This is particularly true for the following: "the percent of the group participating directly and/or indirectly in the use of the property"; "the length of time the group has associated this value with the property"; and "the relationship of the property to the survival of the value or the group". In western Arizona, a lack of detailed information or known current use should not be interpreted as a lack of socio-cultural values attached to cultural resources.

Alternative approaches are available for obtaining additional information on socio-cultural values. These include the following: (1) ethnographic research through interviews with native informants and knowledgeable social anthropologists; (2) the use of native consultants in the interpretation of archaeological sites; and (3) archival research of unpublished ethnographic notes, land claims records, historic U.S. Army journals, or other sources.

The best native informants would be tribal elders, traditionalists, oral historians, or practitioners of traditional crafts. Contacts should be established through tribal councils or anthropologists respected by the Indians. Interviews should be conducted in the near future, since many elderly informants will be gone ten years hence. Native consultants should receive adequate payment for their services.

Many archaeological projects in southern Arizona have employed native consultants. Papagos have participated in ethnoarchaeological studies of natural resource exploitation (Doelle 1976, 1980). Bruder (1983) consulted a Papago artist and Yavapai elders in the interpretation of the rock art at Hedgpeth Hills. Pilles (1981) interviewed Indians for his discussion of Yavapai archaeology. Such sources have been quite helpful, although they may introduce elements of bias or conjecture into an analysis.

Euler (1981) advocated use of the direct historic approach, involving the study of historic aboriginal sites and those said to have been occupied by ancestors. It may not be possible to find Yavapai informants who can identify specific habitation sites in the desert of west central Arizona, and historic aboriginal sites are rare or difficult to distinguish from those of earlier periods. The direct historic approach is probably more feasible for the Hualapai reservation or for sites closer to the Colorado River.

Professional native consultants have appeared in some areas of the Southwest. Despite the help that they can offer, scientists or managers should be cautious in obtaining information from a single source. In addition, such business ventures may be controversial in the native community.

Management procedures should incorporate the following actions: (1) the continued inventory of socio-cultural values; (2) consideration of these values in all phases of the planning process and preparation of relevant documents; (3) notification of tribes in regard to permits issued for archaeological investigations (required by law); (4) the protection of sites or complexes of known ethnic significance; (5) the granting of free access to sites of religious significance (required by law); (6) the granting of access to traditional collecting areas; (7) encouragement of Native American participation in programs that interpret their culture and history; and (8) encouragement of Indian participation in the Student Conservation Aide program. Copies of research reports should be sent to tribes, and researchers should be urged to prepare alternative, less technical interpretive reports for tribal libraries or use in museum exhibits.

PUBLIC USE

Cultural resources may be used as interpretive exhibits or as subjects of supervised, nonprofessional participation in scientific studies. For a site or group of sites to qualify as an interpretive exhibit, several conditions should be met. Sites should be accessible and interesting to the public, and they should be adequately protected. In the absence of frequent or constant monitoring, sites put on display will likely be damaged by vandalism (Bruder 1983; Solari and Johnson 1982). Fences alone may not adequately protect an accessible display. Bruder (1983) discussed a BLM experiment near Bishop, California. A popular "Petroglyph Loop" tour was established with roads, signs, and brochures, but inadequate surveillance led to increased vandalism. However, in New Mexico the BLM had some success with a form of indirect monitoring. Sign-in boards, welcoming visitors and advising them of periodic surveillance, were placed at stabilized sites, and there was a subsequent decrease in vandalism. The best protection, obviously, is achieved through the establishment of parks with on-site museums and full-time attendants. The high cost of establishing such a facility would have to be justified by a healthy visitation rate.

Away from the rivers in the desert of west central Arizona, few archaeological sites would be expected to satisfy the combined criteria of accessibility, visual appeal, and economically feasible protection. Many sites are located in remote or rugged areas, and the public is unlikely to be enticed by low density artifact scatters and isolated rock rings. There is a lack of famous or important excavated sites. In general, the opportunities for direct display are limited. In terms of public interest in viewing sites, the

most appropriate types for display would include accessible rock art and intaglio sites, or areas with combinations of these and other features. Such sites have an intrinsic visual appeal as well as an air of mystery. However, sociocultural values are likely to conflict with their use as public exhibits, since these site types often have sacred significance to Native Americans (Bean et al. 1978). One such area, a collection of trails and other features in the Palo Verde Hills, has been suggested as a suitable area for protection and public display. Landon (1980) described the area's educational potential in these terms:

> There, side by side on the desert would be the evidences of differing approaches to human life support. To the east, the nuclear generating station which will send vast amounts of energy to use locations up to hundreds of miles away. To the west, the small hunting, meeting and camping ground of two prehistoric cultures which were involved in a very delicate, local chain of life-sustaining processes: the locating and hunting of game, which was sustained by an abundance of vegetation.

Although few sites in the study area are appropriate for public display, its cultural resources have interpretive and educational value. The archaeology is interesting if unspectacular. In Arizona, there is a strong public interest in cultural resources as evidenced by the ongoing development of archaeological and historical parks in Yuma, Gila Bend, Globe, and Winslow. Public education to foster responsible attitudes toward cultural resource preservation should be an aspect of recreational and public relations programs.

Managers should consider innovative and economical approaches to the development of interpretive displays. Interpretive materials, such as artifacts, photos, graphics, and publications, could be displayed at local museums, libraries, or schools. Display cases could be set up at recreation areas or highway rest stops. In the late 1970s, the Burnt Mountain rest stop on Interstate Highway 10 offered a display on the archaeology along the Granite Reef Aqueduct. Displays or speakers should stress the nonrenewable nature of cultural resources, the need for conservation, and the existence of antiquities laws.

If in reasonably good condition, highly accessible and well known sites should be developed as interpretive displays. An example would be the Granite Wash petroglyphs and bedrock mortars at the edge of the highway through Granite Wash Pass near Salome. At such sites, data recording or recovery could be followed by the placing of interpretive and antiquities law signs and a sign-in book. Such work would be accomplished in conjunction with an outdoor recreation planner. Fencing would be up to the discretion of the display designer, who should consider the potential for vandalism. Solari and Johnson (1982:429-431) developed recommendations for the selection, development, and protection of intaglio sites for public visitation.

Existing parks and recreational areas offer a promising potential for interpretive displays. Museums or displays could be developed through interagency cooperation at such areas as Alamo Lake (a state park). Alamo Lake, a family recreation area with good facilities and access, is also an area of great archaeological and historical interest. It was utilized intensively by prehistoric and historic Indian groups. In addition, early Spanish explorers and American military surveying expeditions passed through the area. It also contains many historic mines and ghost towns.

An innovative approach would be the development of simulated archaeological sites at such areas as Alamo Lake. Brush structures, trails, intaglios, and activity areas could be constructed and displayed with interpretive materials. These could also serve experimental purposes, yielding information on such phenomena as construction techniques, trail formation processes, or desert pavement regeneration. Such displays would involve yearly maintenance costs.

Several themes could serve as the focus for interpretive displays. Ideally, these would link prehistoric and historic use of the western Arizona desert environment. An ecological theme could focus on human survival strategies in the desert, with an emphasis on the use of natural resources and changes in use patterns over space and time. Such a theme could promote not only cultural resource values but also an appreciation for the management of natural resources. Interpretive programs could incorporate wildlife management, BLM burro roundups, restoration of riparian zones, and management issues. Such a program could represent good public relations for the concept of multiple use management.

Another theme could describe use of the desert as a travel corridor through prehistoric and historic times. Interesting aspects would include the networks of prehistoric trails; the continued use of these routes during historic and modern times; the Spanish and U.S. Army expeditions; the experimental use of camels by the army; the rigors of stage travel; and the construction of the railroads and first highways. Displays might include the reconstruction of stage stations such as Cullen's Well, the "desert lighthouse" near Wenden.

Yet another theme could focus on human use of geological resources, a type of land use important to both prehistoric and historic populations. Relevant aspects would include Indian use of minerals for pigments and lithic raw materials for the manufacture of stone tools; the history of mining; the nature of life in early mining settlements; and ghost towns as evidence of the boom and bust cycle associated with the history of mining.

Another aspect of public use is the supervised participation of non-professionals in scientific studies of cultural resources. Participants might include organized societies of amateur archaeologists; field school students; community groups with an interest in historic preservation; or interested scientists from disciplines other than archaeology (such as astronomers interested in the documentation of petroglyph sites). Projects could be either directly supervised or monitored by BLM archaeologists. Monitoring tasks should incorporate communication with project directors as well as field visits.

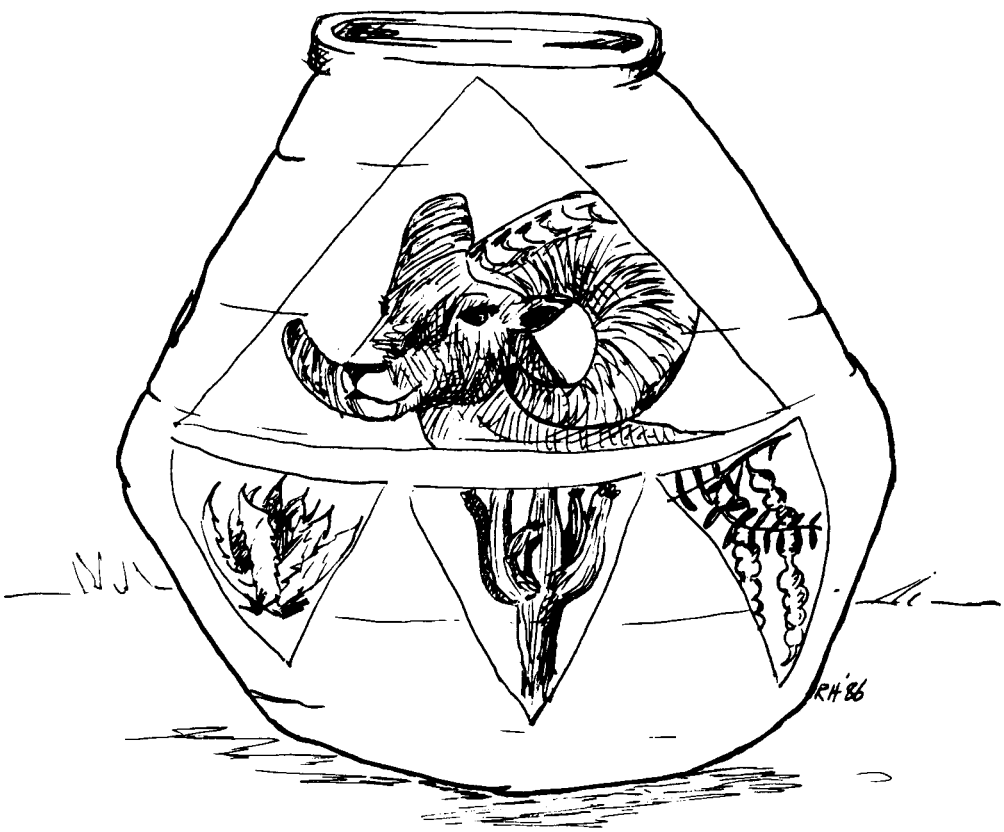
Projects could focus on the recording of rock art sites or the mapping of intaglios or complexes of features and trails. This work would be valuable and would minimally affect

such sites. Managers might direct such work toward the most threatened sites. Obviously, proper permitting procedures should be followed, and emphasis should be placed on the use of scientific methods of data collection. Publication of results should be encouraged.

Arizona has many chapters of dedicated amateur archaeologists advised by professionals. In some areas of the state, such as west central Arizona, there are few organized groups. However, there may be "enlightened" amateurs interested in surveying and recording archaeological sites on public land. By use of careful, scientific methods, these people can contribute to the regional data base. The BLM could issue letters of authorization to such individuals, with the following stipulations: (1) they should not excavate or disturb sites or make any collections; (2) they should make detailed records available to the BLM District Archaeologist; (3) they should specify in writing the particular area surveyed or recorded, the basic nature of the work, and when the work was accomplished; (4) they should not publicize site locations; and (5) they should report any cases of vandalism. Such activities should be monitored by BLM resource area archaeologists, who should offer advice on proper recording procedures and the use of BLM forms. Letters of commendation could be issued to reward good work.

DISCHARGED USE

This use category represents a loss of status in an alternative category. It should be applied with great discretion, since application means that a site's location "no longer presents a management constraint for competing land uses". It could be applied in cases where sites have been destroyed or damaged to the point that they have little remaining value for scientific study or interpretive display. "Discharged" sites could also incorporate those from which data has been scientifically recovered according to a mitigation plan approved by appropriate officials, cultural resource managers, and professional archaeologists. It is possible that a highly significant site could be investigated yet retain its value for further, more sophisticated or confirmatory studies in the future. The Hohokam site of Snaketown is an example of an important site investigated at several times by different people (Gladwin et al. 1938; Haury 1976; Wilcox, McGuire, and Sternberg 1981). Such sites could be assigned to the category of "conservation for future use".



CHAPTER 12

THE DETERIORATION OF THE RESOURCE BASE: MODERN LAND USE AND NATURAL PROCESSES

Archaeological sites can be modified or damaged by human activities and natural environmental processes. In making management decisions, cultural resource managers need to consider the nature and severity of impacts, the history of regional land use, and projected future land use patterns.

Table 12-1 lists agents of deterioration or destruction of cultural resources. Human activities and natural processes can be closely interrelated. Ground disturbance by various activities can contribute to erosion. Using historic case studies, Dobyns (1981) argued that road and railroad construction, mining, woodcutting, and grazing contributed directly to arroyo cutting and loss of riparian habitat in the Sonoran Desert. He also described a historic catastrophe in the study area, the 1890 flood caused by the collapse of the poorly constructed Walnut Grove Dam following a period of heavy rainfall (Dobyns 1981:186). This flood literally scoured the Hassayampa River from the dam to its mouth, possibly destroying archaeological sites as well as the riparian environment.

Many human activities result in the construction of roads. Any increase in the size and density of the road network is likely to increase access to cultural resources and thus to contribute indirectly to their destruction.

Giorgi and Bayer (1981) reviewed the site files in order to determine the condition and sources of deterioration of sites in the overview study area. Although documentation was often poor, they found a "good resource base which has not yet been severely impacted". Out of 326 sites, 36% were relatively undisturbed; 12% were in fair condition; 14% were very disturbed; and the condition of 38% of the sites was unknown. Erosion accounted for most of the damage to sites, followed by ORV and road damage, grazing, and vandalism.

In general, subsequent survey data have supported the low incidence of heavily disturbed sites. The low visibility of many surface scatters, as well as their occurrence on stable desert pavement surfaces, have contributed to their preservation. However, these sites and landforms are fragile, and few have escaped minor impacts from erosion and other factors. Damage has probably been more extreme in certain environmental zones and in areas more accessible to human populations. Adverse impacts are likely to increase with continued population growth and use of the western desert.

THE NATURE OF IMPACTS IN THE STUDY AREA

Real Estate Development

Clearing and construction pose obvious threats to cultural resources. However, for specific projects, adverse impacts can be minimized or directly managed through preliminary planning, avoidance, intensive survey, and scientific data recovery. Surveys should incorporate a buffer zone around the area of direct impact, since associated traffic or erosion are likely to damage cultural resources.

This arid, sparsely populated region is traversed by many transportation routes and transmission facilities linking major population centers. More such projects may be planned as urban populations continue to increase. Additional transmission lines may radiate from the Palo Verde Nuclear Generating Station southeast of Tonopah. Facilities viewed as dangerous or unaesthetic in urban environments, such as hazardous waste dumps or power plants, might be placed near major transportation routes in the relatively uninhabited desert. Finally, population growth may well extend to the small desert towns in the study area, perhaps not due as much to economic development as to an influx of retirees who reject urban living. As settlements expand, increased road construction and recreational use may threaten formerly inaccessible cultural resources.

Construction projects will probably be concentrated on lower bajadas and flatlands with a relatively low density of cultural resources. They will likely be located near areas already surveyed for previous projects, a situation useful for planning purposes. New linear rights-of-way may well follow existing lines. Nevertheless, construction projects will probably impact basin artifact scatters as well as sites located near major drainages. Transmission facilities may affect a broader range of sites, since they sometimes traverse different environmental zones including mountain passes. The consideration of cultural resources should be incorporated into the early phases of the planning process.

Agriculture

Mechanized farming, with its associated leveling, contouring, and plowing, is very destructive to cultural resources and particularly to surface remains. These activities disturb spatial and stratigraphic integrity (Lewarch and O'Brien 1981; McGuire and Schiffer 1982:399; Wildesen 1982). Substantial portions of the McMullen and Harquahala valleys, consisting primarily of private lands, have been placed under cultivation. In the past decade, large areas of the Ranegras Plain and Butler Valley have been cleared for agricultural purposes. The eastern boundary of the study area touches the intensive agricultural zone surrounding the Gila River at Buckeye. None of these areas were systematically surveyed prior to cultivation, because they were on private land.

Several factors may contribute to increased agricultural development in the western Arizona desert. Farms formerly depended on the increasingly costly pumping of groundwater. The availability of Central Arizona Project water, distributed in such areas as the Harquahala Valley Irrigation District, may stimulate further development. An

TABLE 12-1

LAND USE PRACTICES AND NATURAL PROCESSES THAT CAN CONTRIBUTE TO THE DETERIORATION OF CULTURAL RESOURCES

I. Land Use Activities

A. Real Estate Development
   1. Construction of housing or other structures.
   2. Industrial construction: power plants, raw material or waste storage facilities, etc.
   3. Use of linear rights-of-way: construction of roads, transmission lines, pipelines, aqueducts, etc.

B. Agriculture
   1. Clearing, leveling, and contouring.
   2. Plowing and cultivation.
   3. Construction of water delivery systems.

C. Livestock Grazing
   1. Trampling.
   2. Construction of range facilities: tanks, fences, etc.
   3. Revegetation projects.

D. Land and Resource Management
   1. Watershed improvement projects.
   2. Improvement of wildlife habitats.
   3. Fire control activities.

E. Mining and Energy Development
   1. Modification or removal of the surface through exploration and claim development.
   2. Quarrying of desert pavement or gravel.
   3. Associated road construction.
   4. Geothermal energy development.

F. Recreation
   1. Use of off-road vehicles (ORV's).
   2. Hunting, hiking, camping, etc; inadvertent disturbance.
   3. Rockhounding.
   4. Construction of recreation facilities.

G. Vandalism and Theft

H. Military Activities

II. Natural Processes

A. Erosion
   1. Sheetwash.
   2. Arroyo cutting, headward and bank erosion.
   3. Flash flooding.

B. Weathering and Decay

C. Wildlife Damage
   1. Trampling and trail formation.
   2. Burrow excavation.

D. Catastrophic Events

additional impetus may result from the continuing conversion of agricultural land to residential and industrial property in urban areas.

Farms are likely to incorporate lower bajada zones thought to have a relatively low density of cultural resources. However, agricultural development is also likely to destroy relatively rare and significant sites located near major washes, such as Archaic base camps, prehistoric wells, and sites similar to the Bouse site (Harner 1958; Rogers n.d.). The destruction of these and other types of sites would severely limit the information concerning prehistoric use of an important natural resource zone. Agricultural development thus poses a critical threat to the cultural resource base, in areas where much information already may have been destroyed. The threat is intensified by the fact that lands developed for agriculture are generally privately owned.

Livestock Grazing

Historically, much of the region has been used as range land. In 1982, the Phoenix District Office of the BLM prepared a draft grazing environmental impact statement for the Lower Gila North planning area. This report recognized the potential adverse effects on cultural resources from continued grazing (BLM 1982:82). The construction of range facilities can destroy or otherwise directly affect the integrity of sites. Soil erosion can be aggravated by heavy grazing (BLM 1982:46). A pervasive threat is posed by trampling and erosion, processes which result in the breakage and displacement of artifacts and the deterioration of features.

The availability of forage plants has affected the relative intensity of grazing in different portions of west central Arizona. Riparian zones along major drainages have received the most intensive use. Other areas of relatively heavy use include the Aguila Valley; the creosote flats of the Hassayampa Plain, Tonopah Desert, and Harquahala Valley; the chaparral in the Harcuvar Mountains; and the southeastern portion of the Big Horn Mountains (BLM 1981). Upper bajada paloverde-saguaro communities have been the least affected by grazing. Greater damage to cultural resources can be expected in areas subjected to more intensive levels of grazing, especially where less stable soils are more sensitive to erosion. This is particularly true for areas of high and frequent use surrounding natural and constructed water sources. Areas near springs, natural tanks, and major drainages are likely to contain relatively high densities of archaeological sites including base camps.

Some information is available on the effects of trampling in areas of high livestock traffic. In an experimental study, Roney (1977) placed 50 obsidian artifacts in a quarter acre cattle corral. The type, size, and position of the artifacts were recorded prior to disturbance. After a period of 1311 "bovine hours", the artifacts were remapped and recovered. Of the 95% of artifacts that were recovered, 62% sustained little or no damage. A fifth of the artifacts were "severely damaged". Some were broken in half, while others suffered the removal of flakes and "microflakes". Roney noted that some of these modifications could have been mistaken for use wear. The study also documented vertical and horizontal displacement. Horizontal displacement was not as severe as anticipated: "movement of artifacts, as observed in this experiment, would probably not seriously obscure important spatial distributions for most archaeological sites". However, at least 40% of the specimens were displaced by distances of .75 to 1.5 meters. Thus, in heavily trampled areas, grid collection units would be more appropriate than point provenience collection.

More controlled experimental studies, as well as systematic mapping and monitoring of existing sites, could contribute to our knowledge of grazing effects. Roney's study involved a high level of traffic, a small artifact sample size, and a fragile raw material. Additional studies could focus on variable levels of livestock traffic and different raw materials. In the study area, it is possible to compare levels of artifact breakage in areas of variable livestock use along the Granite Reef Aqueduct. An examination of lithic collections from 7 sites, located along different reaches of the aqueduct, showed a breakage rate of 13-17% at all sites except AZ S:7:13 (ASU). The latter site, located near a cattle tank, exhibited a breakage rate of 52% (Lewenstein and Brown 1982:143). The difference should not be attributed entirely to the effects of grazing. Increased vehicle traffic by ranchers may have been a factor. Differences in raw material durability and site function also may have affected the results. A higher proportion of broken artifacts may have been discarded originally at AZ S:7:13, a possible base camp. However, the majority of broken artifacts consisted of small tertiary flakes snapped in half, probably as a result of trampling at that site. Existing information thus indicates that intensive survey and data recovery should be seriously considered for areas surrounding planned reservoirs.

Mining

Mining can adversely affect archaeological sites in a variety of ways. Disturbance by heavy machinery or explosives can destroy sites. Through clearing, road construction, and the destruction of alluvium, mining-related activities can intensify erosional processes (Dobyns 1981:150). Finally, the construction of roads to remote mines can increase access to formerly inaccessible cultural resources.

In west central Arizona, the history and intensity of mining has reflected shifts in the national economy and the demand for minerals. The mining boom provided the initial impetus for the historic settlement of the region. During the period of high activity prior to 1920, large scale operations included the Harquahala, Swansea, and Vulture mines, located respectively in the Little Harquahala, Buckskin, and Vulture ranges. In the past few decades, mines have consisted primarily of small, dispersed operations. Nearly all mountain ranges have been mined to some extent, yielding gold, silver, copper, and other minerals (Stone and Myers 1982:324-328). Small scale mineral exploitation will continue as a major type of land use. However, a return to larger scales of production is expected only if the current depressed market gives way to a high demand for domestic mineral resources. Unlike the northern Rocky Mountain states, western Arizona holds relatively few known oil, gas, or coal reserves. This lack of

energy resources serves to reduce regional conflicts between energy development and cultural resource management. However, experimental geothermal or solar energy developments are future possibilities.

The small scale and dispersed nature of mines pose several problems for cultural resource management. Mines represent numerous small, high impact zones whose exact locations are unpredictable and difficult to monitor. In this region, no large companies dominate this type of land use. Thus there are no overall development plans or exploration strategies to provide input into regional management plans. Managers must deal with numerous land users on a case-by-case basis. Unfortunately, mines tend to be located in areas likely to have attracted prehistoric use, such as canyons and passes. Particularly sensitive zones, also the setting of heavy mining activity, include the Harcuvar, Harquahala, and Big Horn ranges. Since relatively few surveys have been conducted in mountainous areas, little detailed information is available concerning their cultural resources. Information from such areas is crucial for the study of regional settlement and subsistence patterns. Existing information indicates that mountainous areas include site types rare in other environmental zones, such as large roasting pits, pictograph sites, rockshelters, and open base camps. Since most are small in area, they can be destroyed rapidly by surface disturbance and subsequent erosion. Judgmental surveys are indicated in areas of relatively intense mining activity which offered water, dense critical food resources, raw materials, or shelter to aboriginal populations.

Large companies, dealing with larger areas than most current mines, may be required to sponsor surveys and data recovery in order to comply with legislation. In the study area, the Union Minerals Exploration Company funded archaeological surveys of the Anderson Mine area in the Black Mountains (Mayro and Breternitz 1978; Powers, Granger, and Keller 1978). In many areas of Arizona, productive archaeological research has resulted from cooperation among federal agencies, scientists, and large corporations (Doelle 1976; Goodyear 1975; Jeter 1977; Powell, Andrews, Nichols, and Smiley 1983).

Recreation

Recreational activities in the desert include the use of off-road vehicles (ORV's), hunting, hiking, camping, and rockhounding. Alamo Lake, the only major recreational center, offers fishing and boating.

ORV's represent the most direct and destructive threat to cultural resources, especially to surface scatters, rock features, trails, and intaglios. Desert pavement can bear the scars of vehicle tracks for many years (Hayden 1965). Their destructive effect is illustrated in comparative photographs of the Blythe intaglios taken in 1932 and 1974 (Solari and Johnson 1982:430-431). Wilshire and Nakata (1976) discussed the negative effects of ORV traffic on the surface of the Mohave Desert. Authorized uses of these vehicles, for example in well-organized overland races, can be regulated and monitored. Tracks should be limited largely to existing roads and drainages. Such was the case for the "Parker 400" race course, where popular spectator areas were surveyed by archaeologists funded by the BLM (Ambler, Frampton, and Ross 1976). However, the greater threat to cultural resources occurs from unauthorized use. It is difficult to restrict the use of such vehicles to existing roads. Closing areas to ORV use is one option in situations where sites can be seriously degraded. If sites are immediately threatened by localized off-road recreation, survey and data recovery are in order.

Rockhounding occurs in many areas. The major collecting zones include Saddle Mountain for agate and Black Butte for obsidian nodules. Rockhounding activities may result in the disturbance of associated sites, such as rockshelters or quarries. Devotees should be made aware of antiquities legislation. On the other hand, their knowledge of rock type distributions can be of value to archaeologists. Their aid can be sought in the discovery and characterization of lithic source areas.

Other recreational activities have less direct effects on cultural resources. However, an increase in visits to the desert, likely to occur with an increase in urban populations, may lead to a greater degree of artifact collecting, vandalism, and inadvertent disturbance to sites. These impacts should be more severe in the areas most accessible to cities, towns, roads, and existing recreation areas.

Vandalism

Vandalism of archaeological sites, ranging from casual collection of artifacts to the removal of deposits with heavy machinery, is a serious problem in the Southwest. Detailed analyses of vandalism have been published recently by Green and LeBlanc (1979) and by Nickens, Larrralde, and Tucker (1981). Areas of the Southwest with large habitation sites, particularly those with visible structural remains, have been ravaged by vandals seeking artifacts for the black market antiquities trade.

Researchers have found that the degree of vandalism correlates positively with the following factors: the size, artifact density, and visibility of sites; the density of sites in an area; the ease of public access; and public knowledge of site locations. Those sites least likely to be vandalized include unobtrusive sites in areas of low population density with restricted or difficult access and low site densities (Williams 1979).

The latter description fits most sites in the western Arizona desert. These factors, as well as the scarcity of buried deposits containing such specimens as whole pots, have fostered a lower level of vandalism relative to other regions of the Southwest (McAllister 1979). However, even in this remote and sparsely populated region, sites have suffered defacement and theft of artifacts. Artifact collecting has probably been a form of recreation rather than a black market enterprise.

It is difficult to document the nature and extent of vandalism in the region. Most known sites appear to have remained untouched. However, a preliminary assessment can be based on existing information. Collectors have evidently focused on the retrieval of projectile points, formal lithic tools, and grinding implements. Local informants have described large collections of metates. In the 1930s, Malcolm Rogers mentioned a large private collection taken from a site near a spring in the New Water Mountains. This

was quite a large site, as indicated by Rogers' comment that "most of the whole metates and manos were taken away". Nevertheless, he counted 4 whole metates and 74 broken ones. He remarked that "white miners and ranchers, especially a Mr. Millikan, gathered up practically all the arrowpoints, blades, and dartpoints from the area previous to 1930" (Rogers n.d.). He also noted that at a site near Bouse Wash, "arrowpoints almost absent but local ranch boys have hunted this area considerably". At AZ S:7:13 (ASU), an Archaic site in the Harquahala Valley, archaeologists found a small "dump" of artifacts indicative of collecting activities. The particular locus, perhaps more conspicuous due to its proximity to a cattle tank, yielded fewer projectile points relative to other Archaic sites along the wash (Bostwick n.d.; Brown and Stone 1982).

Petroglyph sites are particularly prone to vandalism, due to their high visibility, greater likelihood of public knowledge, and the desire to "leave one's mark" (Nickens, Larralde, and Tucker 1981). They also offer tempting targets for those bored with shooting at saguaros. Rogers (n.d.) noted that many boulders in the Palo Verde Hills had been "trucked away by relic hunters". An additional threat exists in unfounded notions that petroglyphs indicate buried Spanish treasure. These ideas persist despite the fact that few Spaniards passed through this portion of west central Arizona. In the late 1970s, a Tonopah resident searching for treasure reportedly disturbed a petroglyph site on Saddle Mountain.

In summary, sites most seriously threatened by vandalism include relatively accessible petroglyph sites, visible intaglios, and open camps in favorable occupation zones near major water sources. The latter are particularly vulnerable if they contain projectile points and grinding implements. Accessible caves and rockshelters are also likely to lure explorers and pothunters.

Military Activities

A considerable portion of southwestern Arizona has served as a training and testing range for the military establishment. Designated military zones include the Luke Air Force Range south of the Gila River and the Yuma Proving Ground immmediately north of the Gila and east of the Colorado River. In such areas, the destructive effects of weapons tests are offset by the lack of public access to large areas of wilderness, the restriction of other land uses, and the practice of cultural resource management.

In the study area, military activities were associated with the use of Camp Bouse, a station in General Patton's Desert Training Center during World War II (Cook 1978; Greenfield, Palmer, and Wiley 1947; Palmer, Wiley, and Keast 1948). These activities left their own archaeological remains, but their impact on other sites is unknown. It is possible that some artifacts and features were removed or destroyed. Fortunately, Camp Bouse was constructed in Butler Valley, an area characterized by an apparent paucity of cultural resources.

Erosion

All sites are probably affected to some extent by erosion. Indeed, the effects of erosion and weathering have recently been the subject of intensive research by archaeologists studying "site formation processes" (Schiffer 1983). Through the removal and displacement of site contents, severe erosion can disturb the context of artifacts and features and decrease the accuracy of recovered information. At worst, it can totally obliterate sites. Severe erosion has occurred in a very small portion of the study area. The worst conditions exist in the following zones: (1) along Date Creek; (2) in the Black Mountains near the Anderson Mine; and (3) in many areas along major drainages, particularly the Bill Williams and Santa Maria rivers. In these areas, erosion has been accelerated by mining and grazing (BLM 1982:46). In the rest of the region, "soil erosion is generally low due to the gravelly or cobbly surface layer that protects the soil from the impact of raindrop splash and channel runoff" (BLM 1982:46). Desert pavements are particularly stable, although they are vulnerable to disturbance by vehicles.

Table 12-2 is a general guide to the nature and severity of expected impacts on different types of sites. Obviously, these will vary in different environmental zones and local situations. The most common site types, such as artifact scatters, occur in a variety of zones and thus are subject to the entire range of potential impacts. The estimated degree of threatened damage reflects several factors: geomorphological processes and the extent of erosion in particular areas; the geographic distributions of particular site types and land use activities; the relative intensities of land use in different zones; and the relative remoteness of sites in terms of accessibility, obtrusiveness, and public knowledge. These factors have been discussed above in general terms, and this table reflects the content of that discussion. Decisions relating to the management of particular sites or areas will require more detailed contextual evaluations.

STRATEGIES FOR THE PROTECTION OF CULTURAL RESOURCES

Cultural resources are fragile, nonrenewable entities; if destroyed prior to scientific study, their information content and less tangible values are lost forever. Legislation to protect these values was established in response to interested professional archaeologists, avocational archaeologists, Native Americans, and the general public. Thus protective strategies should play a prominent role in cultural resource management as well as broader programs of multiple use management.

Table 12-3 lists some direct and indirect strategies for the protection of archaeological sites and sensitive areas. Indirect approaches to protection incorporate management policies not necessarily specific to any particular site or area. In general, the strategies in Table 12-3 fall into three categories: scientific data recovery, avoidance, and active protection. Data recovery, in the form of a complete investigation, represents active use of the resource rather than preservation. It is generally carried out when a site is imminently threatened by severe damage or destruction. Intensive data recording, such as point provenience mapping during inventory, is a relatively conservative strategy and a type of interim data recovery. For many site types in

TABLE 12-2

EXPECTED IMPACTS AND RELATIVE THREATS TO DIFFERENT SITE TYPES

Impacts	Artifact scatters	Rock feats	Mt. Roasting pits	Trails	Rock art	Caves, shelters	Quarries	Intaglios	Grinding features
Real est. develop.	T	T	M	T	M	M	M	T	M
Agriculture	T	T	M	T	M	M	M	M	M
Livestock grazing	T	T	T	T	M	M	T	T	M
Mining	T	T	S	T	S	T	S	T	T
ORV's	T	S	M	S	M	M	T	S	M
General recreation	T	T	T	T	T	T	T*	T	T
Intentional vandalism	T	M	M	M	S	S	M	S	T
Erosion, weathering	T	T	S	S	S	T	T	T	T

*Subject to rockhounding

M: Minimal overall threat
T: Threatened
S: Serious threat

The table reflects known patterns of site distribution and land use in the study area. Local conditions may vary.

TABLE 12-3

STRATEGIES FOR THE PROTECTION OF CULTURAL RESOURCES

I. Direct Measures

A. Intensive data recording or scientific data recovery.
B. Fencing.
C. Placement of signs.
D. Placement of barriers on access roads.
E. Patrol and surveillance.
F. Periodic monitoring.
G. Successful prosecution of vandals.
H. Repair and restoration.
I. Establishment of cultural resource management plans for special management areas.

II. Indirect Measures

A. Public education.
B. Encouragement of public cooperation in reporting vandalism.
C. Nonpublication of site locations.
D. Incorporation into wilderness areas.
E. Avoidance and conservation through implementation of land management policies and procedures.
   1. Avoidance of adverse impacts from BLM actions.
   2. Avoidance by planned construction projects.
   3. Consideration of cultural resources in all phases of planning.
F. Archaeological permitting and monitoring of research projects.

the western desert, such as trails, intaglios, rock features, and rock art areas, detailed recording is the primary form of data recovery. In general, the costs of data recovery in the study area should be relatively low in comparison to those for sites in other regions of the Southwest. The predominance of small sites, low density surface scatters, and surface features supports an emphasis on mapping, surface collection, and limited testing rather than more costly excavations.

The avoidance of destructive impacts to cultural resources is a general policy of federal land management agencies. Avoidance primarily involves the systematic consideration of cultural resources in planning and general management procedures. For example, the locations of construction projects or rights-of-way might be shifted in order to bypass sites. Wilderness designation represents a form of avoidance. However, it also limits opportunities for surveillance and scientific data recovery, to the extent that these activities require the use of motorized vehicles.

In particular cases, managers will need to choose among alternative strategies for conserving the physical integrity or information value of cultural resources. The choice of scientific data recovery, avoidance, or active protection will be influenced by several factors. These include the following: (1) the evaluation of the resource in terms of BLM "use categories"; (2) the number of "use categories" applicable to a particular property; (3) the uniqueness of a site; (4) the property's condition and the degree of threat from ongoing or planned impacts; (5) the costs and effectiveness of different strategies; and (6) the resolution of land use conflicts. Such decision making can be a complex process.

Direct, active protection measures are indicated for resources of very high scientific or ethnic value. Protective strategies can also be employed where sites are threatened by vandalism, ORV use, or intensive grazing. Very rare site types would merit protection, as would any site developed for the purpose of public display.

Direct protective measures include fencing, signing, road barriers, surveillance, and successful prosecution of apprehended vandals. Costs and relative effectiveness will vary in different situations, but it is possible to make some general observations for west central Arizona. Neither fences nor signs should be placed so that they draw attention to relatively unobtrusive sites. Small fenced areas will undoubtedly attract attention. On the other hand, it may be costly to erect and maintain fences around very large

areas. However, fences should be used to protect such fragile sites as intaglios. Solari and Johnson (1982:429) offered practical suggestions for fencing intaglio sites. Fences could also protect sites from trampling in areas of heavy livestock use.

Road barriers, such as posts and cable, could be erected in order to restrict access to sites. Their purpose would not be immediately apparent. Barriers would be quite effective in canyons and heavily dissected areas with ridges separated by deep arroyos. They could be combined with fences in order to restrict access to areas of high cultural resource density in such environmental situations.

Signs are a relatively low cost measure. They should not draw undue attention to a site, but they should be clearly visible once the presence of the site becomes obvious. Most sites in the western desert will require little direct protection from vandals, since the majority are remote and unobtrusive. Signs should be placed at obvious rock art and intaglio sites as well as publicized sites and those known to have been vandalized in the past.

Patrol and surveillance are generally impractical in this region for several reasons: (1) much of the area is rugged, remote, and relatively inaccessible; (2) the most effective techniques, such as the use of helicopters, would be the most costly; (3) vandalism does not appear to be concentrated in particular areas, although it probably tends to occur in the most accessible zones; and (4) except in specific cases of ongoing vandalism, the costs of surveillance probably would not justify the returns. In ongoing cases of reported vandalism, patrol and surveillance would be a useful option. At best, it would contribute to the arrest of vandals; at the least, visible aerial patrols would discourage their activities. Patrols could be conducted with the aid of county sheriffs, perhaps through a negotiated interagency agreement. For highly sensitive and threatened sites, electronic surveillance is an additional option to be considered.

Certain sites should be periodically monitored in order to ascertain whether they have been subjected to increased traffic or vandalism. Such sites should include highly significant, rare, or fragile resources like stratified caves or rockshelters, intaglios, and rock alignment or trail systems. Conspicuous sites, such as large rock art areas, should also be monitored. Sites publicized in the popular media, for example in newspaper articles or hiking tour books, should also be checked. It is anticipated that only a small proportion of sites should be periodically monitored. For very remote or inaccessible areas, monitoring need only be conducted in response to reported vandalism or potentially destructive changes in land use. For publicized sites or those in more accessible areas, monitoring might be scheduled on an annual basis, or checks could be conducted in conjunction with trips to nearby areas by archeologists, other BLM personnel, or amateur archaeologists or volunteers.

In much of the Southwest, particularly in parks, repair and restoration are useful measures for the protection and display of sites. In west central Arizona, the lack of substantial prehistoric structures reduces their utility. However, an "artificial" desert varnish solution has been developed to eliminate scars, tracks, or recent additions on intaglios, desert pavements, and rock art panels (Elvidge 1979; Moore and Elvidge 1982; Solari and Johnson 1982:431). According to Elvidge (1979:80-99), there are several mixtures that are durable but reversible, relatively inexpensive, and easy to apply.

A final protective strategy would be the establishment of cultural resource management plans for special management areas. The purpose of such plans would be the protection of specific sites or areas with numerous associated features and prehistoric loci within particular environmental situations. In their overview of southwestern Arizona, McGuire and Schiffer (1982:410) offered a similar recommendation:

> We also recommend that the BLM include the establishment of archaeological zones in land use plans . . . so as to enhance the likelihood of preserving sites and other resources for public viewing and future scientific study . . . Clusters of diverse archaeological resources will be found. Such concentrations, perhaps where arroyos cut through the bajada, along the margins of a playa, in the vicinity of a water resource, or on the edge of a river terrace, would be well suited for preservation. The aim should be to preserve not only what is unusual and important, but also good examples of what is typical.

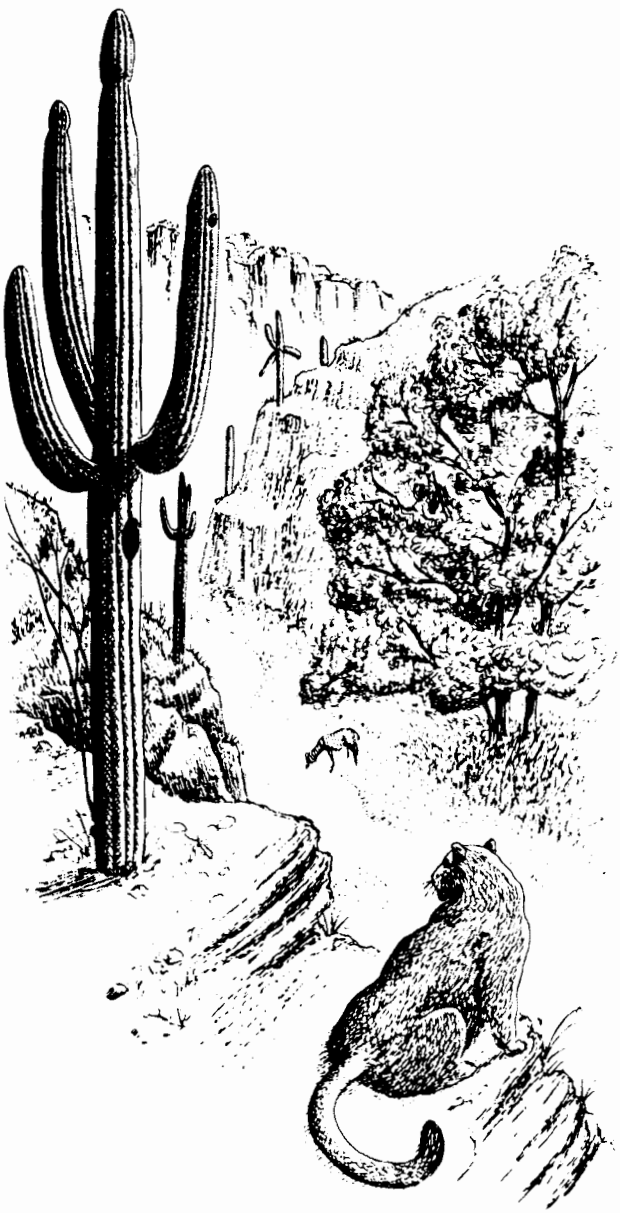
The cultural resource management plan would define the boundaries of a special management area and determine how this area would be managed and protected in the future. Protection might require the erection of strategically placed fences and road barriers or gates. Special measures might be needed to reduce impacts from such potentially destructive forms of land use as intensive grazing, mining, or ORV use. Cultural resource management plans could be incorporated into more general planning documents.

Appropriate special management areas could include areas of well-established desert pavement with numerous, diverse archaeological features and loci. These might incorporate rock rings, trails, rock alignments, artifact scatters, isolated artifacts, and rockshelters on knolls or adjacent slopes. Lithic tools with variable degrees of patination would enhance an area's research value. Desert pavement zones with archaeological remains merit protection in view of their fragility and research value. Hayden (1965) designated pavement zones with surface remains as "fragile pattern areas". Archaeological sites in such areas consist of spatially patterned surface remains easily damaged or disturbed by casual collection or by vehicle, foot, or livestock traffic. Research values are linked to the spatial, temporal and functional interrelationships among loci in a particular environmental context. Experimental dating techniques, such as cation ratio dating, could be carried out in such areas. The results of investigations could be compared to similar studies in other areas of the Sonoran Desert, such as Hayden's work in the Sierra Pinacate (Hayden 1976). In the study area, desert pavement zones with diverse cultural resources occur on the upper bajadas of several mountain ranges as well as the terraces of the Bill Williams River. Particularly interesting areas include

the northern pediment of the Eagletails, the southern pediment of the Harcuvar Mountains, and the area surrounding Saddle Mountain.

Special management areas could also include zones containing intaglios or areas of probable sacred significance to Native Americans. Such an area is the Jagow Wells complex of trails, petroglyphs, intaglios, and artifact scatters in the Palo Verde Hills (Bean et al. 1978; Landon 1980; Stein 1981). Unfortunately, portions of this area are privately owned.

Other appropriate special management areas could consist of selected canyons, particularly those with springs or reliable water sources. Certain canyons in the Harcuvar and Harquahala ranges are known to contain diverse resources including artifact scatters, roasting pits, pictographs, and rockshelters. A petroglyph site in the Eagletail Mountains, AZ S:11:1(ASM), incorporates a small canyon containing rockshelters, bedrock mortars, and artifact scatters. Such areas are the cultural jewels of the northern Sonoran Desert.



CHAPTER 13

SITE CHARACTERISTICS AND MANAGEMENT CONSIDERATIONS FOR THE SKULL VALLEY ZONE

The previous three chapters focused primarily on the desert zone of the overview area. However, they contain information and general recommendations that are also applicable to the Skull Valley zone. Yet the unique cultural and environmental characteristics of the Skull Valley area must be addressed in terms of management considerations. This chapter represents an addendum to the previous three chapters. The lack of research in the Skull Valley area limits the specificity of management recommendations.

SITE TYPES

The area shares many site types in common with the desert zone. However, the upland valleys and mountains also contain types rare or unknown in the desert: rock-lined pithouses, masonry structures, hilltop masonry "forts", ball courts, and possibly canals. In general, there is a greater variety and range of structural types. Some of the more substantial types have interior features, indicating more permanent occupations or an adjustment to a cooler climate. The Skull Valley zone, particularly the Kirkland drainage area southwest of Prescott, has a greater variety of habitation sites. Farming, enabled by arable soils and reliable supplies of water, may have supported "permanent" villages in the Kirkland, Skull, and Peeples valleys. Prehistoric fields and agricultural features may well exist in these areas. With relatively few large areas of desert pavement, the Skull Valley zone probably contains few visible trails, intaglios, or other features normally associated with desert pavement. However, the area does contain zones of more rapid natural soil deposition, indicating a higher proportion of buried and stratified sites. The site files and researchers have documented the existence of many sites with subsurface depth (Jeter 1977; Rice and Dobbins 1981; Rogers n.d.). Long term occupations, relatively large resident groups, or the repeated use of base camps also may have contributed to higher artifact densities relative to most desert sites.

Wood (1980:56-68) developed a preliminary typology for sites in the Kirkland Creek drainage area north of the Weaver Mountains. "Structural" types include sites with architectural or constructed features: pithouse settlements, rock ring pithouse settlements, masonry habitation sites, hilltop "forts", and cleared circles. "Non-structural" types consist of artifact scatters, petroglyph sites, and caves or rockshelters.

According to Wood, pithouse settlements include eight known sites in the Kirkland and Peeples valleys. These surface scatters with associated trash mounds and shallow depressions have been labeled "Hohokam" sites due to the presence of Hohokam decorated pottery. However, ceramics are dominated by local wares. A pithouse excavated by Shutler (1952), in the Williamson Valley north of the study area, exhibited a prepared floor, a clay-lined hearth, storage pits, and jacal walls. In the Kirkland and Peeples valleys, associated sites include ball courts, hilltop "forts", and petroglyphs.

Rock ring pithouse settlements include nine documented sites in the study area. Jeter (1977) investigated several additional sites in his Copper Basin study area. According to Wood, these sites consist of oval to rectangular rock outlines which served as wall foundations for pithouses. They are generally found singly or in small groups. A lack of associated trash mounds indicates a more transient occupation than that associated with other pithouse settlements. Structures excavated by Jeter ranged in size from 2 x 2 m to 6 x 3 m. They contained use-compacted floors, and some had clay-lined hearths. Walls probably consisted of jacal (pole and adobe) or wattle and daub (a light pole and brush framework with adobe plaster). Wood noted similarities between these structures and others investigated at the northern margin of the Salt River Valley (Henderson and Rogers 1979).

Only two masonry habitation sites (pueblos) have been documented in the Kirkland Creek area. They are quite common to the north and east in the Prescott region. These sites, usually assigned to the "Chino Phase", appear to be later than most one-room sites or pithouse settlements (Jeter 1977:250-252).

"Forts" are masonry enclosures located on hilltops and mesa edges. They have few internal features. In the Prescott area, they remain undated (Jeter 1977:252). Multiple functions have been proposed. Recent, detailed studies of such sites have been conducted by Spoerl (1979) along the Agua Fria and bordering mesas and by Czaplicki (1979) at Tumamoc Hill in Tucson.

"Cleared circles" consist of the relatively insubstantial rock rings or "sleeping circles" commonly found in the desert zone of the study region. They do not appear to be common in the area north of the Weaver Mountains.

Artifact scatters are the most common recorded site type in the Skull Valley study area. Some of these sites may represent surface scatters associated with buried features or living surfaces.

The development of productive strategies for subsurface testing should be a major priority for the investigation of sites in the Skull Valley zone. Sites with subsurface depth can be expected in desert areas as well as upland valleys (Rice and Dobbins 1981). In some cases, unusual soil deposits may indicate the existence of sites. The Soil Conservation Service recently contacted BLM archaeologists after test excavations revealed prehistoric deposits in an unusual soil formation (BLM files). The site was located in a desert canyon north of the Desert Gold sites (Rice and Dobbins 1981).

Jeter (1977:274) noted that most excavations in the Prescott region have focused on structures and trash mounds. He urged more attention to the study of outdoor work areas and exterior features, including the recovery of flotation samples from such areas. He also observed that intermingled dense shrubbery and eroded areas impair surface visibility in the chaparral zone. Jeter recommended that

road graders be used to clear the surface in order to detect features. The advantages and disadvantages of such a strategy have yet to be assessed.

CONDITION OF RESOURCES

In the Skull Valley zone, significant sources of cultural resource deterioration include historic and modern settlement, grazing, mining, and vandalism. Wood (1980:88) observed a "duplication of prehistoric settlement patterns by historic and modern Anglos". The areas most likely to contain the more substantial habitation sites, ball courts, and agricultural fields were the first zones settled by modern farmers and ranchers. In the valleys of the Kirkland Creek watershed, areas of Lynx loam and alluvial soils are nearly all privately owned. Sites have likely been disturbed by construction, erosion, and vandalism. However, intact subsurface deposits may still exist. There is a need to assess the affects of historic settlement on upland valley sites.

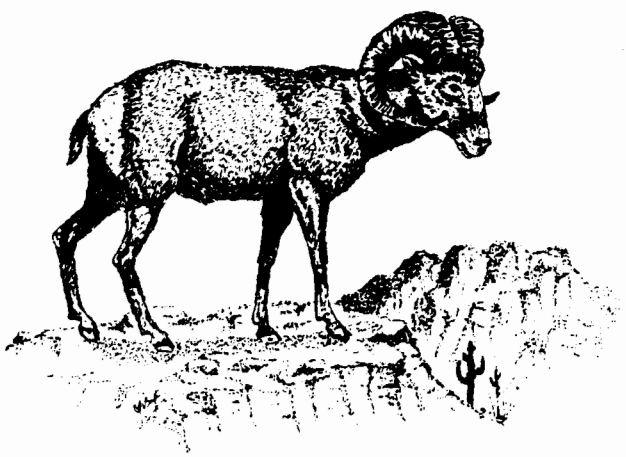
Desert grasslands and riparian zones surrounding Wickenburg have been subjected to intensive grazing (BLM 1982). The upper Hassayampa area and the Weaver Mountains have also witnessed a great deal of mining. Both activities have contributed to erosion and a loss of riparian habitat, as well as probable adverse impacts to archaeological sites.

Vandalism is most likely to occur at structural sites accessible to settled areas. Masonry structures and "forts" are vulnerable due to their high visibility. Data from the Prescott National Forest can be used to indirectly assess the problem of vandalism in the study area. McAllister (1979) conducted a study of vandalism in the national forests of Arizona. Out of a projected 40,000 to 50,000 sites in the Prescott National Forest, he estimated a vandalism rate of 20-30%. This speculative estimate was low compared to an average estimated vandalism rate of 50% for all Arizona forests. The highest rates characterized areas subjected to "commercial" looting. In the Prescott area, recreational use probably contributes to many cases of vandalism or illegal collection.

Site file data from state archaeological quadrant N:6 reveal aspects of vandalism in the forested area immediately north of Skull Valley. Most of this land is administered by the U.S. Forest Service. The 79 documented sites include 48 artifact scatters or pithouse sites, 16 pueblos or rock-lined pithouse sites, 12 hilltop masonry "forts", and 3 additional sites. Vandalism is reported at 25% of these sites, specifically at 12% of the artifact scatters, 33% of the pueblos, and 60% of the "forts". The overall rate of vandalism may reflect the area's proximity to Prescott. The data confirm the vulnerability of masonry structures.

Vandalism, in the form of excavation and artifact theft, is not limited to pueblo sites in the northern portion of the study area. Rogers (n.d.) reported large numbers of metates stolen from an Archaic site south of the Date Creek Mountains.

Protection measures have been discussed in Chapter 12. With poor inventory data, it is difficult to recommend specific measures for the Skull Valley zone. In the future, it may be advisable to monitor grazing or mining in certain areas in order to protect cultural resources.



CHAPTER 14

INVENTORY RECOMMENDATIONS

Two decades ago, Ruppe (1966) issued a "defense" of the archaeological survey as a significant aspect of scientific research, not simply a means to discover sites suitable for excavation. He argued that different types of surveys were appropriate for different purposes. At the same time, Binford (1964) stressed the utility of random sample surveys in the implementation of regional research designs. In the 1970s, several factors led to a proliferation of survey projects and a great deal of attention to methods and techniques, particularly probability sampling (Mueller 1975). These factors included (1) legal compliance manifested in survey and mitigation phases of numerous contract projects; (2) an increased emphasis on regional analyses of settlement patterns and systems of interaction; and (3) the "new" archaeologist's devotion to methodological refinements, particularly those involving the use of inferential statistics. By the end of the decade, archaeological surveys were regarded as an integral component of scientific research (Ammerman 1981).

For the Bureau of Land Management, the importance of inventory data was underscored by the passage of the *Federal Land Policy and Management Act of 1976*. This act established a basic policy of multiple use management and long-range planning, a policy for which regional inventory data can provide crucial input for decisions regarding natural, economic, and cultural resources.

Manual 8111, issued by the BLM in 1978, provided general guidelines for the "proper inventory and evaluation of cultural resources on lands administered by the Bureau and on lands affected by Bureau undertakings". The manual established three classes of inventory, designed to provide specific kinds of data for various planning and management needs. A Class I inventory is a review and compilation of existing data, involving little or no fieldwork. The regional overview details background information, values for research and other uses, and appropriate management recommendations. Class I inventories can also be project-specific.

A Class II field inventory is a sample survey based on a probabilistic sampling design. Class II data on the nature and distribution of sites contributes to long-range planning and the development of predictive models. The rationale for Class II surveys is given as follows:

> Under constraints of time, manpower, and funding, a sampling approach is cost effective, allows large areas to be assessed, and, when coupled with followup purposive surveys, provides an objective measure for accuracy of inventory results [BLM Manual 8111:.12C2c].

Class II inventories can sample large administrative zones, such as resource areas or planning areas, or they can target smaller areas, such as land exchanges or areas set aside for special management purposes. They can consist of several phases. The initial phases must incorporate probability sampling, but later phases can include purposeful selection of sample units. In the study area, designated as the Lower Gila North Planning Area, low level Class II surveys of the Harcuvar and Vulture planning units were completed in 1981. The methods and results will be discussed later in this chapter. The Skull Valley planning unit has never received a Class II inventory.

A Class III field inventory is an intensive survey of a specific area. These surveys are carried out in project areas or zones of expected adverse impacts, and they result in clearances or recommendations for further data recovery procedures.

Any inventory should incorporate two major goals: accurate documentation of appropriate information for research and management purposes, and cost efficiency. Schiffer and Wells (1982) discussed several relevant factors, based on a review of Southwestern survey projects conducted during the 1970s. In western Arizona, accuracy is enhanced by low vegetation cover and the high visibility of most surface sites. Yet although sites are readily visible, they tend to be unobtrusive due to the presence of small loci and low density scatters. Thus adequate coverage involves increased costs associated with low spacing intervals between surveyors (ideally less than 30 meters, as recommended in BLM Manual 8111). Other factors tending to increase survey costs in the western desert include high travel costs and a low site discovery rate associated with an overall low site density. Comparing early surveys to recent, more intensive projects, Schiffer and Wells (1982:357) noted that increases in cost have been justified by the accumulation of more accurate and comprehensive data bases. They also stressed the need for greater efficiency in survey techniques.

The vast literature on survey methods has not generated a single best approach to the design and implementation of surveys. Survey designs should be tailored to fit particular situations and goals. Research goals should take precedence, but cost reduction and other logistic concerns should be important considerations. Many publications have explored issues in survey methodology (Mueller 1975; Plog, Plog, and Wait 1978; Schiffer and Gumerman 1977; Schiffer, Sullivan, and Klinger 1978; Schiffer and Wells 1982). This chapter will present a brief review of issues relevant to the design of BLM inventories and the evaluation of past and proposed surveys. This review will be followed by a consideration of phased survey strategies and by recommendations for future inventories in the study area. The final section will address the topic of predictive modeling.

SURVEY METHODOLOGY

Site Definition

Sites, important units of archaeological analysis, traditionally have been viewed as discrete entities with readily definable boundaries. However, after 1970, researchers focused greater attention on remains that did not fit that definition. Isolated artifacts and features and extensive, low density scatters were recognized as important indicators of land use patterns (Binford 1980; Brown and Stone 1982; Button 1980; Goodyear 1975; Thomas 1973, 1975). Such areas were sometimes designated as "nonsites" (Thomas 1975).

The study of "nonsites" had at least two methodological consequences. Many projects focused on artifacts and features, rather than sites, as units of analysis in regional studies (Goodyear 1975; Thomas 1973, 1975). Archaeologists also devoted much attention to the problem of site definition and the difficulty of distinguishing sites from "nonsites" in the field. The definition of site boundaries was no longer a straightforward procedure.

Low density phenomena are a common aspect of the archaeological record in the Arizona desert. Discrete, bounded loci are also present, but distinctions among areas with isolates, low density scatters, and more traditional "sites" are often unclear. Thus, the approach to site definition in this region should be both flexible and economical. Such an approach should enhance the effectiveness of research and management.

Management procedures are based on the treatment of "sites". Only designated sites are entered into the statewide computer data base and assigned to particular use categories. Thus, many low density areas should be recorded as sites rather than "nonsites", since they might be lost to the management system. The "nonsite" term itself should be abandoned and replaced by reference to isolates or low density artifact scatters. The "nonsite" term is likely to have confusing and negative connotations for land managers. In addition, it has been used in the predictive modeling literature to refer to areas where sites are known to be absent (Kvamme 1982; Larralde and Chandler 1980).

The recommendation to designate low density scatters as sites requires clarification. To decrease the costs of paperwork and computer entry, it is best to avoid assigning site numbers to single rock features, pot busts, or small chipping stations. If these features or small artifact clusters appear to be truly isolated, they can be recorded as isolates. However, the boundaries of low density scatters can be drawn to incorporate several such features or concentrated loci separated by intervening areas. Such "sites" can cover extensive areas (Brown and Stone 1982). Some might consider this approach as extreme, but it offers advantages for record keeping and administration. With a flexible approach to the definition of study units, large low density or multiple locus sites can be broken down into smaller units for analytical purposes. For example, individual pot breaks or lithic chipping areas within such sites could be considered as separate units in an analysis. Low density scatters could be reduced to their component artifacts and features for distributional analyses. Explicitly justified units of analysis can be adapted to research objectives.

There still exists the problem of defining sites on the ground. Where boundaries of artifact scatters are difficult to define, it is best to monitor variations in artifact density and to define site limits accordingly. If decision criteria are used, involving for example a minimum artifact density or the presence of features, these should be made explicit. However, most researchers have cautioned against the wide application of absolute, arbitrary criteria such as a specific number of artifacts per square meter (Plog, Plog, and Wait 1978). Site definition is ultimately a matter of judgment:

> The notion of a density limit on site definitions is problematical but not absurd. Such a definition should never be an absolute . . . On the one hand, it should be tied to some notion of interpretability in the specific context in which the survey is being conducted. On the other hand, it should be regarded by each member of every survey crew as a standard about which arguments are to occur and judgments are to revolve. The occurrence of such arguments and the focusing of such judgments are the most important effect of quantitative definitions of sites [Plog, Plog, and Wait 1978:389].

In western Arizona, it is often possible to distinguish continuous low density scatters from areas that are nearly devoid of artifacts and features (Brown and Stone 1982).

An alternative approach to site definition involves the assignment of site status after the completion of the survey and the evaluation of results. The Granite Reef Aqueduct survey employed the following strategy. Isolates were recorded, and artifact densities were monitored. Features, areas of relatively high density or artifact diversity, and scatters with readily definable boundaries were designated as field loci and were recorded on special forms. After the completion of fieldwork, artifact densities and field locus distributions were evaluated. Field loci and low density scatters were then given site status or were grouped into sites (Brown and Stone 1982:41-42). This method of reevaluating site definitions after the inventory is completed could be employed prior to computer data entry.

Other approaches can aid in the definition of sites in the western desert. Many small, discrete loci may represent the remains of single episodes of use. These include lithic "chipping stations", rock rings, and broken pots. If such phenomena are not associated with other cultural remains, they can be designated as isolates rather than sites. However, the problem lies in the definition of "isolated". Some guidelines can be offered, based on intervening distances, the composition of remains, and landform associations.

Maximum intervening distances could be set, for example 75 meters between rock rings, to define multiple loci within a single site. Thus if two rock rings were 25 meters apart, they would be incorporated into a single site. If they were 100 meters apart, with no associated low density artifact scatter, they would be recorded as isolates. Such an approach is admittedly arbitrary, but it could be of use in field recording or the post-field revision of site definitions.

Some apparently isolated loci may represent site types that are relatively rare or capable of yielding information on particular research issues. These would include, but not be limited to, the following: rock rings with associated sherds or grinding implements; rock rings of unusual size or configuration; and hearths or roasting pits that might yield organic remains. Such loci should be designated as sites because of their unusual nature and potential research contribution.

Series of single event loci, for example lithic chipping stations, are often associated with particular landforms such as ridges, alluvial fans, or naturally bounded zones of desert pavement (Brown and Stone 1982; Carrico and Quillen 1982:62). Site boundaries can be drawn to coincide with such areas.

Trails should receive special consideration. They are often associated with other features which can be incorporated together into sites. Long trail segments, particularly those which pass through several artifact scatters or concentrations of features, should be designated as separate sites. This procedure would simplify the definition of trail networks and long distance routes.

Both flexibility and explicitly reasoned judgments should operate in the definition of sites. The process of site definition should be consistent with research objectives. The process of data entry should not be overtaxed, but neither should information be unnecessarily excluded from the computerized data base.

Field Procedures

Coverage intensity, or the distance maintained between crew members, can affect the accuracy of survey results. Gains in accuracy must be balanced against increases in costs, in the context of research goals. In the western desert, the detection of rock features and small artifact scatters generally requires spacing intervals of less than 30 meters (Brown and Stone 1982:40). Intervals of 15 to 20 meters would allow firmer comparisons with survey results from the Granite Reef and Palo Verde-Devers projects (Brown and Stone 1982; Carrico and Quillen 1982). Spacing strategies can be modified in heavily disturbed areas such as riverbeds or in hazardous zones such as steep mountain slopes.

For initial surveys, BLM policy requires in-field recording rather than surface collection of artifacts. A few suggestions can be offered. Surveyors should continue the point provenience mapping of bounded sites with less than 100 artifacts. Where sites consist of a series of discrete loci, such as chipping stations, a random sample of such loci should be recorded in detail. For the recording of low density scatters or isolates, each crew member could carry a tally sheet for quick tabulations of artifact types, locations, and densities. Sampling would be advisable for recording the composition of continuous scatters or relatively dense loci. One strategy could involve the random selection of small grid units or parallel transects as recording units. Due to variability in the size, artifact density, and composition of sites, it is inadvisable to set strict limits for the number of recorded sample units or artifacts. Effective sampling procedures may vary for different sites. Effland, Green and Robinson (1983) devised a workable strategy for recording artifact scatters along the Yuma 500 Kv transmission line. Where sites were very large, the zones of highest density were sampled. In most cases, recording procedures involved a systematic random sample of transects, measuring 2 x 30 meters, placed perpendicular to the long axis of the site. Within each 30 meter length of the long axis, a transect was randomly selected for recording. Recorded information included artifact numbers and types, and for chipped stone artifacts, the amount of cortex, size, number of utilized edges, raw material, and possible function. Procedural modifications included the nonrandom selection of extra recording units in obvious clusters or other areas of particular interest.

Crew members should be trained in the recognition of artifact types and raw materials. As instructive and analytical aids, the Bureau should acquire and maintain small but comprehensive type collections for ceramics and lithic raw materials. The latter may already exist in geological collections.

Sampling Strategies

Rogge and Fuller (1977:227) summarized the statistical rationale for probabilistic sampling:

> Probabilistic samples are those samples in which every element in the population has been assigned, by means of some mechanical operation of randomization, a calculable, nonzero probability of being selected. Because the laws of probability are used to avoid human bias, probabilistic sampling allows the archaeologist to make quantifiable predictions about entire populations of items on the basis of observations of only a sample of the population.

It is difficult to summarize the volume of literature on sampling strategies for archaeological surveys. In the 1970s, field applications and computer simulation studies yielded variable results concerning the most desirable methods. This situation has been attributed to differences in the quality of data bases and to variations in the environmental settings and data characteristics for different study areas (Stafford, Burton, Grove, and Plog 1978).

Several factors must be considered in the development of sampling strategies: sample fraction and size; sample unit size and shape; and method of sample unit selection. There are a number of statistically valid sampling techniques which could be applied to a given problem. The choice of an appropriate technique should be based on specific research and management needs, logistic considerations, and prior knowledge, if available, on the structure of the population under study. Plog, Plog, and Wait (1978) reviewed the decisions involved in sampling strategies. Major points are discussed briefly below.

Sample Fraction and Sample Size. The sample fraction represents the percentage of the target population subjected to examination. For surveys, this is a percentage of the total area within the study zone. Sample elements consist of areal units. Accordingly, "a 10% sample of a region will discover 10% of the total area of sites in the population but not necessarily 10% of the sites in the population" (Plog, Plog, and Wait 1978:396). Plog (1978:13) argued that "inferences can successfully be made on the basis of very

small sample fractions" and that a 1% sample "is about what typical levels of funding for large regional studies done at a high level of intensity will support". In the study area, the Harcuvar and Vulture planning units were sampled at a level approximating 1%. Such a sample may be appropriate for a large region or for the preparation of a planning document, but archaeologists generally favor sample fractions larger than 1% in order to better characterize an area. However, there is no ideal fraction. The sample size or absolute number of observations, not the sample fraction, is critical in evaluating the validity of the sampling procedure (Cowgill 1975:263).

The sample size represents the actual number of independent cases included in the sample (Cowgill 1975:263). The number of sample units for areal surveys should be maximized within the constraints posed by logistic factors (costs, organization, and available time and funds). In reference to the Central Limit Theorem of statistics, Schiffer, Sullivan, and Klinger (1978) recommended a sample size of at least 30 units. However, if the intent of the survey is to generate an adequate sample of sites for more detailed analyses, the probability of empty sample units is a factor favoring much larger sample sizes. Nance (1983:338) discussed this problem of empty units, which are likely to represent a large portion of the sample in marginal desert areas. Stratified sampling designs can be employed to reduce this problem (Altschul and Nagle n.d.).

Along the Granite Reef Aqueduct, areal sampling was an important aspect of data recovery at very extensive, low density lithic scatters. At least 100 collection units were randomly selected at each site. This rule, coupled with the determination of site and sample unit sizes, automatically assigned a sample fraction in each case (Brown and Stone 1982:44). Smaller numbers of sample units may well be appropriate for surface collection or artifact recording at smaller sites, particularly if the collected or recorded artifacts number in the hundreds. In a data recovery proposal, Rice (1983) recommended a minimum of 15 collection units. In this context of site-specific data recording, sample units should incorporate an adequate sample size of artifacts for analysis.

Sample Unit Size and Shape. Given a specific sample fraction, the use of smaller units will increase the total sample size. This is an important factor to consider in the choice of sample unit size. Small units are likely to be more environmentally homogeneous than larger ones and thus more useful for the study of relationships between site locations and environmental variables. However, smaller sample units also are more costly due to increased travel and labor expended in locating the units. Larger units are likely to be more useful for the study of intrasite or subregional spatial patterning. They may be far more cost effective than smaller units in rugged, mountainous zones. The choice of sample unit size involves compromises among research, statistical, and logistic considerations.

Sample units generally consist of square quadrats or rectangular transects. Both configurations are acceptable alternatives for regional surveys. To increase management efficiency, BLM survey units often consist of quadrats oriented to the cadastral system. The edge effect is a factor to be considered in the choice of unit shape. Since transects have a greater perimeter relative to their area, their boundaries are likely to intersect more sites (Plog, Plog, and Wait 1978:401). This boundary effect is also relevant to the selection of sample unit size. At the same sample fraction, a sample of small units would have a greater cumulative boundary area than a smaller number of larger units. The former case would probably be associated with a higher rate of site discovery.

Methods of Sample Unit Selection. Alternative probabilistic sampling designs can be employed in regional surveys. This brief review will not incorporate detailed definitions or discussion of simple random, stratified, systematic, cluster, and combination designs. Comments will focus on the use of simple random and stratified random sampling.

Use of a simple random sample minimizes prior assumptions. Each potential sample unit has an equal chance of selection, and units are selected on the basis of a random numbers table. The method is simple and straightforward. However, in a regional survey, some areas may remain unsampled while others contain clusters of sample units. Although statistically sound, this situation can represent a practical disadvantage for research or management (Redman 1975:150). One approach is to incorporate an additional, nonprobabilistic sample as a second phase of the sampling strategy. Stratified sampling would also ensure more equal coverage of specified zones.

In stratified random sampling, a study area is divided into separate zones or strata on the basis of prior knowledge or relevant assumptions. Strata are internally homogeneous in terms of the stratifying variables; differences between strata exceed internal variation. Within strata, sample units are selected randomly. Strata can be sampled with equal intensity, or sample fractions can vary. Redman (1975:150) described the advantages of stratified sampling:

> Stratification is the appropriate procedure for utilizing the knowledge, experience, and intuition of the investigator in structuring the universe into separate populations to be sampled. The most productive research design utilizes both the previous knowledge of the archaeological remains and some form of probability sampling. In this way it is possible to take advantage of available archaeological expertise while guarding against the possibility of "creating" what one seeks.

BLM Manual 8111 favors the use of stratified random samples for areal surveys. It recommends that strata be defined on the basis of single or combined environmental variables and that they be "meaningful in terms of past human activities". The manual also recommends that the number of sampling strata be kept to a "working minimum".

The latter comment underscores the importance of clarity and simplicity in sampling designs. Overly complex schemes for stratification or sample unit selection can complicate analyses and promote errors. Berry (1984:843) recently criticized a method of sample unit selection that had been employed by the BLM in Utah. The method systematically excluded certain areas from the random selection process, a violation of sound sampling procedure. In

Arizona and other states, some stratified regional samples have been based on the simultaneous consideration of multiple variables (Giorgi and Bayer 1981; Weide 1973). For example, Weide's sampling design for the California desert was based on different ranges of values within three stratifying variables: vegetation zones, hydrology, and physiography. Using such an approach, combined values might well yield ten or more strata. This situation could complicate analyses and worsen the problem of dealing with small samples of sites. Archaeologists should take care in constructing numerous strata based on multiple variables. As Plog, Plog, and Wait (1978:403) cautioned: "our understanding of prehistoric site distributions is not always sufficient to permit meaningful stratification on any other than areal grounds". An alternative approach would utilize a single stratifying variable and a controlled, "post-stratification" analysis of other variables conducted after the completion of the survey. In the Sonoran Desert, physiographic zones have proved useful as the primary stratifying variable (McGuire and Schiffer 1982; Teague and Baldwin 1978). They tend to be correlated with particular vegetation communities, and topographic distinctions can be clearly defined (Matson 1971). In many areas, historic changes have diminished the suitability of vegetation as the primary basis for stratification. Strata could be based on other variables, for example soil types, access to water sources, or cultural variables such as documented ethnographic boundaries. The explicit justification of sampling strata is the responsibility of the researcher.

The ASU Evaluation of Small Parcel Sampling Strategies. Due to the nature of land ownership and use patterns, management often focuses on the use, evaluation, or transfer of small parcels. In 1978, the BLM awarded a contract to Arizona State University for the examination of small parcel sampling strategies. ASU archaeologists first surveyed 6 parcels, employing total coverage at 20 meter intervals. These parcels, located in the Phoenix and Kingman areas, ranged in size from 1 to 13 square miles. For comparative purposes, the study also included 2 non-BLM parcels from areas of higher expected site density in east central Arizona.

The researchers then developed a computer simulation of different sampling strategies applied to the intensive survey data (Stafford, Burton, Grove, and Plog 1978). Variables included sample fraction, sample unit size and shape, and sampling design. Units included small quadrats (80 x 80 m), large quadrats (175 x 175 m), small transects (30 x 213 m), and large transects (50 x 510 m). Designs were random walk, systematic, simple random, and stratified systematic unaligned. The results of different strategies were evaluated in relation to their costs.

Different sampling strategies showed few notable differences in costs or results (Stafford, Burton, Grove, and Plog 1978:91-93). The study supported the utility of small sample fractions, given sufficiently large sample sizes. Samples greater than 10% yielded relatively minimal gains in precision and accuracy. At fractions lower than 10%, small transects offered a slight advantage in precision and accuracy, but quadrats gave acceptable results. The authors concluded that samples should estimate aggregate site area rather than numbers of sites. They argued that their conclusions also could apply to larger parcels. There were no apparent problems unique to the application of sampling strategies to small parcels. In general, the results of the ASU study support the development of sampling strategies based on sound statistical procedure, research and management needs, prior knowledge, and logistic considerations. A flexible approach guided by particular goals is preferable to any arbitrary, cookbook procedure.

Phased Inventories

Different types of surveys yield different types of information needed to satisfy alternative goals. Increasing demands for information, whether for research or management purposes, are unlikely to be met by a single type of field inventory. Thus, professional archaeologists, as well as BLM Manual 8111 (1978), have advocated multiple phases for inventories (Doelle 1977; Plog 1978, 1981; Plog, Plog, and Wait 1978; Schiffer, Sullivan, and Klinger 1978; Schiffer and Wells 1982). Multiple phase strategies can address both research and management needs, and they can be applied within areas of varying geographic scale. Phased strategies can be project-specific, or they can be incorporated into long-term planning analyses.

In most regions, including western Arizona, one can expect certain types of archaeological remains to be abundant relative to other types. Rare site types are often spatially clustered, and they can be highly significant for research or educational purposes. Rare sites can include major regional centers, sometimes called "magnet sites" or "big sites" in the literature (Altschul n.d.; Rogge and Lincoln 1984). "Permanent" sites of great size and complexity, such as Hohokam villages, are unlikely to occur in the arid western desert away from the major rivers. However, they might well influence settlement patterns in outlying areas. Both rare and relatively abundant site types can yield important information, but a single type of survey is unlikely to document the full range of variability in site types (Schiffer and Wells 1982:375).

Field surveys can generate the following general classes of information:

(1) Basic data on the variety and spatial distribution of archaeological remains and site types; relative densities of sites in different environmental zones; and relationships between environmental factors and site locations.

(2) The discovery and characterization of rare or spatially clustered remains, "big sites", etc.

(3) The filling of areal gaps or the correction of biases in an existing data base. For the federal manager, such gaps or biases sometimes reflect the distribution of state and privately owned lands. Due to the presence of important natural resources, such areas may well have been desirable for prehistoric as well as historic uses. In such cases, adjacent lands or similar environmental zones under federal jurisdiction should be examined.

(4) More specific information for research or management purposes; for example, studies of the nature and distribution of specific site types, such as masonry "forts"; analyses of spatial interrelationships of sites in a specific area; or studies of the impact of erosional processes on archaeological remains.

(5) Data for testing predictive models of site location. The resampling of a region might appear to be redundant and thus uneconomical, but the validity of predictive models is ultimately assessed on the basis of independent data.

(6) "Pilot study" data useful for designing subsequent surveys.

Types of surveys vary in their potential contribution to different classes of information. Reconnaissance surveys are relatively unsystematic, initial appraisals conducted by aerial or ground coverage. This type of survey can be used to field check site file data, to "ground truth" remotely sensed data, to discover "magnet" or "big" sites, or to obtain information relevant for the design of stratified random sample or purposive surveys.

Probabilistic sample surveys allow for the control of biases and the application of inferential statistics. They can yield basic data on site variability and geographic distributions relevant to a variety of research and management needs. Regional surveys are particularly useful for the study of land use patterns and the development and testing of predictive models of site location. Probabilistic sampling can also be used in smaller study areas purposefully chosen to examine areal gaps or to fulfill management priorities.

Purposive samples or survey areas are chosen on the basis of reasoned judgments in order to address particular research problems or management concerns. Such problems might include the discovery of rare or clustered site-types; the filling of gaps in areal coverage or random sample surveys; or the collection of specific, problem-oriented data. Inherent biases are offset by the researcher's ability to employ previous knowledge, relevant models or concepts, and professional insight. Sources for purposive selection include the results of previous surveys; existing predictive models; knowledge of the distribution of limited natural resources; ethnographic data; information solicited from informants; professional judgment; and the distribution of areal data gaps.

Particular study areas can be purposefully selected for intensive coverage. Intensive surveys usually preceed specific construction projects, the goal being clearance or the development of data recovery strategies. However, such study areas need not be project specific. They can be selected for the evaluation of research or management problems. Intensive surveys of areal blocks can contribute to subregional analyses of settlement and land use patterns. Spatial patterning and interrelationships among sites, low density scatters, isolates, and natural features can be examined in detail. Distributional studies of artifacts and features can reveal the dynamics of prehistoric foraging behavior. Survey blocks of high priority could include areas threatened by severe impacts from future land use; zones surrounding rare or particularly significant site types; or areas potentially eligible as National Register districts.

Inventories of a region or study area can incorporate several phases consisting of different types of surveys or an increasingly narrow focus on specific areas. Inventory phases can be designed on the basis of previous survey results. Efficiency is enhanced by the continual refinement of problems and goals. For example, after basic patterns of site distribution are established, efforts can focus on areas likely to yield more information and a better site discovery rate per unit effort (Schiffer and Wells 1982).

Researchers have stressed a need for both probabilistic and purposive surveys (Schiffer and Wells 1982:379). According to Plog, Plog, and Wait (1978:405):

> Most projects will reflect an evolution from a relatively heavy reliance on probabilistic devices in the early stages of the research process, when the dangers of bias are greatest, to a heavy reliance on judgmental criteria at later stages, when the need for specific categories of data can be more precisely identified.

They offered a series of three phases for regional surveys: (1) a simple random or "areally stratified" random sample, the latter with strata of equal size and sample fraction, for the construction of a relative density map; (2) a stratified random sample based on the density map, with denser areas sampled at a higher fraction; and (3) purposive surveys of smaller areal blocks for the definition of spatial patterning in major areas of settlement.

Schiffer (Schiffer, Sullivan, and Klinger 1978; Schiffer and Wells 1982) proposed that sample transect surveys be followed by purposive and areal block surveys. The initial phase, geared toward site discovery and the evaluation of site variety, would incorporate very long (1-3 miles) transects covered at low intensities (100 meter intervals). These transect lengths and coverage intervals were said to minimize the costs of site discovery. However, they are of questionable value. The interval is suitable only for an initial reconnaissance, since many loci would be missed or inadequately recorded. Extremely long transects could incorporate a considerable degree of environmental variability, complicating the correlation of site distributions with environmental variables. A stratified random sample of a larger number of smaller survey units seems preferable to Schiffer's strategy for the initial phase. However, the basic sequence of a sample survey followed by purposive and block surveys is a workable strategy. According to Schiffer, purposive surveys would focus on "priority areas" predicted to have high site densities or rare sites. Such priority zones could be surveyed intensively at low spacing intervals. This phase could also target the "rich and varied nonsite resource base" (Schiffer and Wells 1982:380).

Rogge and Lincoln (1984) reported that predictive models of site location, based on probabilistic sample surveys structured by environmental zones, did not work well in the Santa Cruz River valley of south central Arizona. In this area, large Hohokam communities or "big sites" exerted a great influence on resulting settlement patterns. Altschul and Nagle (n.d.) suggested that stratified sampling designs could be based on the locations of "big sites" discovered by aerial reconnaissance. Although such a strategy would be useful in many areas of the Southwest, it would not work where "big sites" are absent or difficult to detect.

In summary, inventory phases within regions or project areas generally incorporate a progressive focus on smaller areas and more specific problems and a shift from relatively unbiased to more purposive approaches. Proposed strategies for research or management oriented surveys

tend to follow a progression from reconnaissance to probabilistic samples to purposive and intensive block surveys. Intensive, project defined surveys, such as transmission line transects, also commonly incorporate a series of increasingly specific phases culminating in data recovery.

PLANNING FOR FUTURE INVENTORIES IN WEST CENTRAL ARIZONA

Phased inventory strategies and large-scale regional sample surveys were not carried out extensively until the advent of cultural resource management studies in the 1970s (Schiffer and Gumerman 1977). In the western United States, large sample surveys have been conducted primarily by Federal agencies for purposes of legally mandated inventories of cultural resources, long range planning, and the preparation of environmental impact statements (Berry 1984; Cook and Fulmer 1981; Coombs 1979a,b; Gallegos 1980; Giorgi and Kincaid 1980; Larralde and Chandler 1980; Plog 1978; Thompson 1978; Weide 1973).

Nevertheless, in many regions, the majority of known sites were recorded during early reconnaissance efforts, purposive investigations, and intensive, contracted surveys of project areas. This is true in much of southwestern and west central Arizona (McGuire and Schiffer 1982). This situation reflects the history of archaeological survey and the nature of modern land use. Most future surveys, particularly in remote areas with relatively unspectacular remains, will probably be funded and carried out in connection with specific modern land uses. The BLM will carry out or oversee such projects. Project-specific surveys, conducted prior to changes in land use or ownership status, should obviously receive the highest priority, since specific projects may directly threaten cultural resources. However, since such surveys are likely to be clustered in particular environmental zones or located near previously surveyed areas, they may not adequately serve overall planning and inventory needs. Thus the BLM should not neglect Class II phased surveys and related Class III surveys designed to serve explicit research or management purposes. As Plog (1981:163) recommended, some inventory should be accomplished "in areas where immediate project needs are not substantial". All surveys, project-specific or not, should be conducted with regional research and long term management objectives in mind.

Several factors need to be considered in planning for future surveys. These factors are listed in Table 14-1. Table 14-2 presents an outline for assigning priorities for inventory.

As previously discussed, surveys associated with development projects or land exchanges will necessarily receive first priority. In general, this priority should also apply to any area where there is an imminent threat to cultural resources, such as heavy ORV use or probable vandalism. For regional planning information, BLM Manual 8111 defines the initial, most obvious priority: Phase II sample surveys designed to provide basic, unbiased data on the nature and distribution of cultural resources throughout the targeted region. Surveys associated with such management activities as the preparation of cultural resource management plans and environmental impact statements are also a high priority. Assessment of additional survey priorities should involve the consideration of baseline factors, informational gaps, research needs, and projected impacts from land use activities. Efforts should focus on areas having a combination of sensitive values for several factors. An example would be an area expected to contain concentrated, diverse, or rare cultural resources, located in an environmental zone that has received little survey coverage due to remoteness or predominantly private ownership.

Previous surveys, land disturbance, or existing predictive models may indicate that certain zones have a low expected density or diversity of cultural resources. These areas can be assigned a lower priority for inventory, but they should not be "written off" entirely. At the least, additional information from such areas could contribute to the testing and refinement of predictive models by confirming a paucity of archaeological remains in certain zones. However, there is also the possibility of surprises. Such areas might include sites which were previously difficult to detect or recognize. Examples would be buried sites or rare site types only recently recognized by researchers, such as metate manufacturing areas. Cultural resources might also be associated with natural resources not previously recognized as being important in aboriginal economies. In areas of relatively low expected density or limited potential for research, emphasis should be placed on survey efficiency. Methods could involve relatively low sample fractions and an emphasis on purposive selection of survey units.

The West Central Desert: Baseline Considerations

Although much work remains to be accomplished, the past 15 years have witnessed a great acceleration in the number of intensive and sample surveys conducted in the study area. As a consequence of recent archaeological research, the region no longer represents the informational void perceived by Euler in his 1963 review of western Arizona prehistory.

Despite this relative proliferation of data, gaps and biases exist in the regional data base. Areal gaps reflect the locations of completed surveys and the distribution of public, state, and private lands. Federal lands in the study area, as well as smaller zones of mixed ownership in the Butler Valley, Alamo Lake, and Black Mountains areas, have been covered by low level sample surveys (less than 10% sample fractions). The majority of intensive surveys have consisted of narrow transects, in addition to intensive surveys of areas in the Harquahala Valley and Palo Verde Hills, concentrated in zones of relatively low relief and elevation. Mountainous zones, and to a lesser extent upper bajadas, have received relatively little coverage. Except for transect crossings and projects within Alamo Lake State Park and the Harquahala Valley Irrigation District, riparian zones along rivers and major washes have been largely ignored. This latter gap can be attributed primarily to patterns of land ownership and use.

TABLE 14-1

CONSIDERATIONS FOR PLANNING FUTURE SURVEYS

I. Baseline Considerations

A. Present status of the regional data base: size, reliability, degree of documentation, existence of Class II sample survey data.

B. Land ownership patterns: large contiguous areas vs. small dispersed plots vs. "checkerboard" federal holdings; under-representations of certain environmental zones.

II. Specific Research or Management Priorities

A. Preparation of planning documents and environmental impact statements.

B. Preparation of cultural resource management plans.

C. Special projects: Vandalism assessment, land exchanges, etc.

D. Regional predictive modeling: development, testing and refinement.

III. Present and Future Land Use

A. Geographic distribution and nature of activities.

B. Projected impacts on cultural resources.

IV. Informational Gaps

A. Regional or environmental gaps related to survey area or sample biases, land ownership patterns, or poor access.

B. Gaps related to research priorities; these may correlate with regional gaps.

Approximately two-thirds of the desert portion of west central Arizona is administered by the BLM. Federal land tends to be distributed continuously in large blocks. Mountain ranges, pediments, and upper bajada zones are almost entirely under federal administration, as are vast areas of the desert basins. With a few exceptions, the distribution of state and private lands is correlated in space, forming blocks of property in the vicinity of towns and major washes. Major blocks are located along Centennial Wash in the McMullen and Harquahala valleys and along Bouse Wash on the Ranegras Plain. The major consequence of land ownership patterns has been the disturbance of riparian zones and a limited survey coverage of areas adjacent to major washes.

The Class II Survey. Management priorities and available funds for the preparation of a grazing environmental impact statement led to the completion of a Class II regional sample inventory between 1979 and 1981 (BLM 1982; Giorgi and Bayer 1981). The survey was designed to yield basic information on the types, distributions, environmental associations and overall density of archaeological sites in the Harcuvar and Vulture planning units which together comprise the desert portion of the overview area. A stratified random sampling design was employed, incorporating five sampling strata defined on the basis of slope and topography: flats, dissected areas, upper bajadas, open canyons, and mountains (Giorgi and Bayer 1981). Flats incorporated valley floors of less than 5% slope.

TABLE 14-2

OUTLINE FOR ASSIGNING PRIORITIES FOR INVENTORY

Priority I: High probability of imminent cultural resource destruction or significant deterioration associated with natural processes or changes in land use or ownership status.

A. Project and area-specific impacts from construction projects or agency actions.

B. Unauthorized, area-specific impacts from ongoing vandalism, heavy ORV use, etc.

C. Conditions of severe erosion or weathering.

Priority II: Management and planning directive.

A. Information for preparation and updating of planning documents and environmental impact statements.

B. Establishment of special management areas for cultural resources and preparation of cultural resource management plans.

Priority III: Basic knowledge for cultural resource management.

A. Closing of informational and regional gaps.

B. Documentation of areas with particularly concentrated, diverse, rare or valuable cultural resources.

C. Testing and refinement of predictive models.

In this category, three factors can be used to assign inventory priorities: expected research potential, data gaps, and the relative severity of threats to the integrity of cultural resources.

Priority	Expected Research Potential	Data Gap	Threats
1	High	Present	Severe
2	High	Present	Minimal
3	Low	Present	Minimal
4	Low	None	

Dissected areas included zones of broken ridges, foothills, and highly dissected alluvial fans in areas of 5-20% slope. The upper bajada stratum represented the pediment zone with a slope range of 5-20%. In areas of higher overall slope, open canyons and passes ranged between 0.5 and 1 km in width. The mountain stratum incorporated rugged areas and constricted canyons. Table 14-3 describes the Harcuvar-Vulture sampling design. Basin flats were sampled at a lower fraction than were the bajada and mountainous zones. The latter areas, particularly the upper bajada and canyons, were poorly known areas expected to yield evidence of human activities, as indicated by ethnographic data and other Sonoran Desert surveys. These areas were sampled at higher fractions in order to enhance the efficiency and utility of the sample survey. Sample units consisting of 40 acre quadrats (quarter-quarter sections) were randomly selected from each stratum. However, units of 160 acres were selected in the mountain stratum. These larger units decreased the effort required to survey and gain access to steep, rugged areas. Finally, in addition to the stratified random sample, a purposive sample incorporating 800 acres targeted the areas surrounding several extant springs.

The total sample represented approximately 1.1% of BLM-administered lands in the study area. Areal biases reflected the distribution of state and private lands, resulting primarily in a paucity of potential sample units along the margins of major drainages, as well as reduced coverage of the Black Mountains and the Hassayampa Plain. Fortunately, other sample surveys and intensive transect surveys have provided information on many of these areas (Bostwick n.d.; Brown and Stone 1982; Kemrer, Schultz, and Dodge 1972; Powers, Granger, and Keller 1978; Stein 1981; Stone 1977, 1985).

Intensive surveys of the sample units documented over 75 sites and numerous isolates in the random sample as well as 17 sites in peripheral areas or purposive sample units. A series of standardized forms were used to record the size, artifact densities, assemblage characteristics, features, and environmental context of sites. Environmental data were recorded for all units. Of the 316 random sample units, 59% yielded no remains; 21% were "subsite" units with isolates only; 16% contained a single site; and 4% had 2 or more sites. Over half of the sample units containing sites also yielded isolates. These results are not inconsistent with those from other desert regions incorporating large areas of low cultural resource density. For example, in northeastern Utah, a Class II survey of 274 40-acre units yielded only 41 sites and 106 isolates (Larralde and Chandler 1980).

TABLE 14-3

THE HARCUVAR - VULTURE SAMPLING DESIGN

Stratum	Percent of Total BLM Area	No. of Units	Acreage	Sample Fraction	Percent of Surveyed Area
Flats	62.1	109 (40ac)	4,360	0.5	28.3
Upper Bajada	5.4	82 (40ac)	3,280	4.3	21.3
Dissected Areas	9.8	55 (40ac)	2,200	1.6	14.3
Open Canyon	3.0	47 (40ac)	1,880	4.4	12.2
Mountains	19.7	23 (160ac)	3,680	1.3	23.9
Total	100.0	316	15,400	1.1	100.0
Purposive	800				
Grand Total	16,200 acres				

Tables 14-4 and 14-5 offer a general summary of the distribution of cultural resources among the environmental strata. The first table shows, within each stratum, the percentage of sample units containing sites, subsites, and no remains. In the second table, which compares the results between strata, the percentages are adjusted to compensate for the larger size of mountain sample units. Large proportions of the dissected and mountain strata yielded no cultural resources or isolates only. Although the upper bajada and open canyon strata comprised 33% of the total surveyed acreage, they contained 54% of the sites and 53% of the sample units with sites. Since these strata constituted only 8% of the total BLM land area, it appears that cultural resources tend to be geographically concentrated in these zones. The basin flats showed a disproportionately high percentage of sample units containing isolates only. This indicates that low density scatters predominate in such areas. The overall results indicate that cultural resources tend to be concentrated in space and that environmental factors figure strongly in their distribution. Ongoing analyses will address these patterns in greater detail.

TABLE 14-4

SUMMARY OF CLASS II SURVEY RESULTS WITHIN STRATA

Stratum	Percent of Empty Units	Percent of Units, Isolates Only	Percent of Units With Sites	Total Percentage
Flats	51	29	19	99
Bajada	59	17	24	100
Dissected	76	11	13	100
Canyons	55	17	27	99
Mountains	70	22	9	101
Mountains*	90	7	3	100

*Adjusted for unit sizes.

TABLE 14-5

SUMMARY OF CLASS II SURVEY RESULTS COMPARING STRATA

Stratum	Percent of Surveyed Area	Percent of All Sites	Percent of Empty Units	Percent of Units with Only Isolates	Percent of Units with Sites
Flats	28	29	22	49	33
Bajada	21	35	19	22	32
Dissected	14	15	16	9	11
Canyons	12	19	10	12	21
Mountains*	24	3	33	8	3
Total Percent	99	101	100	100	100

* Adjusted for unit sizes.

The West Central Desert: Recommendations

The Class II sample survey and existing site file data have provided a basis for management decisions and future research in west central Arizona. There is little need for any additional large scale, low level sample inventory. However, this option should be kept open for the testing of any predictive locational models generated on the basis of the stratified random sample.

Inventory planning should focus on informational and areal gaps, specific research or management priorities, and followup studies based on the Class II survey results. There is a need for purposive surveys to locate rare, particularly significant site types. Purposive surveys, involving either intensive block coverage or sampling, could target the following types of areas: those expected to yield rare site types or a relatively high density or diversity of cultural resources; areas expected to yield either very ancient sites or historic aboriginal sites; open canyons, pediment zones, springs and waterholes, and the margins of major drainages; and areas for which environmental impact statements or cultural resource management plans are under preparation. Purposive surveys should be systematically conducted to enable comparison with the results from other surveys. They should thus incorporate standardized recording procedures, explicit coverage intervals, and units or transects of specified size, shape, and orientation.

In the eastern portion of the study area, lower Centennial Wash is likely to yield Archaic, Hohokam, and late prehistoric Patayan or Yuman sites. Reported sites include possible base camps. Federally owned areas along this major drainage should be examined, since much private land has been disturbed by ranching and agricultural activities. In addition, the Palo Verde nuclear power plant will continue to generate human traffic that may threaten sites in the area. In the vicinity of the power plant, the Jagow Wells area, a possible ceremonial complex, has been proposed as a possible National Register district; however, much of that area is privately owned (Landon 1980). Saddle Mountain deserves closer scrutiny; reported sites include caves, sites with shell remains, Archaic artifact scatters, and possible agricultural terraces. The mountain may also yield lithic quarries. Saddle Mountain is a highly accessible recreational area, and its sites are vulnerable to vandalism.

In the southwestern portion of the study area, the Eagletail Mountains promise to yield Archaic or even earlier remains. At the northwestern end of the range, Malcolm Rogers documented ancient lithic scatters. These scatters, as well as a quarry site, have been revisited by archaeologists from Arizona State University and the BLM. Cultural resources may well be associated with the Archaic occupation of Centennial Wash (Bostwick n.d.; Brown and Stone 1982). In addition, amateur archaeologists have recently reported an unusual association of rock rings and prehistoric ceramics in open canyons. The desert pavements surrounding the western end of this range would be a good location for block or sample surveys. Areal block surveys could incorporate the mapping of low density scatters, rock features, lithic raw materials, and trails. The Eagletails are also reported to contain cave sites, and the Eagletail petroglyph site (AZ S:11:1 (ASM)) is probably the best National Register candidate in the study area (Stone 1986).

In the central and western portions of the study area, zones of high cultural resource potential include the margins of Bouse Wash, the canyons and pediments of Harquahala and Harcuvar mountain ranges, and the Black Butte area at the intersection of the Big Horn and Vulture ranges. San Dieguito, Archaic, Patayan, and Hohokam materials have been reported along Bouse Wash, and the Ranegras Plain is undergoing intensive agricultural development. Cave sites have been reported in the Big Horn Mountains. The Harquahala and Harcuvar ranges offered a variety of natural resources, including water, to native groups. They are known to contain possible hunting camps, base camps, and such unusual features as large roasting pits and pictographs. The bajadas, canyons, and spring areas deserve more detailed study. Such study could incorporate purposive surveys of particular canyons. Another interesting area incorporates the southeastern extension of the Harcuvars, the eastern end of the Harquahalas, and the Eagle Eye Peak area. This triangular zone seems to one of cultural diversity incorporating rockshelters and possible base camps used by the Patayan, Yavapai, Prescott, and Hohokam cultures. It may have incorporated a major travel route, and it also affords an opportunity to examine the utilization of the Vulture obsidian source.

At the northern margin of the study area, the terrace margins of the Bill Williams and Santa Maria rivers, as well as spring areas in the Black Mountains, may contain base camps. Recreational traffic and erosion threaten these cultural resources. Table 14-6 summarizes inventory recommendations for the desert zone of the overview study area.

Class III Clearance Surveys

Archaeological researchers in central Arizona have demonstrated that small clearance surveys, considered as a cumulative body of data, can contribute to the study of regional research problems (Green and Effland 1985; Powell and Rice 1981). According to Powell and Rice (1981:602), "it is necessary to treat each small survey as a sample unit within a region and to synthesize the data from several such surveys". Despite locational biases, they suggested that "a systematic or random sample can be approximated in nearly every case by finding appropriate means of stratifying the regional universe" (Powell and Rice 1981:609). Clearance surveys should be conducted systematically within explicitly defined boundaries. To increase the utility of such surveys, Powell and Rice (1981:609) recommended a minimum survey unit size of 10 acres. Likewise, in his overview of the Little Colorado region, Plog (1981:163) recommended that very small and irregular project areas be expanded and redefined within regular boundaries.

The Skull Valley Zone: Recommendations

The existing data base for this area is so limited that nearly any inventory effort would be a major contribution. Lands administered by the BLM constitute a relatively small proportion of the total area. Large blocks of BLM land are confined to the area between Wickenburg and Yarnell east of State Highway 89. Smaller blocks ranging from 5 to 12 square miles are located near Copper Basin, in the Aguila Valley, and in the area between Congress and the Date

TABLE 14-6

INVENTORY RECOMMENDATIONS FOR THE DESERT ZONE

I. **Riparian and Xeroriparian Zones**

A. Terraces of Bill Williams and Santa Maria rivers.

B. Areas along Bouse Wash.

C. Areas along Centennial Wash, particularly in the vicinity of Palo Verde Hills.

D. Areas surrounding springs; resurvey of spring areas in Harquahala Mountains.

II. **Desert Pavement Zones and Pediments**

A. Base of Eagletail Mountains, particularly at NW end.

B. Southern base of Harquahala and Harcuvar ranges.

C. Areas surrounding Saddle Mountain and the Black Mountains.

III. **Canyons**

A. Harquahala and Harcuvar Mountains.

B. Eagletail Mountains.

C. Black Mountains

D. Saddle Mountain

IV. **Other Potentially Sensitive or Poorly Known Areas**

A. Black Butte area in Vulture Mountains.

B. Eastern extension of Harcuvar Mountains.

C. Eagle Eye Peak/Tiger Wash area.

D. Sugarloaf Mountain area in Big Horn Mountains.

E. Geological zones likely to contain caves, rockshelters, or high quality lithic raw materials.

F. The chaparral vegetation zone.

Creek Mountains. Otherwise, BLM lands consist of small, scattered parcels. State lands cover much of the area, but the Peeples, Kirkland, and Skull valleys consist predominantly of private lands.

Archaeologists should be sensitive to the detection of buried sites in this area. Geomorphological information could indicate likely zones of Holocene soil deposition. Eroded stream banks or dune areas should be checked for the existence of buried archaeological deposits. Dense vegetation in the grassland or chaparral zones could also restrict the visibility of sites.

Jeter (1977) and Wood (1980) stressed the need for probabilistic sample surveys to obtain basic information on the types and distribution of archaeological sites. Wood (1980:103) offered recommendations for future inventory in the Kirkland Creek watershed north of the Weaver Mountains. He reasoned that it was first necessary to "re-record existing inventory at currently acceptable information standards". Inadequately documented sites, such as reported "Hohokam" pithouse villages and ball courts, should be relocated and reevaluated. Wood advocated a subsequent program of systematic transect sampling in the valleys of the Kirkland Creek watershed. Transects spaced at one-half to one mile intervals would be oriented perpendicular to streamcourses. They would extend for a minimum distance of a mile beyond the limits of the streambed or any existing parcel of Lynx loam. A program of stratified random transect sampling, conducted at a lower sample fraction, was proposed for the bordering upland areas. Finally, Wood proposed that purposive sampling, followed by testing programs, be used to test and refine models of site location.

Probabilistic sample surveys (Class II inventories) are also needed in areas administered by the BLM. A stratified random sample would yield important basic information for the block of land east of Highway 89. This area incorporates flats, bajada zones, foothills, and canyons. Stratification schemes could be based on these topographic zones. Vegetation zones provide a less acceptable basis for stratification, since historic grazing has altered vegetation patterns.

Simple random sample surveys are advocated for the smaller blocks of land in the Congress area and the Aguila Valley. A sample survey of the Copper Basin block would provide comparative information for assessing the predictive models developed from Jeter's study of the adjacent area.

Purposive surveys should be conducted in areas expected to contain habitation sites, unusual site types, or a high density or variety of cultural resources. Hilltops should be examined for the presence of "forts". Sites may be associated with springs in the mountain canyons. Major drainages are likely to be "sensitive" areas; these include the Hassayampa River and intermittent creeks south of the Weaver and Date Creek Mountains. The latter drainages include Weaver, Antelope, and Martinez Creeks and Sols Wash. The Yavapai are reported to have farmed along drainages in the Congress area (Mariella 1983), and Schroeder's (1979) land claims maps showed Yavapai "camps" south of the Date Creek Mountains. These areas should receive special consideration in the implementation of long range inventory and management plans. Table 14-7 summarizes inventory recommendations for the Skull Valley zone. Map 14-1 shows recommended inventory zones on federally administered lands in the overview area, also known as the Lower Gila North planning area.

TABLE 14-7

INVENTORY RECOMMENDATIONS FOR THE SKULL VALLEY ZONE

I. Basic Site Type and Distributional Data

A. Stratified random sample survey of Wickenburg-Yarnell block of federal land.

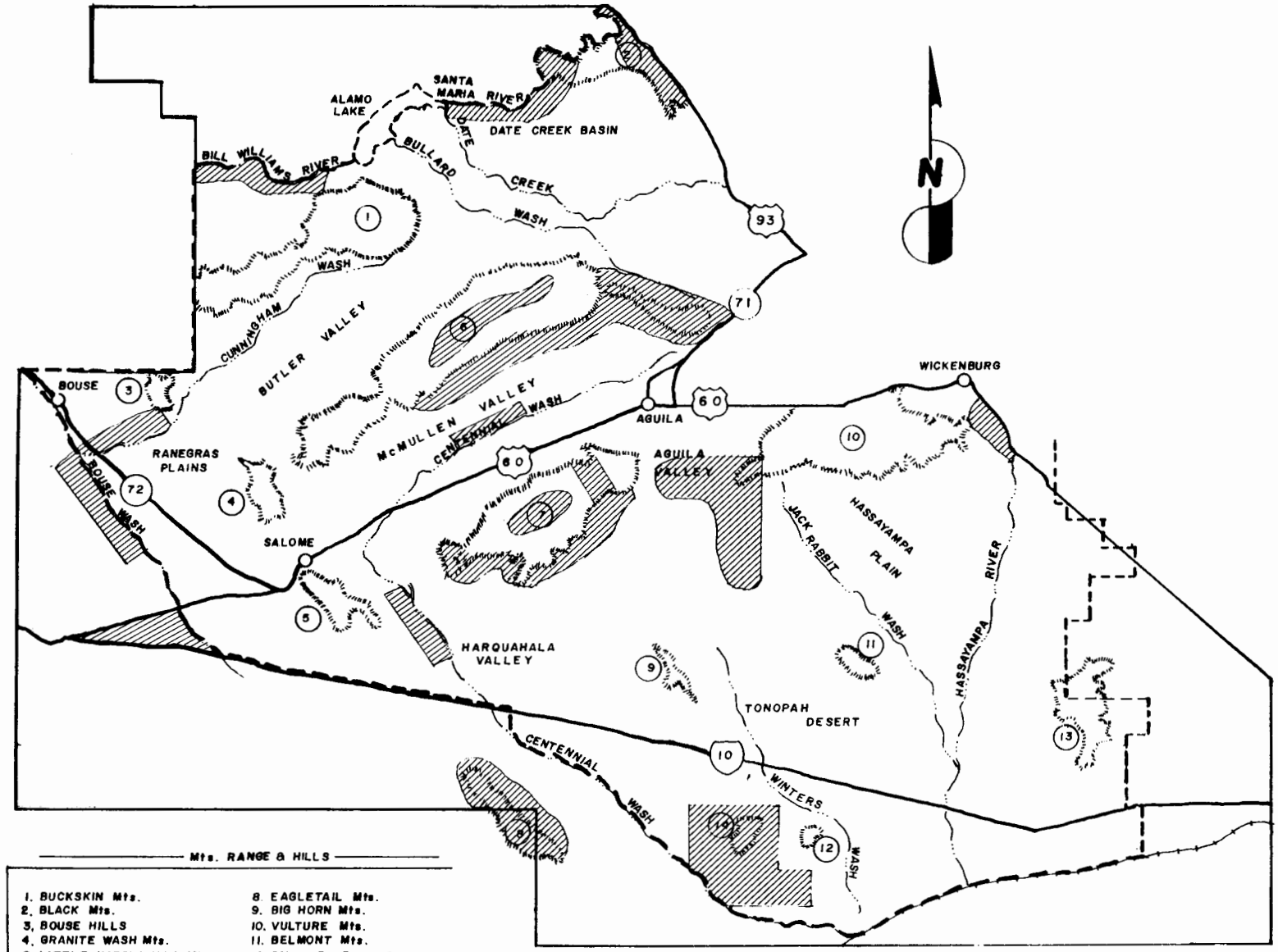
B. Simple random sample surveys of other blocks of federal land in vicinity of Copper Basin, Congress, Aguila Valley, and Parker Mesa east of Peeples Valley.

II. Purposive Surveys

A. Areas along the Hassayampa River, major creeks and washes.

B. Areas surrounding springs.

C. Hilltops as possible "fort" sites.



Mts. RANGE & HILLS

1. BUCKSKIN Mts.
2. BLACK Mts.
3. BOUSE HILLS
4. GRANITE WASH Mts.
5. LITTLE HARQUAHALA Mts.
6. HARCUVAR Mts.
7. HARQUAHALA Mts.
8. EAGLETAIL Mts.
9. BIG HORN Mts.
10. VULTURE Mts.
11. BELMONT Mts.
12. PALO VERDE HILLS
13. WHITE TANKS Mts.
14. SADDLE Mts.

—Mountain ranges are drawn at 2500 ft contour.—

MAP 14-1a: RECOMMENDED AREAS FOR INVENTORY: FEDERAL LANDS IN THE DESERT ZONE

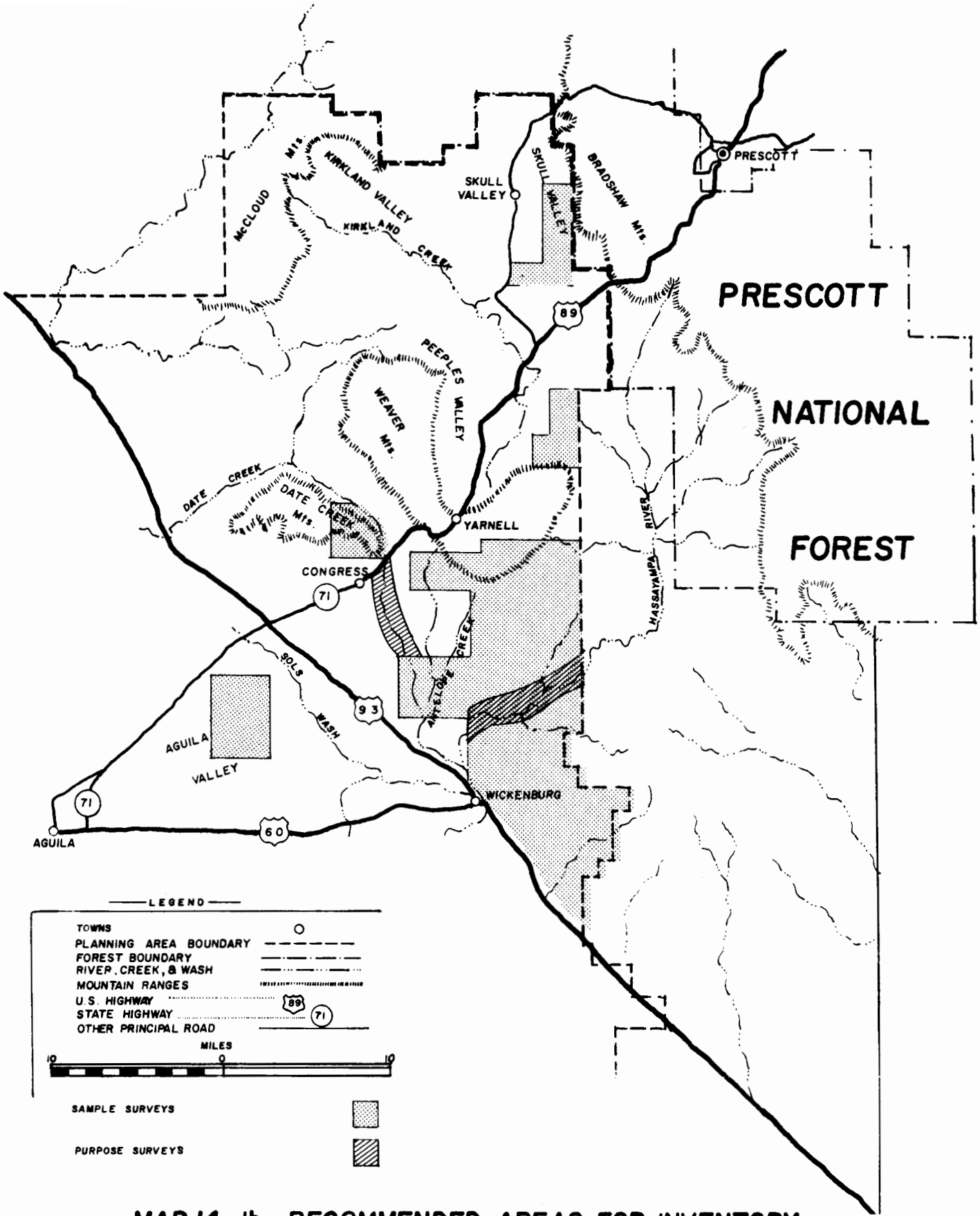
LEGEND

STUDY AREA BOUNDARY
PLANNING AREA BOUNDARY
MOUNTAIN RANGES
TOWNS

INTERSTATE HIGHWAY 10
U.S HIGHWAY 60
STATE HIGHWAY 71

RAILROAD

10 0 10
MILES



MAP 14-1b: RECOMMENDED AREAS FOR INVENTORY: FEDERAL LAND IN THE SKULL VALLEY ZONE

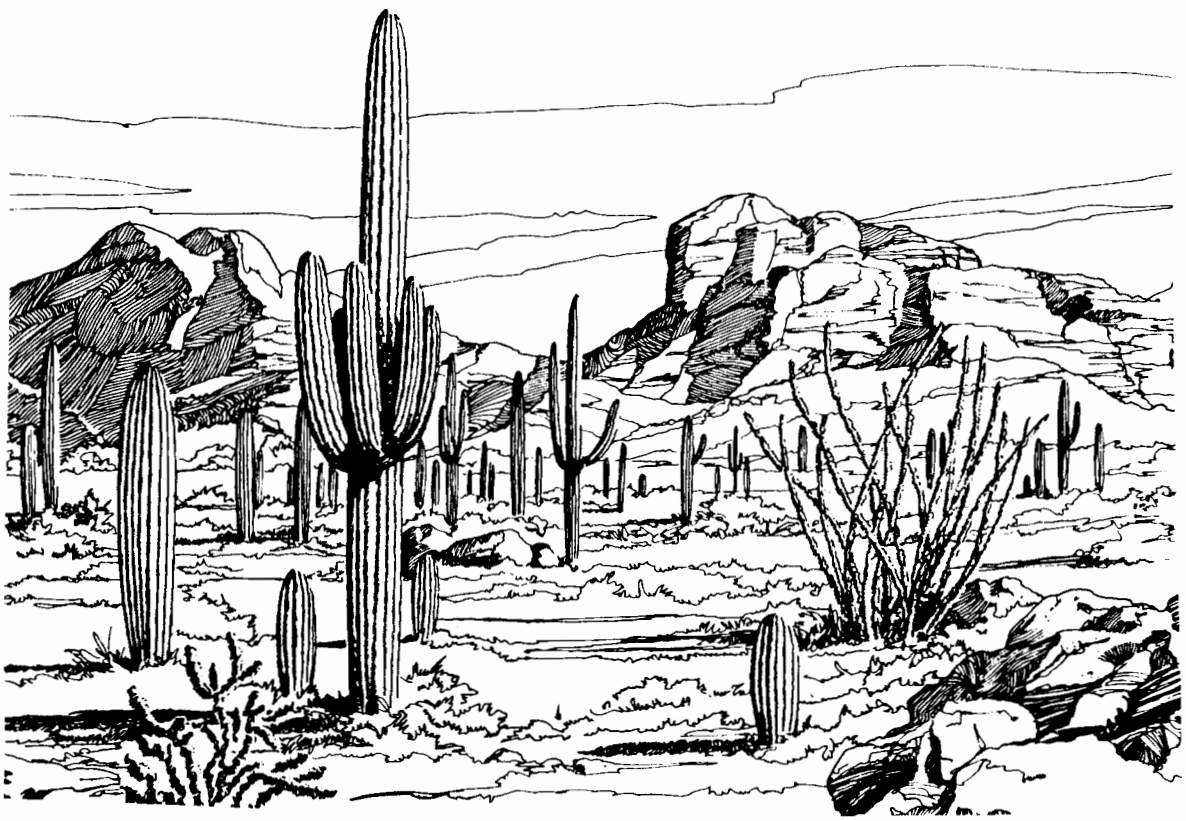
A Note on Predictive Modeling

Predictive locational modeling represents an interface between archaeological research and cultural resource management. In the former case, predictive locational models reflect the theoretical and methodological complexities of research in human settlement, economic, and social systems. In terms of management, they have been recognized as potentially useful, cost effective tools in long term regional planning. In accordance with this dual role, the issue of predictive modeling has generated controversy. Not only do archaeologists disagree on appropriate methods and theoretical orientations; they also recognize a grave potential for the generation of inadequate, inaccurate, or poorly tested models, their subsequent misuse, and a consequent loss of cultural resources. It will take years to resolve such issues, if they can be resolved at all.

In recognition of both the controversial nature and the potential utility of predictive locational models, the Bureau of Land Management recently commissioned a detailed study of predictive modeling (Judge and Sebastian n.d.). Although controversies may remain unresolved, the final report should serve as a useful basic reference for all professionals.

West central Arizona represents a good potential laboratory for the generation and testing of predictive locational models. Its boundaries roughly coincide with those of at least one aboriginal settlement system, that of a regional band of the Western Yavapai (Gifford 1936; Schroeder 1959). Natural resources of probable importance to prehistoric folk, such as water and particular plants, tend to be limited or highly localized in distribution. These environmental constraints indicate a possibility of clear relationships between prehistoric land use patterns and environmental factors. Initial predictive models were generated during the Granite Reef project (Brown and Rubin 1982), and the author is undertaking further analyses. It is important to stress that present models do not provide an adequate basis for specific management decisions, although they can provide a preliminary context for long term planning. At this point in time, the Class I overview is a more appropriate resource for management decisions.

In the future, the BLM should explore possibilities for predictive modeling in conjunction with the adoption of computerized geographic information systems. Such systems represent an unparalleled resource for spatial information processing, multidisciplinary studies, and multiple use management. However, technical sophistication in the generation of maps need not indicate a similar degree of sophistication in data collection or analytical techniques. Researchers and managers should reject a "pinball mentality" which focuses on the "artistry" of the final product rather than its analytical validity (Fishbine 1980).



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