DOLORES ARCHAEOLOGICAL PROGRAM TECHNICAL REPORTS

Report Number: DAP-084

Grass Mesa Village (Site 5MT23), Overview and Surface Collection Results: 1979 and 1980

by

Timothy A. Kohler

Prepared for
Cultural Resources Mitigation Program: Dolores Project
Bureau of Reclamation, Upper Colorado Region
Contract No. 8-07-40-S0562

Under the supervision of
David A. Breternitz, Senior Principal Investigator

Final Submission

22 November 1983

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

Grass Mesa Village (Site 5MT23) is a large Pueblo I habitation site in southwestern Colorado. During investigation by the Dolores Archaeological Program in 1979 and 1980, a systematic surface collection was completed, and a probability sampling program was initiated alongside more intensive excavations. A total of 42 surface structures and 20 pitstructures (including a possible great kiva) were wholly or partially excavated during these first two field seasons. A statistical comparison of the results of the surface collection with the results of the probability sample suggests that the surface collection is not representative of total site content. However, the distributions of stone building materials and other artifacts on the surface were used to predict the locations of structures, and the ceramic materials recovered from the surface were used to tentatively place the site within the Dolores Archaeological Program temporal sequence. Based on ceramic dating evidence, the occupations of the site are believed to have spanned the Dos Casas (A.D. 760-850), Periman (A.D. 850-900), and Grass Mesa (A.D. 880-925) Subphases, with the population peak occurring sometime during the Periman Subphase. Future investigations at Grass Mesa will be directed toward further clarification of the spatial, temporal, and functional relationships of the various surface structures and pitstructures and toward the refinement of the chronological placement of the various occupations of the site.

INTRODUCTION

This report summarizes the first two seasons of investigation by the DAP (Dolores Archaeological Program) at Grass Mesa Village (Site 5MT23) located in southwestern Colorado. Because two more seasons of excavation are required to fulfill research objectives at the site, this is a progress report. During the 1979 and 1980 seasons, the gridding and surface collection operations were completed, as was the probability sampling program in Areas 1, 3, 4, 5, and 7. In addition, substantial additional excavations were undertaken in Areas 3, 4, and 5.

Grass Mesa Village is unique in the DAP area. Although it is not the largest of the several Pueblo I villages known in the Escalante Sector, the density and frequent superpositioning of structures at the site and the amount of cultural material on the surface suggest that the population density was greater at Grass Mesa Village than elsewhere in the sector during much of the McPhee Phase. The site is the farthest downstream of the McPhee Phase villages investigated to date in the Dolores River valley. Of these villages, Grass Mesa is the only one that has severely limited space and potential defensive advantages. An unusual and still not fully understood feature, tentatively called a great kiva, is located at the site; this type of structure appears to have been unique in the sector during the first half of the ninth century A.D. In addition to the large pithouses typical of the mid-A.D. 800's, smaller, later pit-structures, often lacking typical architectural features, appear to have functioned as domiciles as well. The arrangement of these structures ranges from the formal Pueblo I plan to a more haphazard intermingling of pitstructures, surface structures, and trash in some areas of the site.

The challenge of Grass Mesa to the DAP is to provide a record of the complex history of construction and occupation at the site and to provide explanations for some of the unique characteristics just discussed. This overview is primarily descriptive and is intended to summarize the progress made by the DAP in addressing these issues. In addition, the various occupations at Grass Mesa Village are tentatively placed within the DAP temporal scheme, based on ceramic dating evidence.

Environmental Setting

Grass Mesa Village was constructed on loess and fluvially deposited sediments atop a prominent outcrop of Junction Creek Sandstone that extends onto the flood plain of the Dolores River at its confluence with Beaver Creek and Dry Canyon (fig 1). From the center of the site 50 m above the flood plain, the view up the Dolores River valley is unobstructed for 7 km, while 3 km downstream the river takes a sharp bend to the south and flows through a restricted neck of the canyon, the site of the McPhee Dam. The elevation of the site above the valley floor is slight in comparison with the height of the canyon walls that tower another 230 m above Grass Mesa at an average slope of 20°. (Refer to Hogan 1980 and Kohler 1983 for discussions of Grass Mesa Locality, the 13-km^2 area immediately surrounding the village.) Figure 2 is an aerial view of Grass Mesa Village at the close of the 1979 field season.

A landform map of the Escalante Sector identifies the eroded remnant of Junction Creek Sandstone underlying the site as a second terrace (Leonhardy and Clay 1982). Two bedrock benches of indeterminate age occur in the Junction Creek Sandstone (Holliday and Piety 1980). The lower bench underlies the western and the southern portions of the site

Figure 2. Aerial view of Grass Mesa Village (DAP 053704). The top of the photo is southeast.

approximately Areas 5, 6, 7, and 8) and is covered by 2 to 3 m of well-rounded, cobble- and pebble-sized gravels of fluvial origin (Holliday and Piety 1980). These gravels are overlain by bedded sandy loam alluvium, which in turn is overlain by a 1- to 2-m layer of loess and alluvially deposited sediments that has provided the parent material for a well-developed, fine silty Mollisol, classified as Granath Loam (Leonhardy and Clay 1982). On the upper bench underlying Areas 1, 2, 3, and the northern portions of Areas 4 and 5, the gravels and loess are generally absent from the sequence, and a redder soil with a coarser-grained B horizon than that in Area 5 has developed out of the relatively shallow, sandy alluvium. Water has eroded much of this sandy alluvium and has cut a shallow trench into the bedrock between Area 1 at the eastern extreme of the site and the scarp of Junction Creek Sandstone rising above the site to the east.

Granath Loam is believed to be one of the most suitable soils in the sector for agriculture (Leonhardy and Clay 1982). Until the site was cleared for gridding, it was covered with a dense growth of sagebrush, rabbitbrush, true mountain mahogany, and squawbush (table 1). Portions of the western extreme of the site were obscured by a thick stand of scrub oak; wildrye, the grass that has given the site its popular name, was abundant in the shallow depressions that marked the locations of many of the pitstructures at the site. This grass is of particular interest because it is otherwise rare in the sector.

Table 2 provides a list of mammals and birds that are assumed to have been available to the prehistoric inhabitants of Grass Mesa Locality. The species included were drawn from a list of mammals and birds compiled from data in Benz (1981), Bissell (1978), and Kingery and Graul (1978).

Table 1. Plant species observed at Grass Mesa Village, June 1980

Scientific name	Common name
Trees:	
Pinus Ponderosa	Ponderosa pine
Pinus edulis	Pinyon pine (2-needle)
Juniperus spp.	Juniper
Quercus gambelii	Scrub oak
Shrubs:	
Fendlera rupicola	Cliff fendlerbush
Cercocarpus montanus	True mountain mahogany
Purshia tridentata	Antelope bitterbrush
Amelanchier utahensis	Utah serviceberry
Artemisia tridentata	Big sagebrush
Chrysothamnus nauseosus	Rubber rabbitbrush
Chrysothamnus viscidiflorus	Rabbitbrush
Peraphyllum ramosissimum	Squaw apple
Grasses:	
Bromus tectorum	Cheatgrass brome (exotic)
Elymus spp.	Wildrye
Oryzopsis hymenoides	Indian ricegrass
Stipa sp.	Needlegrass
Herbs:	
Penstemon spp.	Beardtongue
Sisymbrium spp.	Tumble mustard (exotic)
Cirsium spp.	Thistle (some spp. exotic)
Sphaeralcea coccinea	Scarlet globemallow
Lactuca spp.	Prickly lettuce
Eriogonum umbellatum	Sulphur eriogonum
Calochortus nuttallii	Mariposa lily
Stellaria spp.	Starwort (some spp. exotic)
Lappula spp.	Stickseed (some spp. exotic)
Cryptantha spp.	Cryptantha
Sedum lanceolatum	Wormleaf stonecrop
Yucca baccata	Broadleaf yucca
Melilotus officinalis	Yellow sweetclover (exotic)

Species were included in or excluded from this table on the basis of practical size as a food resource, availability in the Escalante Sector today, and/or occurrence in the Dolores area archaeological record. In addition to the species listed in table 2, many migratory birds (e.g., Charadriformes, the shore birds), small birds (e.g. Passeriformes, the perching birds), reptiles, amphibians, and fish might have been exploited by the inhabitants of Grass Mesa.

Table 3 compares the percentages of various geological formations, landforms, soil types, and vegetation types within a 1-km radius of the site with those for the 38 sites known for the locality during the 1979 field season and 38 points chosen at random within the portions of the locality surveyed by the end of the 1979 field season. The choice of a 1-km radius was arbitrary, but a wider radius would have merely increased the overlap among adjacent site catchments. The site appears to be located in such a way as to maximize the area of soils believed to be most suitable for agriculture within its catchment. It is also situated close to a permanent water source without sacrificing good drainage or view characteristics. Compared to the locations of all the sites in the locality and the set of randomly located points, Grass Mesa Village is situated adjacent to a notably diverse set of soil types and potential vegetation zones[1] (Shannon-Weiner diversity indices = 0.48 and 0.50, respectively; see table 3). Finally, river cobbles for building materials are readily available on the mesa, and the ascending ridge of Junction Creek Sandstone to the southeast provides convenient access to the wood and lithic resources of the uplands. In general, Grass Mesa Village is located in an area that has an abundant supply of the materials and resources usually recognized as essential to the Anasazi.

---

[1]Potential vegetation (Bye 1982) refers to the vegetation that would result if the persent-day environment were permitted to reach equilibrium with present climatic conditions; it is believed to reflect past vegetation, prior to human alteration, during periods when paleoclimatics resembled the present climate. Refer to Bye (1982) for a discussion of the potential vegetation zones defined in the Dolores Project area.

Table 2. Potential faunal resources in Grass Mesa Locality

Scientific name	Common name
Mammals:	
Ochotona princeps *	Pika
Sylvilagus audubonii	Desert cottontail
Sylvilagus nuttallii	Nuttall's cottontail
Lepus americanus*	Snowshoe hare
Lepus townsendii	White-tailed jackrabbit
Lepus californicus	Black-tailed jackrabbit
Eutamias minimus	Least chipmunk
Eutamias quadrivittatus	Colorado chipmunk
Marmota flaviventris	Yellow bellied marmot
Amnospermophilus leucurus	White-tailed antelope squirrel
Spermophilus spilosoma	Spotted ground squirrel
Spermophilus lateralis	Golden-mantled ground squirrel
Spermophilus variegatus	Rock squirrel
Cynomys gunnisoni	Gunnison's prairie dog
Sciurus aberti	Abert's squirrel
Tamiasciurus hudsonicus	Chickaree
Thomomys bottae	Valley pocket gopher
Thomomys talpoides	Northern pocket gopher
Pappogeomys castanops	Chestnut-faced pocket gopher
Perognathus flavus	Silky pocket mouse
Perognathus apache	Apache pocket mouse
Dipodomys ordii	Ord's kangaroo rat
Castor canadensis	Beaver
Reithrodontomys megalotis	Western harvest mouse
Peromyscus maniculatus	Deer mouse
Peromyscus boylii	Brush mouse
Peromyscus truei	Pinyon mouse
Peromyscus difficilis	Rock mouse
Peromyscus crinitus	Canyon mouse
Onochomys leucogaster	Northern grasshopper mouse
Neotoma cinerea	Bushy-tailed wood rat
Neotoma mexicana	Mexican wood rat
Neotoma albigula	White-throated wood rat
Microtus montanus	Montane vole
Microtus longicaudus	Long-tailed vole
Microtus mexicanus	Mexican vole
Microtus pennsylvanicus	Meadow vole
Clethrionomys gapperi	Gapper's red-backed vole
Phenacomys intermedius	Heather vole
Ondatra zibethicus	Muskrat
Zapus princeps	Western jumping mouse
Zapus hudsonius	Meadow jumping mouse
Erethizon dorsatum	Porcupine
Canis familiaris	Domestic dog
Canis latrans	Coyote
Canis lupus	Gray wolf

* Habitat preferences are for habitats located outside the Grass Mesa Locality, but these species are present in the DAP archaeological records.

Table 2. Potential faunal resources in Grass Mesa Locality--Continued

Scientific name	Common name
Vulpes vulpes	Red fox
Vulpes macrotis	Kit fox
Urocyon cinereoargenteus	Gray fox
Ursus americanas	Black bear
Ursus arctos	Grizzly bear
Bassariscus astutus	Ringtail
Procyon lotor	Raccoon
Martes americana	Marten
Mustela erminea	Ermine
Mustela vision	Mink
Mustela nigripes †	Black-footed ferret
Mustela frenata	Long-tailed weasel
Gulo gulo	Wolverine
Taxidea taxus	Badger
Spilogale putorius	Spotted skunk
Mephitis mephitis	Striped skunk
Lutra canadensis	River otter
Lynx rufus	Bobcat
Lynx canadensis	Canada lynx
Felis concolor	Mountain lion
Cervus elaphus	American elk
Odocoileus hemionus	Mule deer
Antilocapra americana	Pronghorn
Ovis canadensis	Bighorn
Birds:	
Ardea herodias	Great blue heron
Nycticorax nycticorax	Black-crowned night heron
Egretta thula	Snowy egret
Botaurus lentiginosus	American bittern
Plegadis chihi	White-faced ibis
Branta canadensis	Canada goose
Chen caerulescens	Snow goose
Anas platyrhynchos	Mallard
Anas crecca carolinensis	American green-winged teal
Anas discors	Blue-winged teal
Anas cyanoptera	Cinnamon teal
Anas strepera	Gadwall
Anas americana	American wigeon
Anas clypeata	Northern shoveler
Aythya americana	Redhead
Aythya collaris	Ring-necked duck
Aythya valisineria	Canvasback
Aythya affinis	Lesser scaup
Bucephala clangula	Common goldeneye
Bucephala albeola	Bufflehead
Oxyura jamaicensis	Ruddy duck
Mergus merganser	Common merganser

† Actual habitat is unknown since this species is extremely rare today.

Table 2. Potential faunal resources in Grass Mesa Locality--Continued

Scientific name	Common name
Mergus serrator	Red-breasted merganser
Cathartes aura	Turkey vulture
Accipiter gentilis	Goshawk
Accipiter striatus	Sharp-shinned hawk
Accipiter cooperii	Cooper's hawk
Buteo jamaicensis	Red-tailed hawk
Buteo lagopus	Rough-legged hawk
Buteo swainsoni	Swainson's hawk
Aquila chrysaetos	Golden eagle
Haliaeetus leucocephalus	Bald eagle
Circus cyaneus	Marsh hawk
Pandion haliaetus	Osprey
Falco mexicanus	Prairie falcon
Falco peregrinus	Peregrine falcon
Falco columbarius	Merlin
Falco sparverius	American kestrel
Centrocercus urophasianus	Sage grouse
Dendragapus obscurus	Blue grouse
Pedioecetes phasianellus	Sharp-tailed grouse
Lophortyx gambelii	Gambel's quail
Meleagris gallopavo	Turkey
Grus canadensis	Sandhill crane
Rallus limicola	Virginia rail
Porzana carolina	Sora
Fulica americana	American coot
Zenaida macroura	Mourning dove
Columba fasciata	Band-tailed pigeon
Otus asio	Screech owl
Otus flammeolus	Flammulated owl
Bubo virginianus	Great horned owl
Glaucidium gnoma	Pygmy owl
Asio otus	Long-eared owl
Asio flammeus	Short-eared owl
Aegolius acadicus	Saw-whet owl
Athene cunicularia	Burrowing owl
Strix occidentalis	Spotted owl
Phalaenoptilus nuttallii	Poor-will
Chordeilus minor	Common nighthawk
Corvus corax	Common raven
Corvus brachyrhynchos	Common crow
Cyanocitta stelleri	Steller's jay
Nucifraga columbiana	Clark's nutcracker
Gymnorhinus cyanochephalus	Pinyon jay
Aphelocoma coerulescens	Scrub jay
Pica pica	Black-billed magpie
Perisoreus canadensis	Gray jay

Table 3. Catchment values for Grass Mesa Village, other Grass Mesa Locality sites, and random locations

Variable	Percentages of catchments		
	Grass Mesa Village	Mean, all sites	Mean, random locations
Geological formations:			
Junction Creek	35	24	37
Morrison	24	22	19
Burro Canyon	9	12	11
Dakota	10	25	17
Alluvial deposits (Quaternary)	22	17	16
Landforms:			
Canyon wall	69	67	63
Flood plain	22	17	16
Second terrace	3	2	1
First terrace	2	1	<1
Dip slope	3	12	18
Alluvial fan	0	<1	0
Hillock	1	1	2
Soil types:			
Batterson-Gladel-Rock outcrop complex	68	73	66
Fluvents	12	9	8
Stream channel	6	5	5
Otero fine sandy loam*	7	3	2
Cheyenne sandy loam*	4	2	2
Gladel stony fine sandy loam	2	8	16
Granath loam*	1	<1	<1
Potential vegetation:†			
Pinyon-juniper	55	58	53
Douglas-fir/mountain shrub	18	17	20
Riparian	21	14	15
Ponderosa pine	5	8	10
Sagebrush	1	3	2
Diversity indices and distances to critical resources:			
Shannon-Weiner diversity index,§ soil units	.48	.40	.45
Shannon-Weiner diversity index,§ potential vegetation zones	.50	.46	.46
Meters to nearest permanent water	170	306	380

* Soils most suitable for agriculture according to Leonhardy and Clay (1982).
† Based on Bye (1982).
§ The Shannon-Weiner diversity index, $\overline{H}$, measures both richness and evenness. Logarithms to base 10 were used in the computations. For the formula used in this study, refer to R. L. Smith (1974:242).

History of Discovery and Excavation

Grass Mesa Village is so conspicuous that it was recognized as an ancient settlement by early Euroamerican settlers in this area of the Dolores River Valley. One U.S. Forest Service photograph dating to 1912 describes "Grassy Mesa" as "a nearly inaccessible mesa at junction of Beaver Creek and Dolores River, covered with old Aztec pottery and other relics"; another photograph (fig. 3) calls attention to the "Old Aztec grinding stones" to be found there. (The popular belief that the local prehistoric occupants were Aztec was still widespread at that time, although professional archaeologists as well as dedicated amateurs like Richad Wetherill, for example, had generally abandoned that idea by the 1890's [McNitt 1966:35]).

In 1917 and 1918 Jesse Walter Fewkes of the Bureau of American Ethnology undertook partial reconnaissance of the McElmo and Yellowjacket Districts to place the better-known ruins at Mesa Verde in a wider spatial context and to investigate the possibility that the cultural antecedents of the Mesa Verde Pueblo Indians underwent their development in these districts (Fewkes 1919:9-10). These surveys, although better known for their descriptions of ruins in the Hovenweep group and Sand Canyon, resulted in the first known published account of the Grass Mesa site. As such, it is worth quoting in its entirety:

> Grass Mesa, a plateau with precipitous sides overlooking the Dolores River, is about 10 miles down the river from Dolores on the right bank of the stream. There remain few signs of former buildings at this place, but very many artifacts, pottery, stone implements, and fragments of well-worn metates occur at various places, some of which are among the best seen by the author. This bluff seems to have been the site of a settlement, possibly pre-Puebloan, like that on McElmo Bluff, with rough walls, resorted to for refuge, and later used as a cemetery. It is well adapted for these purposes, its top being almost inaccessible on

Figure 3. Forest Service photo (15442-A) on Grass Mesa. Caption on back of photo reads "Old Aztec grinding stones, pieces of pottery, etc., found on Grassy Mesa." Note the vegetation in this photo which was probably taken in Area 1 or 2 (DAP 148708).

> the river side. There are many other similar sites of Indian settlements farther down the river, but this is one of the most typical. The scenery along the road that follows the banks of the river from Dolores is ever to be remembered on account of high cliffs on each side (Fewkes 1919:64).

Fewkes' identification of Grass Mesa as a cemetery seems to be based on the presence of upright stone slabs, often forming enclosures vaguely reminiscent of Euro-American headstones. Elsewhere in the same report, however, he offers another interpretation of such features, this time in the discussion of the "Megalithic and Slab House Ruins at McElmo Bluff":

> In verification of the various theories that have been suggested to account for these rectangular structures [made of slabs set on edge]--their interpretation as storage bins, burial places, and cremation rooms--we have no proof. . . . The rude, massive character of the masonry leads me to refer them to the slab-house culture of Kidder [Kidder and Guernsey 1919:203-204] and the imperfect masonry suggests they were habitations in a period antedating that of the pure pueblo culture. . . . The author regards the structures made of stones set on edge as very old, possibly examples of the most primitive buildings in the McElmo region, antedating the pueblos with horizontal masonry farther east. . . . similar remains have been reported at various points from Dolores far into Utah. They are called cemeteries and crematories by the farmers and stockmen, but skeletons or burnt bones do not occur in them; the charcoal shows wood fiber, and is not bone ash (Fewkes 1919:61).

From Fewkes' account of the Grass Mesa site, it is possible to deduce that there was a considerable number of upright slabs at the time of his visit; by the beginning of DAP excavations in 1979, this was no longer the case. It is not clear from his account whether the "rough walls, resorted to for refuge" were on Grass Mesa or on the McElmo Bluff site, at the junction of McElmo and Yellow Jacket Canyons. Although no certain defensive walls have been noted on Grass Mesa, a rough alinement of large stones on the bedrock saddle east of Area 1 may be the remnant of a more extensive system that perhaps was better preserved at the time of Fewkes' visit.

By 1921, the term "pre-Pueblo" was being substituted by Kidder and Guernsey for the "slab house" nomenclature, in accordance with the growing perception that the "slab house" manifestations provided the logical developmental link between the Basketmaker and Cliff-dweller groups (Guernsey and Kidder 1921:114-116). In the 1927 Pecos classification, this became the Pueblo I or Proto-Pueblo period (Kidder 1927).

During much of the first half of the 1900's, Grass Mesa was used for the grazing and keeping of horses; because access to the site is easily blocked off, the animals could be effectively penned on the rich, 5.5 ha mesa top. Figure 4 shows Grass Mesa prior to clearing operations in 1979, covered with tall grass and sagebrush. The present trail up the southeast side of the mesa is the same as that used by the ranchers. Circular, 10-cm-deep holes in the sandstone mark the former location of a fence that prevented the animals from straying off the path on the climb up the mesa and that anchored the confining gate.

Grass Mesa was brought into the state site survey in 1955 as Site 5MT23 by Joe Ben Wheat, who estimated that the site contained 300-400 contiguous surface structures along the northern edge of the mesa, and saw the depression on the western end which he interpreted as a reservoir. There was in 1955 alredy "considerable pothunter evidence." By 1972, when the site was revisited by DRP (Dolores River Project) archaeologists E. Charles Adams and C. Breternitz, the surface rooms had been "extensively potted." (It is rumored that one former landowner went so far as to lease potting rights on the property, so renowned had it become.) The DRP archaeologists assigned a series of hand- and toe-holds descending the shelf of Junction Creek Sandstone on the north side of the mesa a separate site number, 5MT2207 (fig. 1).

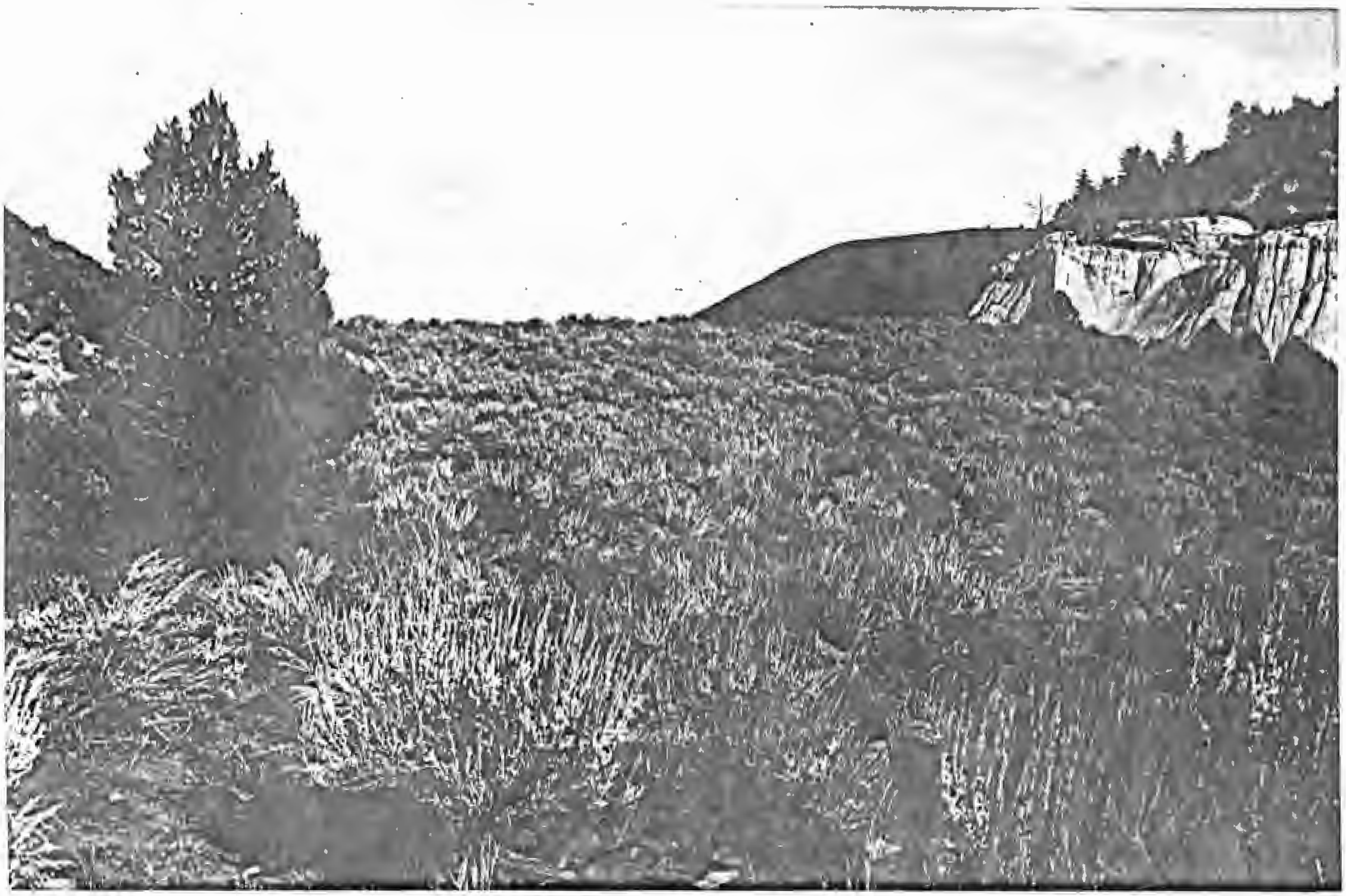


Figure 4. General view of Grass Mesa Village (DAP 135235). View is east-northeast from Area 6, looking up Beaver Creek Canyon.

1979 DAP Field Season: Summary of Operations

Figure 5 shows the locations of Areas 1 through 8 at Grass Mesa Village. The site was subdivided into areas that could serve as sampling strata, to eliminate possible clustering in the planned probability sample of 2- by 2-m test units. In addition, horizontal subdivisions were needed to assist in provenience control and to break up this very large site into manageable administrative units that could be the focus of work by an excavation crew. Demarcation of Areas 1 through 8 was based on a subjective assessment of the surface distributions of roomblock rubble and of refuse middens, in conjunction with topography. The goal was to define areas that might correspond to roomblock units, with their associated pitstructures and trash.

Initial reconnaissance prior to surface collection indicated that surface roomblock rubble was concentrated along the north edge of the mesa in Areas 1 through 4; the separation of these areas was based on small but clearcut breaks in topography. Although it was recognized that a roomblock might have been continuous across Areas 1 through 4, the breaks in topography suggested that several segments might well have been present.

The linear rubble distributions that demarcated the north edge of Areas 1 through 4 also continued west to form the northern boundary of Area 5. South of this, however, rubble suggestive of other roomblocks was also observed; the large depression thought to mark the location of a great kiva was also noted. All these manifestations were grouped together when the Area 5 boundaries were drawn.

Starting just south of the large depression and extending east just below Areas 3 and 4 was another long, low mound of rock rubble, thought to be indicative of a roomblock. Because there were no obvious breaks in the

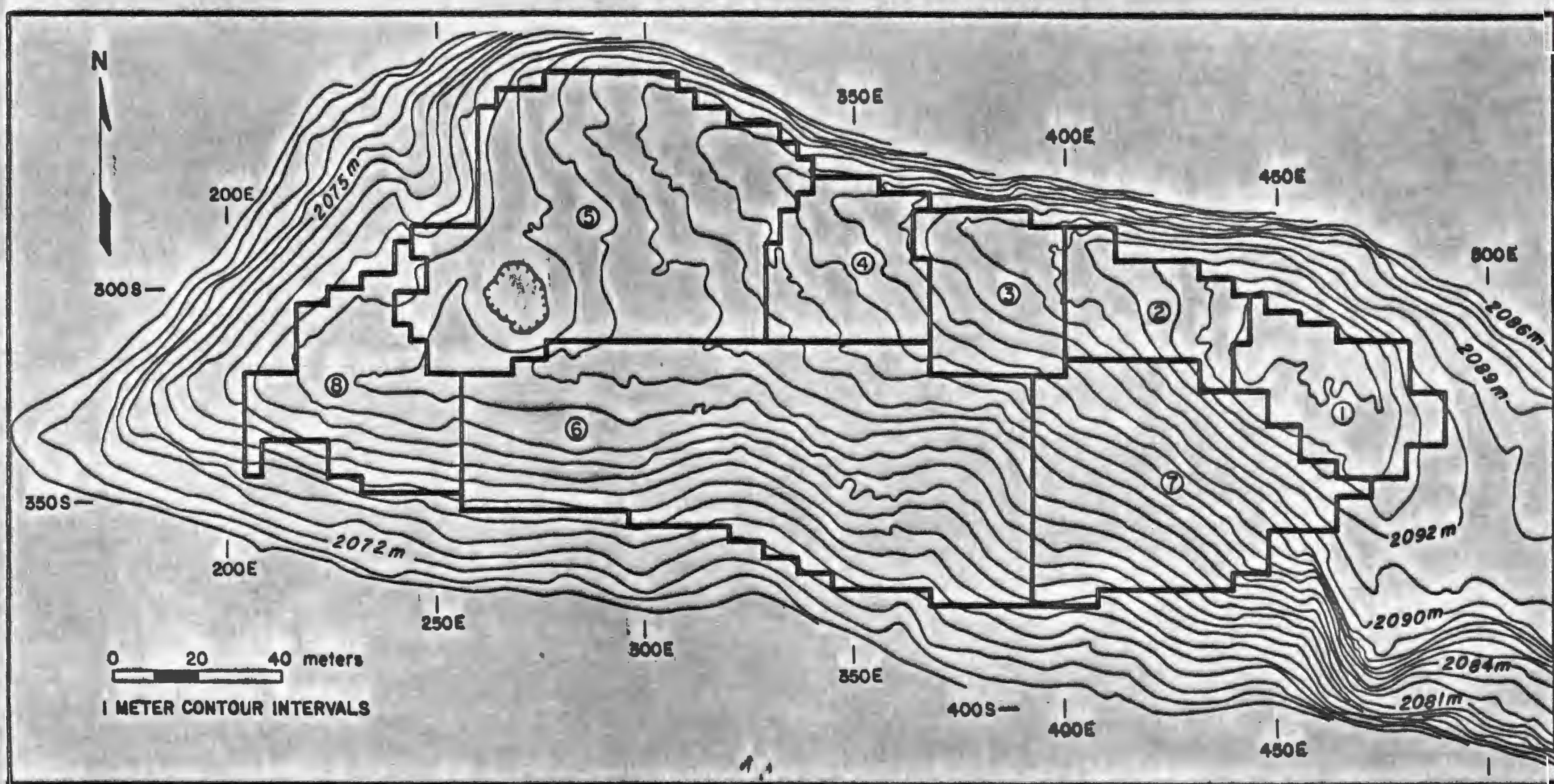


Figure 5. Topographic map of Grass Mesa Village showing locations of Areas 1 through 8.

topography or in the rubble within this distribution, it formed the basis for a single large subdivision, Area 6. The space south of the rubble mound was inferred to contain pitstructures as well as midden and sheet trash on the slope below them.

East of Area 6 and south of Areas 1 and 2 was a steeply sloping portion of the mesa lacking obvious evidence of roomblocks; it was labeled Area 7. This area was thought to be primarily sheet trash that had been redeposited from the steep slopes above. Area 8 was delineated at the west end of the mesa. This area, which was heavily overgrown with scrub oak, was initially considered to be part of Area 5, but when clearing of part of the brush revealed linear distributions of probable wall rubble, it was given a separate designation.

During the first season of DAP investigations on Grass Mesa, three 10-person crews accomplished preliminary gridding and surface collection operations on the mesa, completed a probability sample in Areas 3 and 4, and began intensive excavations in Areas 3, 4, and 5. The results of the surface collection are reported in the "Surface Collection" section of this report. Figure 6 shows the distribution of recent disturbance across the site as it existed during the 1979 surface collection. Most pothunting had been confined to the shallow surface rooms and to the sheet trash, with the deeper pitstructures having been little disturbed. The probability sample on Grass Mesa consisted of a random sample of 2- by 2-m grid units that covered approximately 1 percent of the surface area of the site, stratified by area. A discussion of the results of this sample is deferred until the next reporting stage, when the sample has been drawn from all areas of the site.

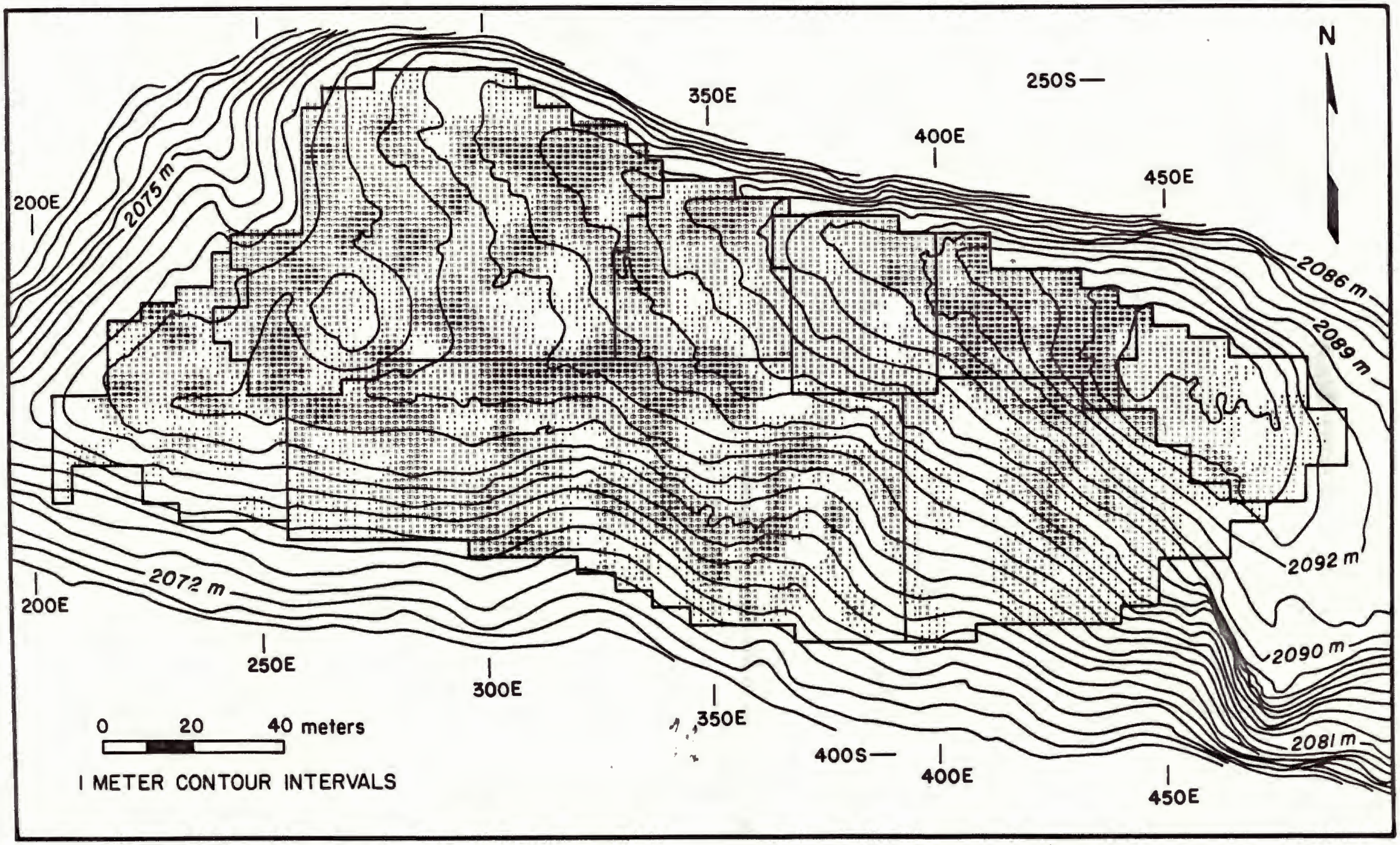


Figure 6. SYMAP plot of disturbance, Grass Mesa Village (DAP 107606). Value class intervals: ~~black~~ white, less than 10 percent surface disturbance/collection unit; lightest shading, 10-20 percent disturbance; third level, 20-35 percent disturbance; fourth level, 35-60 percent disturbance; darkest shading, greater than 60 percent recent surface disturbance.

During 1979, intensive excavations in Area 3 were concentrated on the investigation of three superimposed pitstructures in the center of the area and a series of superimposed surface structures on the northern rim of the mesa (a fourth pitstructure that was not superimposed was tested). Although highly disturbed, the surface structures provided evidence of two types of surface rooms. The first type consists of loosely associated basin-shaped depressions with corner posts; the second, apparently later type consists of contiguous masonry rooms. These excavations and additional investigation of Area 3 during the 1980 field season are reported in C. Breternitz (1982a).

In Area 4, one pitstructure was completely excavated and several superimposed surface rooms that were somewhat less disturbed than those in Area 3 were partially excavated. These excavations are reported in Ahlstrom and Dohm (1980).

Excavations in Area 5 were started later in the 1979 season than excavations in Areas 3 and 4. Only 6 of the 13 2- by 2-m units identified for probability sampling were completed. Intensive excavations in this area were confined primarily to expansion around designated probability squares, with the exception of a 1.4-m-wide trench from the southwest edge of the "great kiva" to its center. The results of the 1979 excavations and the results of additional intensive excavation during the 1980 field season are reported in Emerson et al. (1983).

1980 DAP Field Season: Summary of Operations

Two crews conducted excavations on Grass Mesa during the second three-month field season. One crew excavated most of Pitstructure 3 in Area 3 and began probability testing in Areas 1, 2, and 7 at the eastern extreme of the site. The probability sample in Areas 1 and 7--a total of 11 2- by 2-m units--was completed, with no expansion around the four probability squares in Area 1 and only minimal expansion around the seven squares in Area 7. These excavations in Area 7 revealed numerous superimposed nonmasonry surface structures and at least one pitstructure in steeply sloped portions of Area 7 that were believed to be composed primarily of sheet trash and slope wash. Time spent in expansion around the four probability squares in Area 2 prevented complete excavation of these units to sterile deposits but permitted the exposure of several features and structures. The greatest number of superpositioned structures and deposits on the site was encountered in Area 2, a circumstance which, in conjunction with the occurrence of early ceramic assemblages in some units, suggests a relatively long occupation of this area beginning in the Dos Casas Subphase (refer to the discussion of the DAP temporal sequence in this report). An account of the excavations in progress in Areas 1, 2, and 7 is presented in Dohm and Gould (1983).

In Area 5, the most northwestern area on the mesa, excavation of the remaining 7 of the 13 probability squares was completed and the intensive excavations that were begun during the 1979 field season were continued. Portions of 10 pitstructures and 20 surface structures had been investigated by the end of the 1980 field season. The trench across the "great kiva" that dominates the western portion of Area 5 was extended northeast across the structure. The north end of this trench intersected with a later pitstructure that cut through the north wall of the larger structure. Expansion of the trench to the southwest revealed yet another pitstructure that postdated the larger structure and that had been excavated partially through its floor. Portions of additional small, relatively late pitstructures were excavated in Area 5 during this season. The informal placement of these pitstructures, which do not appear to be closely associated with surface structures, violates the normal orientation and patterns of symmetry characteristic of earlier construction episodes on the mesa.

Summary of Structures Encountered, 1979 and 1980

Tables 4 and 5 contain brief summaries of the major structures encountered during the 1979 and 1980 field season at Grass Mesa. These tables reveal that the temporal placement of the surface structures is less certain than that of the pitstructures. This is due to the general absence of physically datable materials (e.g., tree-ring samples) and the smaller samples of stylistically datable materials from the surface structures; in addition, many of the surface structures had been subjected to greater degrees of disturbance than the pitstructures. A comparison of tables 4 and 5 indicates that no surface structures have been confidently assigned to the Grass Mesa Subphase, while roughly 25 to 35 percent of the pitstructures so far encountered may represent this subphase. This incongruity may be the result of the abovementioned factors, or it may indicate a difference between the Grass Mesa Subphase occupation and earlier occupations of the site. Further discussion of dating evidence, the phase sequence on the mesa, and remaining research problems can be found in the last section of this report.

Table 4. Surface structures at Grass Mesa Village, 1979 and 1980

Area No.	Surface Structure No.	% excavated	Probable floor area (m^2)	Probable phase or subphase				
				Sagehen		McPhee		
				Indeterminate	Dos Casas	Indeterminate	Periman	Grass Mesa
1	27	<50	>3			?		
	28	<5	?			?		
3	1	100	2		?			
	2	75?	9				?	
	5	100	6		?			
	*6	100	6				?	
	*7	<50	>8				?	
	11	<50	?		?			
4	3	100	6			?		
	4	100	5			?		
	8	100	6			?		
	12	100	6			?		
	30	75?	17?			?		
5	9	<50	5		?			
	13	50	10			?		
	14	<30	6?			?†		
	15	<20	8?		?			
	16	<30	6?		?			
	17	<40?	5?				?	
	18	<50	4?		?			
	19	<20	?					?
	20	<10?	?			?		
	21	<10?	?			?		
	22	<10	?	?				
	23	<10	?	?				
	25	60?	>3	?				
	26	30?	>4	?				
	29	<25?	?	?				
	32							?
	33							?
	42						?	
	46	?	?		?			
	47	<30?	>4?	?				
7	34	75	>3				?	
	35	?	?				?	
	38	<50	?			?		
	40	25?	>4				?	
	41	<50	>6			?		

* May be a ramada-like structure.
† However, a preliminary neckband dating suggets an early A.D. 800's placement.

Table 4. Surface structures at Grass Mesa Village, 1979 and 1980--Continued

Area No.	Surface Structure No.	% excavated	Probable floor area (m^2)	Probable phase or subphase				
				Sagehen		McPhee		
				Indeterminate	Dos Casas	Indeterminate	Periman	Grass Mesa
7 (cont.)	43	50	4?				?	
	45	50	>4			?		
	48	?	>2				?	
	49	<10	?				?	

Table 5. Pitstructures at Grass Mesa Village, 1979 and 1980

Area No.	Pit-structure No.	% excavated	Probable floor area (m^2)	Probable phase or subphase				
				Sagehen		McPhee		
				Indeterminate	Dos Casas	Indeterminate	Periman	Grass Mesa
2	13	<25	36				X	
	14	<20	16					?
	20	<5	?			?		
	21	<5	?			?		
3	1	100	19					X
	3	80	55				X	
	5	100	17					X
	8	<5	?				?*	
4	2	100	14				late†	
5	4	50	10				X*	
	6	50	8					?
	**7	10	380			?		
	9	20	>20?		late?			
	10	20	>20?				late§	
	11	<40	8?					X
	15	<20?	>25?		?			
	16	100	8					X
	17	<10?	?					X
	18	<5	?			?		
7	19	<25	?				?	

* Preliminary neckband dating suggests an abandonment date in the A.D. 860's.
† Preliminary neckband dating suggests an abandonment date in the late A.D. 860's.
§ Preliminary neckband dating suggests an abandonment date in the A.D. 870's.
** Pitstructure 7 is a great kiva.

THE SURFACE COLLECTION

The interpretation of the surface collection from Grass Mesa is a challenge to the propositions repeatedly stated in the past 10 years (cf. Binford et al. 1970; Powell and Klesert 1980) that the patterning of surface deposits yields considerable information concerning the distribution of subsurface features and that site surface content yields important clues about site function. In the case of Grass Mesa, the function of the site as a habitation is not in question. However, questions concerning intrasite functional differences and the sequence of occupation at the site are of interest, and because current research plans call for at least low-level sampling in all portions of the site, the surface collection material can be used to formulate hypotheses to be tested later in the investigation.

Method

The standard DAP surface collection methods (Kane et al. 1981:3) were revised for use at Grass Mesa Village in an attempt to avoid gathering redundant data, to reduce the size of a potentially vast collection of materials, and to gain information concerning the distribution of building materials, disturbance, and vegetative cover at the site. Instead of the standard 100 percent surface collection in 4- by 4-m grid units, surface artifacts were collected from every other 4- by 4-m grid unit in a systematic, checkerboard fashion to obtain a 50 percent sample of the surface materials. The percentages of vegetative cover and of disturbed surface area were estimated for each collection unit, and building materials were separated, counted, weighed, and piled in one corner of the unit (counts and weights were estimated when materials appeared to be in place). It soon became obvious that if the surface collection was to be completed in 1979 without diverting labor from the probability sampling and excavation also in progress, the sample proportion would have to be further reduced. However, since high spatial resolution was necessary for mapping surface aspects of site structure, the distance between collection points could not be increased. Instead, artifacts were collected from only the southwest diagonal half of each unit that formerly would have been completely collected. This decreased the number of artifacts recovered, without increasing the distance between the centers of collection units. Of the 2.19-ha gridded area on the mesa top, 320 4- by 4-m squares were completely collected, and 365 squares were collected only in the southwest diagonal halves. Thus, 37 percent of the gridded surface area was sampled. Material counts for all artifacts recovered during the intensive surface collection are reported in table 6. Table 6 will be discussed in the analysis of site structure and development below.

Comparison of Surface and Subsurface Materials

Before beginning analysis of the distribution of surface materials, it is appropriate to establish whether these surface materials reflect the entire material content of the site they overlie. It is not yet possible to do this for the entire site, but at the time of this writing, the results of the probability sample excavations in Areas 3 and 4 are available. The probability sample squares were drawn by simple random sample within each area of the site, and all material from each unit was screened through one-quarter-inch mesh screen. Counts for selected materials from the pooled probability sample and from the pooled surface collection for the two areas are compared in table 7.

Table 6. Surface materials differentiating site areas, Grass Mesa Village

Variables	Areas ranked by density 1	2	3	4	5	6	7	8	Total N	Grand mean	r2*	Probability
Surface conditions:												
% vegetative cover	6	8	4	3	2	1	5	7		43.6	.07	.0001
% disturbance	6	1	5	3	2	4	8	7		29.5	.14	.0001
Building materials:												
Total stone†	8	4	1	5	7	2	3	6	15,914		.05	.0001
Total stone (kg)	5	2	1	6	7	3	8	4	15,985		.06	.0001
Cobbles	8	5	3	7	6	2	4	1	5,030		.12	.0001
Kg cobbles	8	6	3	5	4	2	7	1	6,311		.07	.0001
Jacal fragments	8	4	1	2	3	5	6	7	648		.05	.0001
Ceramics:												
Total ceramics	8	5	3	4	7	2	1	6	22,396		.09	.0001
Total ceramics (g)	8	5	4	3	6	1	2	7	119,270		.09	.0001
Early ceramics§	7	2	1	7	5	4	3	7	23		.02	.0192
Indeterminate ceramics**	7	6	4	3	5	1	2	8	1,778		.05	.0001
Late ceramics††	5	4	6	7	8	1	2	3	322		.06	.0001
Nonlocal ceramics§§	4	2	6	3	7	8	1	5	35		.03	.0242
Flaked lithic tools:												
Total flaked lithic tools	6	3	4	5	8	2	1	7	1,340		.12	.0001
Total flaked lithic tools (g)	5	3	4	7	6	1	2	8	151,406		.07	.0001
Unifaces	6	5	4	7	8	2	1	3	291		.06	.0001
Cores	5	1	4	7	6	3	2	8	263		.06	.0001
Projectile points	6	6	6	2	6	3	1	6	7		.02	.0354
Utilized flakes	6	4	3	5	8	2	1	7	603		.10	.0001
Flaked lithic debitage:												
Total debitage	8	6	5	3	7	2	1	4	12,276		.09	.0001
Total debitage (g)	7	6	5	3	8	2	1	4	109,271		.09	.0001
Debitage with cortex	7	5	6	4	8	2	1	3	3,598		.09	.0001
% debitage with cortex	4	1	8	7	5	3	6	2		37.0	.04	.0013
% debitage with platforms	2	3	8	5	1	6	7	4		64.0	.11	.0001
Nonflaked lithic tools:												
Metates	3	1	2	7	6	4	8	5	252		.04	.0025
Nonflaked lithic tools (excluding metates)	5	1	2	4	7	3	6	8	361		.06	.0001
Composite categories:												
Sherds and debitage	8	6	3	4	7	2	1	5	34,672		.09	.0001
Mean wt per item, sherds and debitage (g)	7	1	6	2	3	4	5	8		3.52	.05	.0001

* r^2 - Coefficient of determination: measuring the degree to which the material category was significantly differentially distributed across the areas, based on analysis of variance. Thus, there is more difference among the areas in degree of disturbance than in amount of vegetative cover.
† "Total stone" refers to the cobbles and shaped and unshaped blocks and slabs that appeared to have been used for construction. Nonflaked lithic tools that appeared to have been incorporated into construction are also included in this category. Jacal (daub) fragments are excluded.
§ "Early ceramics" consist of types that peaked in popularity prior to A.D. 800: Chapin Black-on-white and Abajo Red-on-orange.
** "Intermediate ceramics" consist of types that peaked in popularity towards the middle of the ninth century A.D.: Bluff Black-on-red, Piedra Black-on-white, and Moccasin Gray.
†† "Late ceramics" consist of types that peaked in popularity during the 10th century A.D., especially Cortez Black-on-white, Deadmans Black-on-red, and Mancos Gray.
§§ Ceramics are defined as nonlocal on the basis of temper and paste characteristics. This category includes ceramics assigned to any of the following "culture categories" during preliminary analysis: Chaco-Cibola, Chuska, Kayenta, Little Colorado, Nevada-Virgin, or Kayenta-Virgin.

Table 7. Surface to total site material comparisons, Grass Mesa Village*

Variables	Surface	Probability sample
No. of units	79	8
Size of individual units	16 m^2	4 m^2 (surface area)
Sample proportion	0.50	0.05
Debitage		
N	1,491	†5,361.75
column %	30.3	44.9
Projectile points		
N	2	19
column %	<0.1	0.2
Total flaked lithic tools		
N	160	309
column %	3.3	2.6
Bowl sherds		
N	242	392
column %	4.9	3.3
Jar sherds		
N	2,983	5,858.25
column %	60.6	49.0
Metate fragments		
N	45	6.5
column %	0.9	0.1
Total artifacts	4,923	11,946.5

* Total site as reflected by results of probability sample in Areas 3 and 4.
† The surfaces of some of the probability squares were originally collected as 4- by 4-m units. Hence, the estimates of artifact counts on the surface of each probability square involves dividing the counts from the original 4- by 4-m units by 4. This explains the fractional artifact counts in the right hand column.

NOTE: Probability of obtaining a greater Chi-square value in a sample drawn from a population in which there were no surface/whole site differences in proportions of materials: <.001 (Chi-square = 390.27; df = 5; contingency coefficient: 0.15).

Interpreted conservatively, as is appropriate since neither of the samples shown in the table is simple random, table 7 reveals striking differences between the surface and whole-site (sample) contents.

Debitage and projectile points are underrepresented in the surface collection in comparison with the whole-site sample. While the underrepresentation of debitage may be due to the size effect (refer to Baker 1978), the relative scarcity of projectile points is probably due to differential collection by amateurs. The overrepresentation of metate fragments on the surface is at least partly due to the Anasazi practice of incorporating worn-out metate fragments into surface structure walls.

It is apparent from table 7 that the surface collection is not representative of total site content, as reflected by the probability sample in Areas 3 and 4. In analyzing the distribution of surface materials it will be assumed that this lack of fit is consistent across the site.

Reliability of the Two Collection Intensities

Are the collections from the portions of the site collected at 25 percent as reliable as those from the portions collected at 50 percent, or should the entire site have been collected at 50 percent had time and funds permitted? One way to approach this question is to compare the internal variability of the units collected at 25 percent with the variability of the units collected at 50 percent. If the variability among the units that were half collected was higher than that among the units that were completely collected, then the 25-percent collection technique could be considered less reliable. A related method, adopted here, is the use of the intraclass correlation coefficient R. This coefficient (not to be confused with the Pearson product-moment correlation coefficient r) measures the extent to which there is a greater tendency towards homogeneity for scores within classes (here, portions of the site collected at the same intensity) than for scores among all classes (Haggard 1958:6). When classes are completely homogeneous, the coefficient takes on a value of 1; all the variation in the data set is between the classes. The lower bound for R is -1/(k-1), where k is the number of grid units in each class. Therefore, R can never be less than -1 (when k=2), and for a large k, the lower bound approaches zero. The value of R is zero when there is no tendency for units collected using one intensity to be more similar to each other than they are to units collected at the other intensity. If the values of R are zero, negative, or very low positive, the differing intensities of collection probably had little effect on the reliability of the sample.

Table 8 shows the values of R for a suite of variables and the probability that such values of R could have been observed in a sample drawn from a population in which the true intraclass correlation coefficient was zero.[2] Roughly one-third of the variables reported in table 8 appear to have been affected by the different sampling intensities between the two areas. However, the very low R values for most variables tested and the nonrandom distribution of the units in the two intensity classes favor an interpretation of these differences as being due primarily to real differences among the areas collected, rather than in the varying collection strategies employed. Indeed, there is evidence in table 6 that the areas

[2]These probabilities cannot be interpreted strictly because the assignment of units to a collection intensity was not random. Areas 3, 4, 5, and the central portion of Area 6 were collected at 50 percent intensity, while Areas 1, 2, 7, 8, and the remainder of Area 6 were collected at 25 percent intensity. Thus, some of the differences in table 8 result from real differences between these sets of areas rather than differences resulting from surface collection at varying intensities. All counts and weights were corrected for density in calculating these R values, and the corrected values are used throughout the remainder of this report and in table 6.

collected at 25 percent intensity represent a much greater proportion of the total sheet trash at the site than the areas collected at 50 percent. Tentatively, there is little evidence that the collections made at 25 percent intensity are less reliable than those made at 50 percent intensity.

Table 8. Intraclass correlation coefficients

Variable	R*	Probability
Ceramics		
Early ceramics	0.001	0.245
Intermediate ceramics	-0.002	0.595
Nonlocal ceramics	0.005	0.112
Total ceramics (count)	0.021	0.006
Total ceramics (weight)	0.013	0.023
Flaked lithic items		
Cores	0.038	0.000
High-input flaked lithic tools	-0.003	0.669
Nonlocal material flaked lithic tools	0.000	0.357
Projectile points	0.004	0.131
Unifaces	0.043	0.000
Utilized flakes	0.017	0.011
Total flaked lithic tools (count)	0.052	0.000
Total flaked lithic tools (weight)	0.038	0.000
Debitage with cortex	0.064	0.000
Flaked lithic debitage (weight)	0.043	0.000
Nonflaked lithic tools		
Metates	-0.001	0.450
Other nonflaked lithic tools	-0.001	0.365
Building materials		
Cobbles	0.003	0.150
Jacal fragments	0.059	0.000
Total surface building stone (count)	-0.002	0.454
Total surface building stone (weight)	-0.003	0.743

* R - Intraclass correlation coefficient.

Site Structure

It is generally recognized that Anasazi sites are comprised of three major structural units: surface rooms, pitstructures, and refuse areas. In most cases these three units appear to have been carefully segregated in the systemic context: the surface structures are often to the north, the pitstructures are not far away to the south, and the trash disposal areas are located south of the pitstructures. Reed (1956) traced this remarkably consistent "front-directed" plan throughout the San Juan area from Pueblo I up to Pueblo IV times. Only slight deviations from this plan in order to take into account the slope of a particular site seem to have been acceptable in Grass Mesa Locality. During the Pueblo I period, sites containing more than three or four pitstructures were arranged in multiples of the same basic configuration rather than in recombinations of the elements into new patterns. This often resulted in several J-shaped rows of surface rooms partially enclosing an associated plaza and pit-structure area. Each of these units has been called an "interhousehold cluster" by Kane (1981) and is similar in scale to what Flannery (1976:75) termed a "courtyard group." The "tail" of the J was usually at the western end of the row of surface structures, forming a partial curve to the south. Examples of this arrangement can be seen in communities from the Chuska slope (Pueblo I portions of the Skunk Springs site; Marshall et al. 1979:110), the Ackmen-Lowry area (Site 3; Martin and Rinaldo 1939), and southwest Utah (Site 13; Brew 1946). Figure 7 is adapted from Brew's plan of Site 13 on Alkali Ridge.

The surface structures at Grass Mesa Village vary considerably in shape, size, and construction materials. Jacal architecture was known (e.g., Surface Structure 11 in Area 3); however, construction incorporating vertical slabs, horizontal blocks, or cobbles has been noted as well. The masonry sometimes appears by itself and sometimes appears in alternating courses with earth mortar. There is some indication at Grass Mesa of a tendency to replace early jacal structures with structures

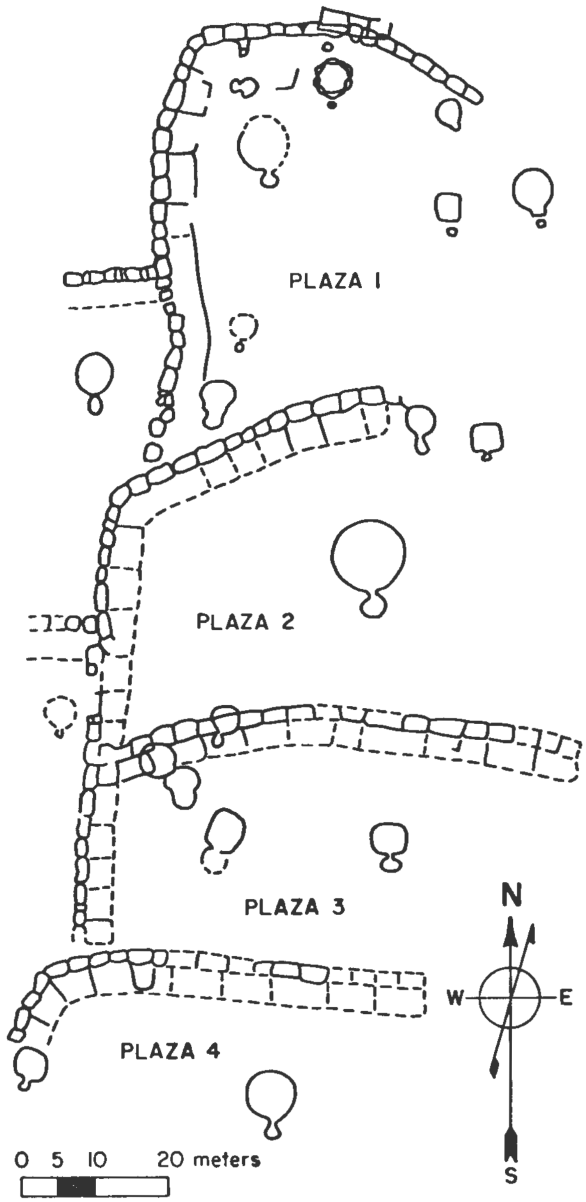


Figure 7. Early Anasazi village plan, adapted from Brew's (1946) Site 13 on Alkali Ridge.

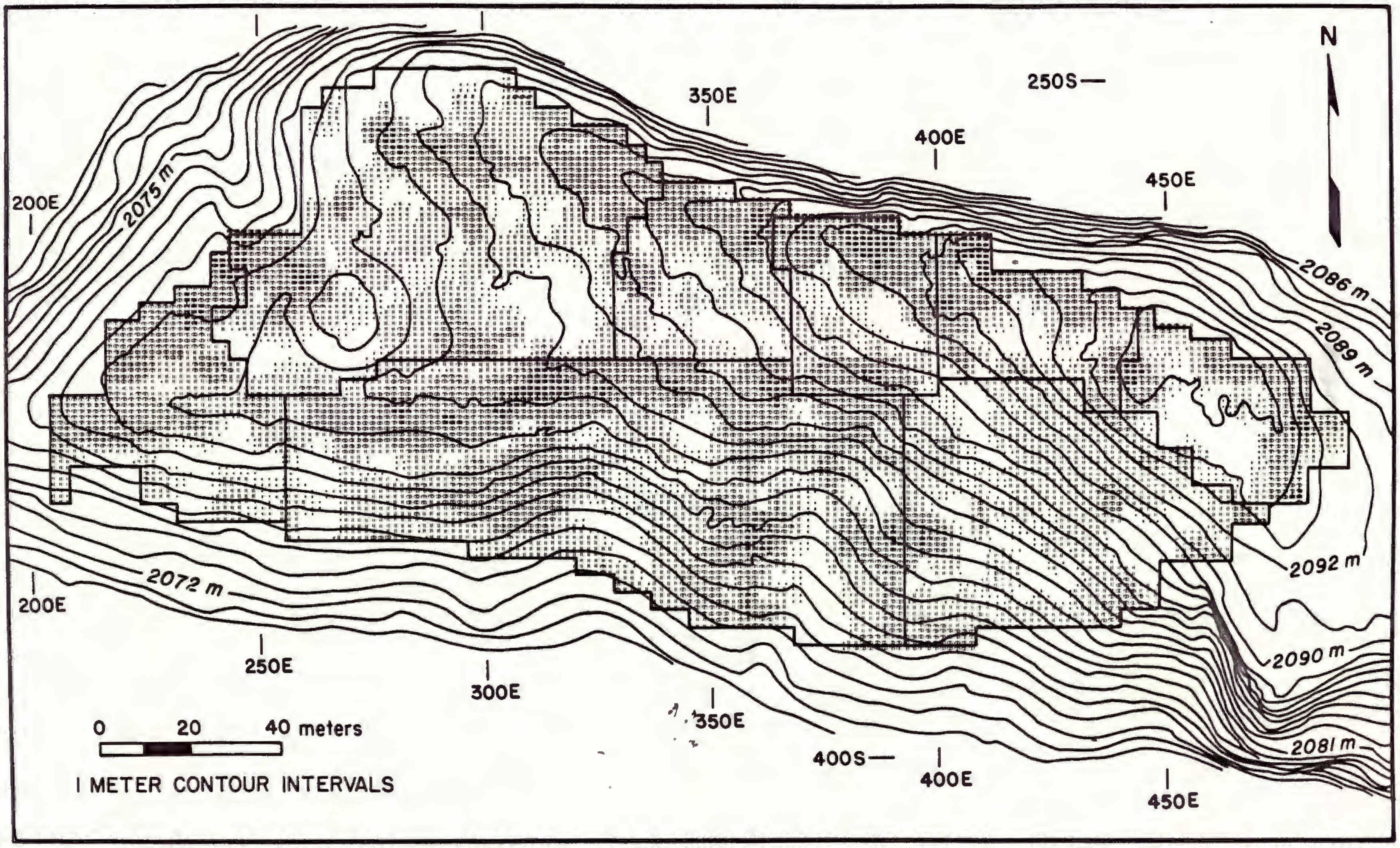
incorporating more masonry (refer to C. Breternitz [1982a] and Emerson et al. [1982]). However, a map of the surface distribution of jacal fragments (not reproduced here) is not very informative about the sequence of site development because many of the burned jacal fragments on the surface seem to be backdirt from prehistoric excavations through burned roof fall of earlier pitstructures.

The pattern of total weights of stone building materials is considerably more informative (fig. 8). In Area 1, on the east end of the site, the stone distribution describes a semicircle open to the west and south, partially encircling a large, shallow, stone-free depression that may be similar to the larger, more distinct depression in Area 5 on the opposite end of the mesa. Concentrations of stone indicative of roomblocks are found in Areas 2, 3, and 4 on the north rim of the mesa. The roomblocks curve to the south at their western ends, particularly in Areas 2 and 4. Immediately to the south of each of these four roomblocks is an area that is relatively free of building rubble.

Figure 9 is a map showing the distribution of flaked lithic debitage and sherds across the site. It is apparent that the areas immediately south of the roomblock in Areas 1, 2, 3, and 4 are also relatively free of sheet trash, which appears to be most concentrated in Areas 6 and 7. The areas that are relatively free of both building rubble and sheet trash are zones with high densities of pitstructures; in Areas 2, 3, and 5, these pitstructures are frequently partially superimposed.

The distribution of building materials in Area 5 (fig. 8) is not as easily interpreted as the distributions in Areas 1 through 4. Each of the first four areas appears to have constituted a single interhousehold cluster. However, a concentration of stone building materials (oriented

Figure 8. SYMAP showing distribution of stone building materials across the surface of the Grass Mesa Village. Manos and metates were included when they appeared to have been recycled as building materials. Jacal fragments were not included. Value class intervals are as follows: blank, less than 0.7 kg/m^2; lightest shading, 0.7-1.4 kg/m^2; second shading, 1.7-4.6 kg/m^2; third shading, 4.6-17.6 kg/m^2; darkest shading, greater than 17.6 kg/m^2 (DAP 149902).



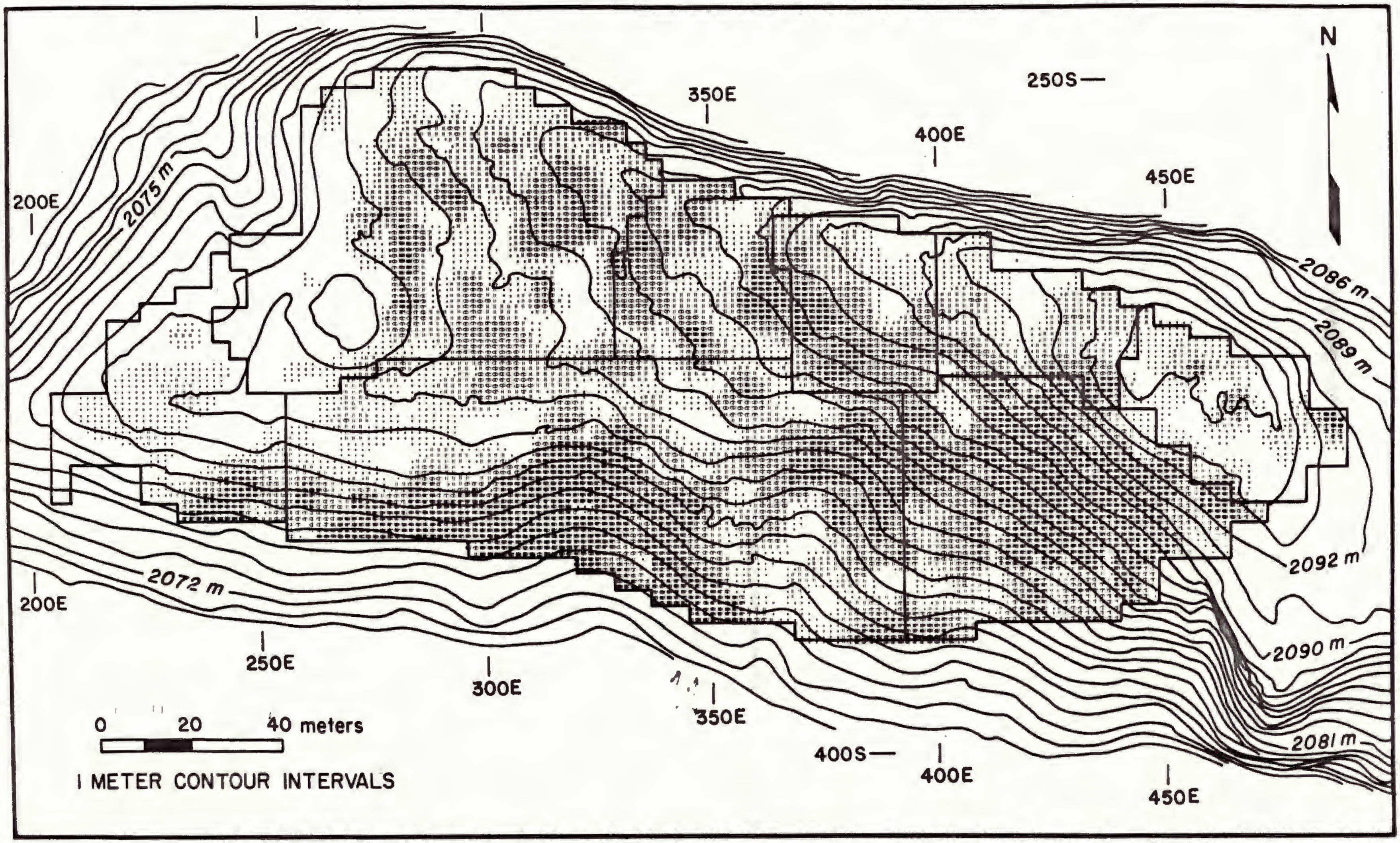


Figure 9. SYMAP plot of sherd and debitage counts, Grass Mesa Village. Value class intervals: black, less than 1 item/m^2; lightest shading, 1-2 items; third level, 2-3 items; fourth level, 3-6 items; darkest shading, 6-100 items/m^2 (DAP 149903).

northwest-southeast) on the northeast boundary of Area 5, and what appears to be a separate concentration (oriented east-west) in the north-central portion of this area, may indicate the presence of one or two distinct roomblocks. Another complex of surface rooms appears to begin northwest of the large depression in Area 5 and to extend southwest into Area 8. All of the surface rooms on the western end of the site have a much higher proportion of cobbles in relation to total stone builing materials than do the roomblocks on the eastern end of the site. This is probably due to the availability of cobbles on the western point of the mesa, at the interface between the bedrock and the overlying loess-derived sediments. To the east, easy access to the Junction Creek bedrock saddle probably influenced the greater use of sandstone blocks and slabs in the masonry structures. There are some scant indications, particularly from the surface rooms excavated in Area 4, that cobble architecture may be most typical of the middle years of building on the site. If this is also true for Areas 5, 6, and 8, it might indicate that these areas of the mesa were not heavily occupied during the latest occupations of the site. As will soon be seen, however, this suggestion is not corroborated by the surface ceramics in these areas.

Figure 8 shows that the large south-central portion of the site, Area 6, has one or more linear roomblocks along its northern boundary, just north of where the mesa starts to slope down towards bedrock. A narrow, linear band immediately south of these surface structures has very little building stone (fig. 8) or sheet trash (fig. 9) and is interpreted as an area where pitstructures are located. South of these presumed pitstructures is a large area of dense sheet trash stretching nearly to the southern mesa edge. To the west, the surface of Area 7 appears to be almost entirely covered by sheet trash (fig. 9).

Sequence of Site Development as Seen from the Surface Ceramics

To map site development using surface materials, the ceramics on the site that are diagnostic of relatively limited time spans have been divided into early, intermediate, and late groups (table 6). The ceramic type date ranges used in this report are from Breternitz et al. (1974).

The early ceramics, composed of Chapin Black-on-white (A.D. 575-900, decreasing after A.D. 750) and Abajo Red-on-orange (A.D. 700-850), are much less abundant on the site than ceramics from the two later groups (table 6). Distributions of the ceramics from these three groups have been mapped so that collection units that deviate from the expected (mean) number of sherds diagnostic of the temporal subdivision are represented by plus and minus signs, while units with an average number of diagnostic sherds are represented by blanks. (This is done by mapping the residuals from a regression of temporally diagnostic sherds from a particular time interval against all sherds. For a detailed discussion of the logic and interpretation of maps of residuals from regression, refer to Thomas 1968.) One advantage of plotting residuals rather than absolute frequencies is that it is possible to distinguish areas that have low frequencies of a particular group of ceramics because there are few ceramics from areas that have low frequencies of particular ceramics despite a high total ceramic count. This kind of map is also superior to a map based on relative frequencies since this technique differentiates between areas in the zero category having small and large sample sizes. In order to smooth the distribution of the resultant residuals, the residuals have been fitted, insofar as possible, to a mathematical surface described by a regression equation with first- through sixth-order algebraic polynomial terms, allowing maximum reflection of local variability. SYMAP trend surface software was used (Dougenik and Sheehan 1977:III/38). (Refer to Chorley and Haggett [1968:195-217] for a full discussion of trend surface mapping.) Mapping site development in this manner assumes that broken ceramics will be discarded in the area where they were used. This may not be true, since there is a possibility that occupants of Areas 1, 2, and 3 used Area 7 for occasional trash disposal, while some trash from Areas 4 and 5 may have been discarded in Area 6. Based on reconnaissance on the slope immediately below the mesa (including backhoe trenches at the foot of the mesa below Area 5), it appears that few materials used on the mesa were discarded over the edge. It is also necessary to assume that ceramics from early periods were neither obscured by later occupations nor differentially exposed. Obviously, some additional exposure of the early materials is caused by later inhabitants excavating previously buried surfaces. However, concentrations of early materials in such instances will be diluted by the addition of later materials. It is hoped that these two processes are approximately balanced in their effects.

Based on the coefficient of determination (r^2), the distribution of the early ceramics on the site is uncorrelated with total ceramic count ($r^2 = 0.00$). The large number of zeros used in the computation of this relationship may even be masking a slight negative correlation between the two categories. This information, considered in combination wih the SYMAP's that follow, suggests that much more of the site was in use during the middle and late periods of occupation than during the earliest period. The result is that all variation in early ceramic quantities across the site is displayed in the residuals from the regression of early ceramics against total ceramics. The coefficient of determination for the fit between the actual residuals and the mathematical surface predicted by the trend surface analysis is 0.03, the least satisfactory of the three trend surface maps. This relatively poor fit probably is due to the small sample size of early ceramics and to their patchy distribution across the site. Figure 10 shows that broad areas of the mesa, mapped with a "-," have relatively few early ceramics. The rest of the site, except for small areas marked by "+" (which have a relative abundance of early ceramics), are within one standard deviation of the mean of the residuals. The few isolated high-positive residuals occur primarily in Areas 3 and 7, with another notable concentration in the eastern portion of Area 4. Trend surface maps show both the trend (in the background shading) and the shading for the actual value of the residual at each data point. Thus, no information is lost in mapping the trend surface, even when the fit between the surface and the data points is low. Fewer early ceramics than expected are seen throughout most of Areas 1 and 6, which probably indicates that the early occupants did not use these areas for habitation or for refuse disposal. Two methodological factors should be noted. Near the geographical boundary of the data there will usually be unrealistic values for the dependent variable, since the surface is unconstrained by real data beyond these boundaries (Whitten 1975:290.) In addition, mapping high-order trend surfaces across areas longer than they are wide usually tends to produce some lengthening of the mapped surface in the direction of the longer axis, which suggests that the actual shape of the areas of high and low residuals in the trend surface maps presented here might be somewhat less elongated (Unwin 1975:32).

The correlation between ceramics belonging to the temporally intermediate group (primarily Bluff Black-on-red [A.D. 750-900], Piedra Black-on-white [A.D. 750-900], and Moccasin Gray [A.D. 775-900]), and all

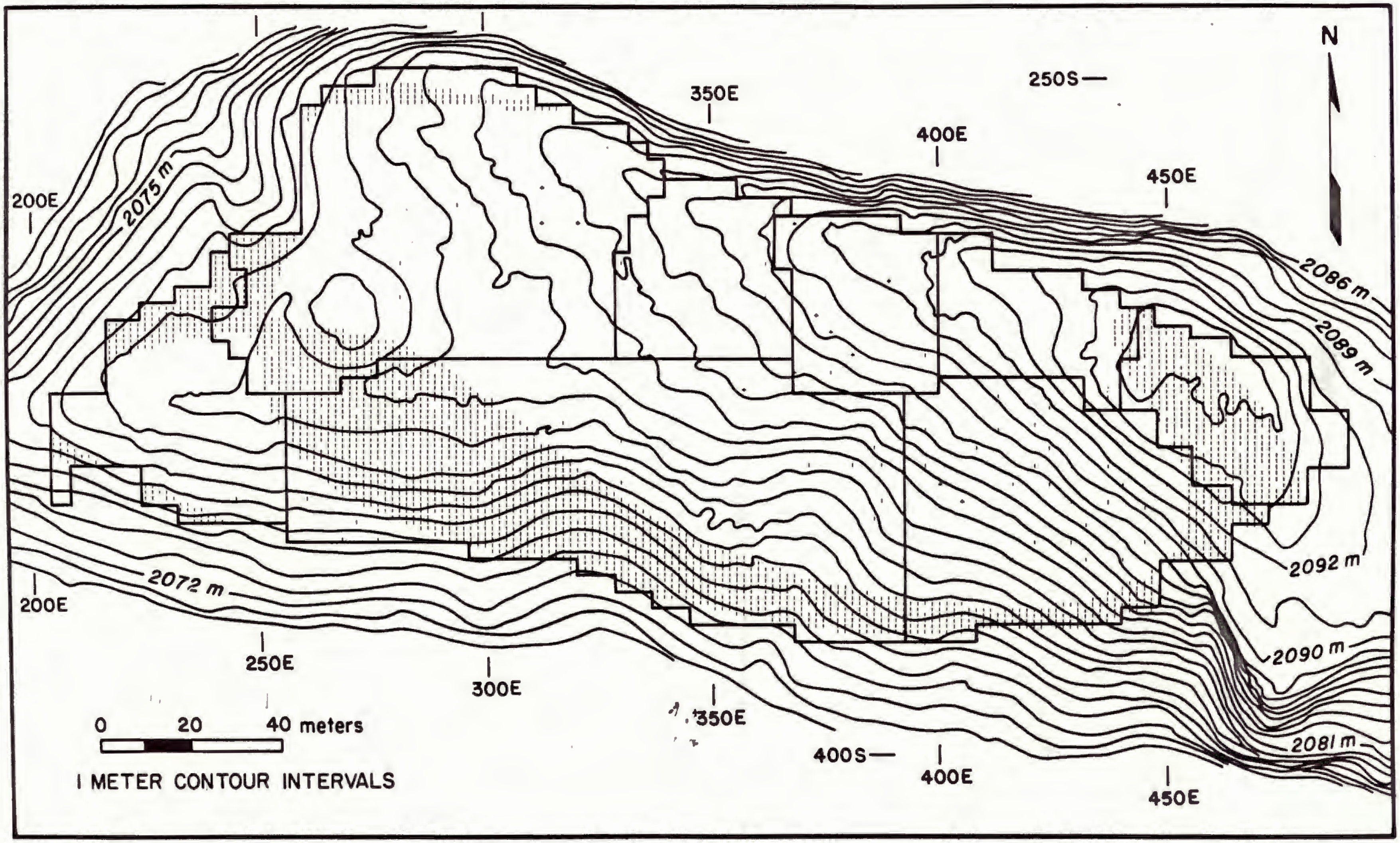


Figure 10. SYMAP trend surface map of residuals from regression of early ceramics against all ceramics, Grass Mesa Village (DAP 149802).

ceramics is quite high ($r^2 = 0.73$). This suggests that, generally, wherever there are ceramics, there are ceramics dating to this intermediate, mid-ninth-century group. Moreover, relatively less information about the distribution of the intermediate group is concentrated in the residuals, since most of the total variation in their distribution is "explained" by the variation in the distribution of the total counts of ceramics across the site. The fit between the trend surface (fig. 11) and the actual values for residuals is still rather low ($r^2 = 0.10$). The clearest trends are for relatively high concentrations of intermediate ceramics in the central portions of Area 6, the same area that had relatively few ceramics from the earliest occupation. This probably indicates that the construction of the roomblock along the northern boundary of Area 6 dates to this intermediate occupation, rather than to the earliest use of the site. Occupation of Area 6 during this time might have been necessitated by the "filling up" of the other mesa top areas. Another conclusion to be drawn from the differences between the trend surfaces for the earliest and the intermediate ceramics is that Area 7 was less densely occupied relative to the occupation of the entire mesa after the earliest occupation at the site.

The group of late ceramics is comprised primarily of Cortez Black-on-white (A.D. 900-1000), Deadmans Black-on-red (A.D. 800-1000), and Mancos Gray (A.D. 875/900-950). (Corrugated ceramics, which appear after A.D. 900, are extremely rare at Grass Mesa Village.) The correlation between the distribution of this group and the distribution of all ceramics across the site is moderately high ($r^2 = 0.53$), suggesting that about half of the total variation in the distribution of these sherds can be "explained" by the distribution of the total ceramic collections. The trend surface map for this late group (fig. 12) has much more in common

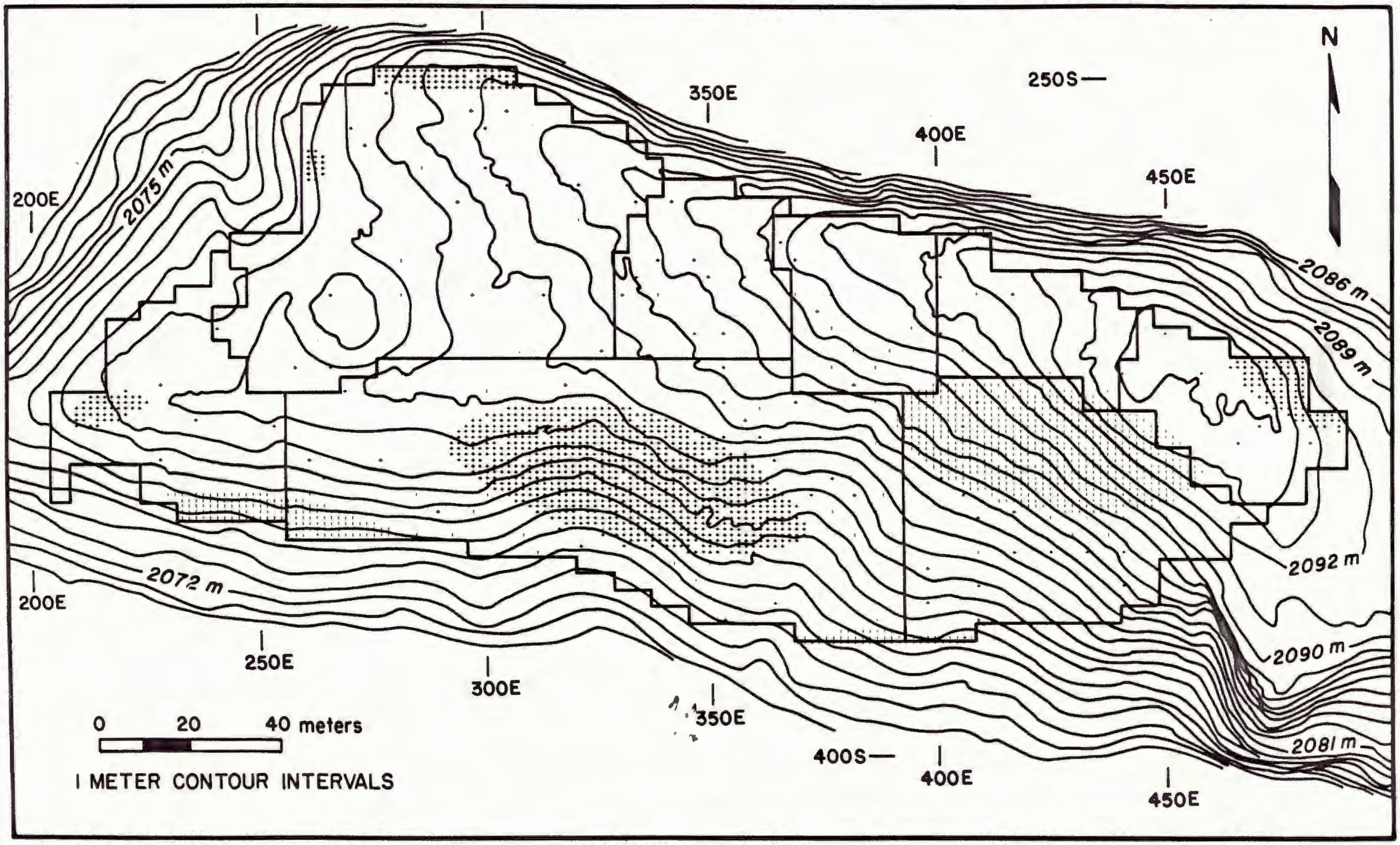


Figure 11. SYMAP trend surface map of residuals from regression of intermediate ceramics against total ceramics, Grass Mesa Village (DAP 149803).

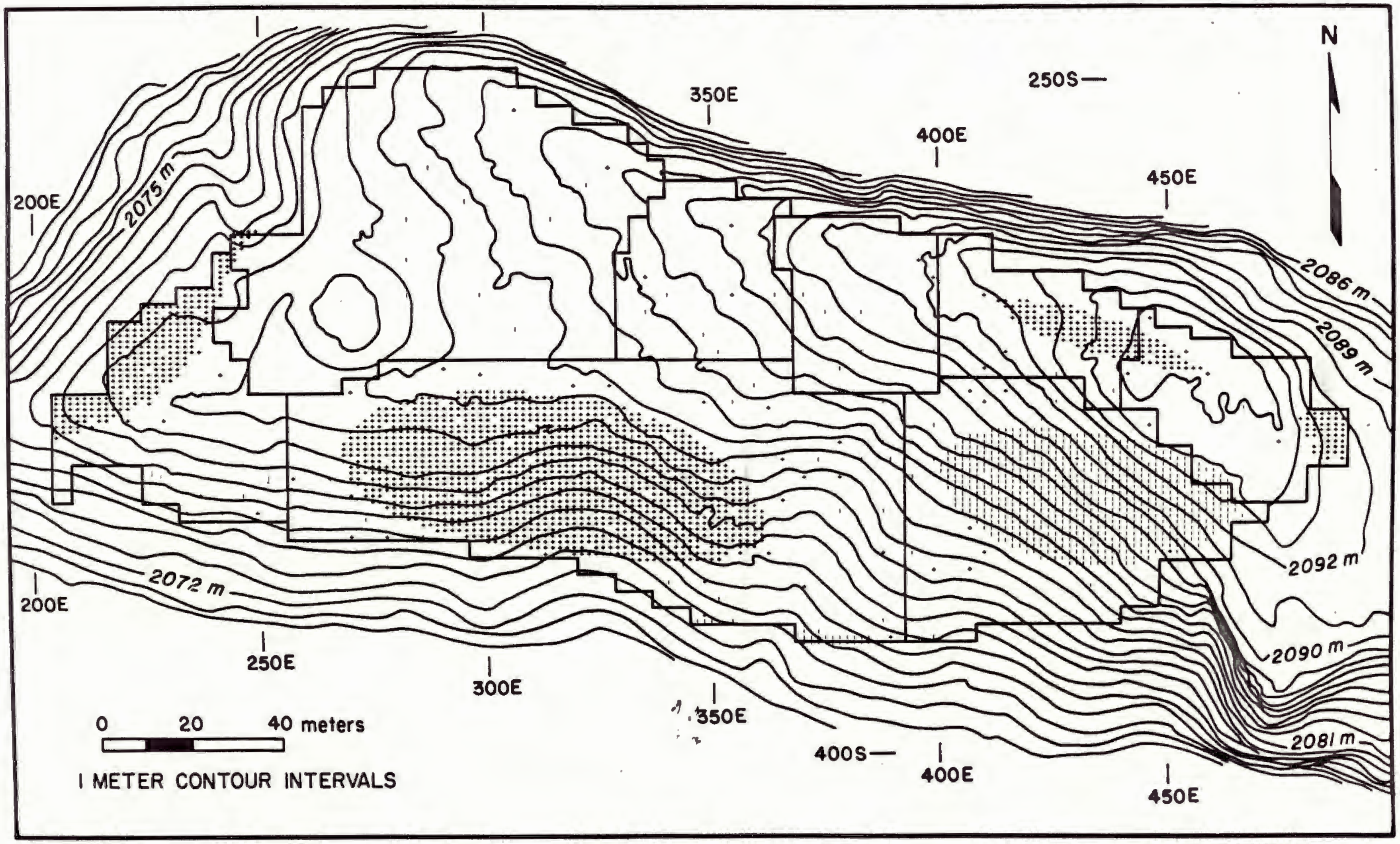


Figure 12. SYMAP trend surface map of residuals from regression of late ceramics against total ceramics, Grass Mesa Village (DAP 149804).

with that for the intermediate group than with that for the early group. Differences between the maps for the intermediate and late ceramic groups can probably best be explained by increased occupation of the roomblock that parallels the northwestern boundary of Area 8 and perhaps by a more intensive occupation of Areas 1 and 2. The total fit between the trend surface map and the actual residuals is once again rather low ($r^2 = 0.10$).

Considered together, these maps of the distributions of temporally sensitive ceramics, the distributions of sheet trash and building materials across the site, and the information presented in table 6 suggest several tentative conclusions:

1. The earliest occupation of the site, which on the basis of the co-occurrence of Chapin Black-on-white and Abajo Red-on-orange probably should be placed no later than the early decades of the ninth century A.D., seems to have been much less intense than the later occupations. Perhaps as few as three or four (still undiscovered) households occupied the mesa top at this time.
2. The more intensive later occupations might have obliterated any structures dating to the earliest occupation of the site. The distribution of early ceramics on the site suggests that evidence of the earliest occupation at the site might be found in Area 3. However, there are also some early ceramics in Areas 1, 2, 6, and 7.
3. The major occupation on the mesa can be placed between A.D. 775 and 900, the period of overlap of the three ceramic types used to map the temporally intermediate period of occupation. Sometime during this period, the use of most of Area 6 and the north edge of Area 5 began, and eventually the entire mesa top was occupied.

4. The final occupation on the mesa is believed to date to sometime between A.D. 875 and 900 on the basis of the presence of Mancos Gray and Cortez Black-on-white and the extreme rarity of any corrugated types.

5. The similarities in the ceramic distributions for the intermediate and late occupations suggest that most of the mesa was still occupied during this late period. Most of the Area 8 occupation may date to this period, and the occupation of Area 6 seems to have expanded during this time.

6. Because evidence for gradual reduction in the level of occupation from the intermediate to the final period has not been encountered, the use of the mesa for habitation is believed to have come to an end relatively abruptly, soon after A.D. 900.

GRASS MESA VILLAGE AFTER TWO FIELD SEASONS

Fortunately for our knowledge of Grass Mesa, work at the site has not been limited to surface collection. The results of the surface collection and the results of the first two seasons of excavation are used here to present a preliminary summary of the culture history of the site.

The DAP Temporal Sequence

Dos Casas Subphase

According to the current version of local temporal systematics (Kane 1981), the occupation of Grass Mesa Village probably began during the Dos Casas Subphase of the Sagehen Phase. This subphase, which began approximately A.D. 760 and ended approximately A.D. 850 (Kane 1981:67), is characterized here, as elsewhere in the study area, by the beginnings of population aggregation and an apparent rise in the rate of population growth/influx. Kane (1981:67) argues that by A.D. 800, the shift from dispersed farmsteads to small pueblos of three to six household clusters was essentially complete. According to his model, towards the end of the subphase, households were centered in three-room surface apartments of one front living room and two rear storage rooms. A large pitstructure located in front of the center of the roomblock was shared by adjacent households.

Present evidence from Grass Mesa is insufficient to corroborate or refine this model. As is apparent in tables 4 and 5, no structures have yet been assigned to the Dos Casas Subphase with high confidence; however, based on ceramic dating and stratigraphy, several structures (e.g., Pitstructures 9 and 15 and Surface Structures 9, 15, 16, 18, and 46) probably do belong to this subphase. If so, then these pitstructures conform to the general model for pitstructures of this subphase described by Hewitt et al. (1981); that is, they have floor areas of at least 20 m^2 and probably more; they may or may not have wingwalls, but, if this particular feature is present, it is usually of jacal; and they are probably rectangular with rounded corners. Depths of excavation below prehistoric ground surface ranged from 1.0 to 1.3 m. Apparently, the usual roof support pattern consisted of four coniferous upright posts, one in each corner of the structure. The superstructure usually consisted of <u>Populus</u> beams and branches sealed with mud. Floor features included small unburned pits, wingwall postholes, and upright sandstone slabs; other features such as hearths and deflectors were undoubtedly present, although they were not encountered during limited excavation.

Even less is known of surface structures of the Dos Casas Subphase. Given the general architectural similarity of the basin-shaped rooms in Areas 3 and 5 to Pueblo I structures in the Chaco area (McKenna 1981), the Mesa Verde District (Sites 1676 and 1679; Hayes and Lancaster 1975:7) and to the known Dos Casas Subphase structures in the Esclante Sector (e.g. Windy Wheat Hamlet [Brisbin 1982]), it is very possible that Rooms 1, 5, and 11 in Area 3 and several rooms in Area 5 (see table 4) belong to this subphase.

<u>Periman Subphase</u>

The Periman Subphase of the McPhee Phase corresponds approximately to A.D. 850-900 elsewhere in the Escalante Sector (Kane 1981:69), but in Grass Mesa Locality it probably terminates somewhat earlier for reasons yet to be determined. Several pitstructures and surface structures can be assigned to this subphase and in their spatial distribution appear to follow the classic pattern for late Basketmater III/Pueblo I sites illustrated in figure 7. The pitstructures are by far the better preserved and understood and are highly variable in size and internal characteristics, attributes noted by Kane for the project area in general during this subphase (1981:71). On Grass Mesa, floor areas range from 55 m^2 to less than 15 m^2. It seems probable that at least two functional subclasses of pitstructures are identifiable during this subphase (Hewitt et al. 1981), with the larger structures perhaps better termed "protokivas" (refer to Morris 1939; Hayes and Lancaster 1975). The very deep and large Pitstructure 3 in Area 3 is an example of this latter group, with its apparently "ceremonial" subfloor features and a large hearth. On the other hand, Pitstructures 2 (Area 4) and 10 (Area 5) are small, date to late within the Periman Subphase, and exhibit unusual characteristics such as wall cists and U-shaped wingwalls (Pitstructure 2) and large rectangular floor features (Pitstructure 10). Surface structure construction becomes more substantial, with full masonry structures probably appearing by the middle of the Periman Subphase. Internal features of individual rooms and the spatial relationships of these features to one another are still poorly known. Based on measures such as numbers of cutting dates and numbers of excavated surface structures probably assignable to this subphase, the Periman Subphase is believed to mark the population peak at Grass Mesa (fig. 13). The surface collections suggest that the entire mesa, including previously unoccupied portions, probably received some use during this subphase. During this time, each arc of surface rooms in Areas 1 through 4 may have housed a ward cluster that shared a structure similar to the possible protokiva that was excavated in Area 3. Roomblocks in Areas 5, 6, and 8 appear to have been in use, and even portions

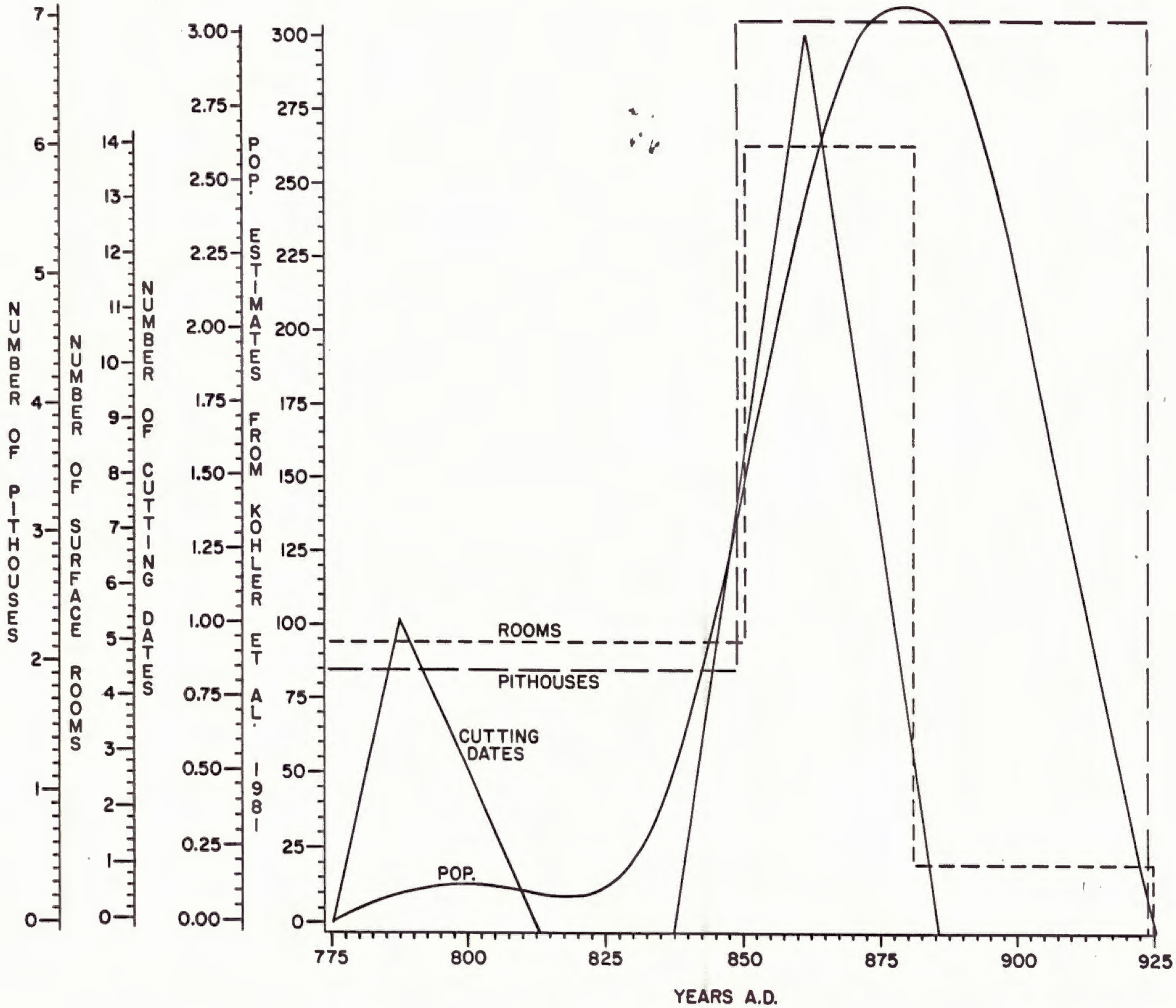


Figure 13. Proxy population variables, Grass Mesa Village.

of Area 7, far down the slope, were occupied. In addition, it seems probable that the large depression (Pitstructure 7) in Area 5, the "great kiva," dates to the early or middle portions of this subphase. While in use, this structure might have been partially surrounded by several small surface structures that perhaps served as storage rooms. Since this structure is so much larger than the presumed protokivas that probably served single interhousehold clusters or ward clusters, it may have served similar functions for groups of interhousehold clusters or ward clusters, perhaps including some located beyond the mesa itself.

Grass Mesa Subphase

The most curious, and in many ways, the most intriguing period at the site was during the final years of occupation, which have been assigned to the Grass Mesa Subphase (A.D. 880-925) of the McPhee Phase (Kane 1981:73). The characteristics of this subphase have so far been identified only from Grass Mesa Village and from the closest contemporaneous village upstream, Rio Vista Village (5MT2182) in the Periman Locality. Contemporaneous occupations in other portions of the Dolores Project area are assigned to the Cline Subphase (A.D. 900-975; Kane 1981:71). The Cline Subphase settlement pattern corresponds more closely to the typical Pueblo II pattern, with its aggregated villages, masonry roomblocks with residential features, true kivas, and outlying field houses. By contrast, the only structures that can be assigned with certainty to the Grass Mesa Subphase are small pithouses that reflect little labor investment; some (e.g., Pitstructure 5 in Area 3) lack wingwalls. In a study of activity areas, C. Breternitz (1982b:167) determined that this apparent lack of architectural formality was not accompanied by a lack of formality and differentiation in the definition of activity areas, especially grinding areas; included in his study were Pitstructures 1 and 3 in Area 3 at Grass Mesa.

It is clear that the formal site layout of the Periman Subphase was abandoned, or at least muddied, during this last occupation. Evidence of this disregard of the formal plan is the positioning of at least two pithouses and perhaps some surface structures within the limits of the "great kiva," which by that time had fallen into disuse. Pitstructure 16, the only pitstructure in the depression that has been completely excavated, is a small structure, rather irregular in outline and oriented about 45° east of north, itself an unusual characteristic. The partial excavation of this structure into the loose fill of the earlier "great kiva" may indicate an unwillingness to expend the effort necessary to excavate the entire structure into compact sterile sediments or the inability to find other vacant locations on the mesa. In this pitstructure, wingwalls were absent, but a wall cist, floor cist, and wall shelf provided storage areas often lacking in earlier structures (Pitstructure 2 in Area 4, also contained a wall cist; this structure appears to reflect the transition from the Periman to the Grass Mesa Subphases). Clear and abundant evidence for household activities such as cooking and grinding in the pitstructures from this subphase leaves little doubt that they were used as habitations during at least part of the year.

The failure to clearly identify surface structures from the Grass Mesa Subphase does not necessarily mean that none exists, but it does suggest that, if such structures were present, they were less formal and probably served more limited functions than those of the Periman Subphase.

Trends in wood use for construction at the site have been reviewed by Kohler et al. (1981). They conclude that there is a general decrease in the relative frequency of juniper use through time, accompanied by an increased use of Populus (probably cottonwood), Douglas-fir, ponderosa pine, and pinyon pine. Without additional information it cannot be determined whether these trends are the result of changing climatic conditions, depletion of the most readily available supplies of suitable wood (as the authors propose), or an unwillingness to invest extensive effort in the construction of the latest structures.

Future Investigations

From the information presented in this report, it is clear that many important questions remain to be answered about Grass Mesa Village. Many of these are general problems, including the difficulty of relating surface structures to pitstructures in a highly disturbed, multiple-occupation site. A special subset of this problem is the need to determine the temporal and functional relationships between the "great kiva" and nearby surface structures. The construction and use of the "great kiva," examined with reference to the population history of the site and that of the surrounding area is another matter of special concern. Investigating this issue will require more precise dating of the structure and more accurate reconstructions of the site and sector population histories. In this regard, the poor dating of all occupation of the site prior to A.D. 850 is unfortunate, since there is so little evidence for occupation anywhere in the Escalante Sector from about A.D. 810 to 840, and the possibility of a short-term abandonment of large portions of the study area during this period cannot be ruled out.

Finally, the nature of the occupation during the eccentric Grass Mesa Subphase must be clarified. What causes can be forwarded for the departures from the trajectories of change noted elsewhere in the sector at this time? Is there any connection between these causes and the somewhat later general abandonment of the study area? While most such questions require a breadth of inquiry much greater than that possible on the individual site level, it is essential to have reliable information on the nature of the occupation at Grass Mesa Village before these questions can be satisfactorily resolved. A framework for asking and answering such questions has been proposed by Lipe (1981), and further research at Grass Mesa will address the specific concerns of this model.

REFERENCES CITED

Ahlstrom, Richard V. N., and Karen Dohm
1980 Archaeological investigations on Grass Mesa: Area 4, 1979. Ms. on file, Dolores Archaeological Program, Dolores, Colorado.

Baker, Charles M.
1978 The size effect: an explanation of variability in surface artifact assemblage content. American Antiquity 43:288-293.

Benz, Bruce F.
1981 Status of faunal analysis. In Environmental studies report, compiled by Bruce F. Benz and Vickie L. Clay, pp. 32-38. Dolores Archaeological Program Technical Reports DAP-061. First draft submitted to the U.S. Bureau of Reclamation, Upper Colo. Region, Salt Lake City, in compliance with Contract No. 8-07-40-S0562.

Binford, Lewis R., Sally R. Binford, and R. Whallon
1970 Archaeology at Hatchery West. Memoirs of the Society for American Archaeology 24.

Bissell, Steven J. (editor)
1978 Colorado mammal distribution latilong study. Colorado Division of Wildlife, Denver.

Breternitz, Cory D.
1982a Excavations in Area 3, Grass Mesa (5MT23), 1979 and 1980 seasons final descriptive report. Ms. on file, Dolores Archaeological Program, Dolores, Colorado.

1982b Identifying prehistoric activity areas: analysis of temporal and functional variability among Dolores area structures. Unpublished M.A. thesis, Department of Anthropology, Washington State University, Pullman.

Breternitz, David A., Arthur H. Rohn, and Elizabeth A. Morris
1974 Prehistoric ceramics of the Mesa Verde Region. Museum of Northern Arizona Ceramic Series 5.

Brew, John Otis
1946 Archaeology of Alkali Ridge, southeastern Utah, with a review of the prehistory of the Mesa Verde Division of the San Juan and some observations on archaeological systematics. Papers of the Peabody Museum of American Archaeology and Ethnology 21.

Brisbin, Joel M.
1982 Excavations at Windy Wheat Hamlet (Site 5MT4644), a Pueblo I habitation site. Ms. on file, Dolores Archaeological Program, Dolores, Colorado.

Bye, Robert A. Jr.
1982 Botanical studies. Dolores Archaeological Program Technical Reports DAP-047. Final report submitted to the U.S. Bureau of Reclamation, Upper Colo. Region, Salt Lake City, in compliance with Contract No. 8-07-40-S0562.

Chorley, R. J., and P. Haggett
1968 Trend-surface mapping in geographical research. In Spatial analysis: a reader in statistical geography, edited by B. J. L. Berry and D. F. Marble, pp. 195-217. Prentice-Hall, Englewood Cliffs.

Dohm, Karen, and Melissa Gould
1983 Preliminary report of 1980 excavations at Grass Mesa Areas 1, 2, and 7. Ms. on file, Dolores Archaeological Program, Dolores, Colorado.

Dougenik, James A., and David E. Sheehan
1977 SYMAP user's reference manual (revised). Graduate School of Design, Harvard University. Cambridge.

Emerson, Alice, Ricky Lightfoot, and Eric Blinman
1983 Preliminary draft of the Grass Mesa, Area 5 descriptive report, Ms. on file, Dolores Archaeolgical Program, Dolores, Colorado.

Fewkes, J. Walter
1919 Prehistoric villages, castles and towers of southwestern Colorado. Bureau of American Ethnology Bulletin 70.

Flannery, Kent V.
1976 Two possible village subdivisions: the courtyard group and the residential ward. In The early Mesoamerican village, edited by Kent V. Flannery, pp. 72-75. Academic Press, New York.

Guernsey, Samuel J., and Alfred V. Kidder
1921 Basketmaker caves of northeastern Arizona. Papers of the Peabody Museum of American Archaeology and Ethnology 8.

Haggard, Ernest A.
1958 Intraclass correlation and the analysis of variance. Dryden Press, New York.

Hayes, Alden C., and James A. Lancaster
1975 Badger House Community, Mesa Verde National Park, Colorado. National Park Service Publications in Archeology 7E.

Hewitt, Nancy J., Allen E. Kane, Arthur Rohr, and Dorin Steele
1981 Temporal implications of architectural characteristics of Anasazi pitstructures, southwestern Colorado. Paper presented at the 46th Annual Meeting of the Society for American Archaeology, San Diego.

Hogan, Patrick
1980 Grass Mesa Locality overview. Ms. on file, Dolores Archaeolgical Program, Dolores, Colorado.

Holliday, Vance, and Lucy Piety
1980 A geological overview of the Grass Mesa Locality. Ms. on file, Dolores Archaeolgical Program, Dolores, Colorado.

Kane, Allen E.
1981 The prehistory of the Dolores Project area. Dolores Archaeological Program synthetic report, 1978-1981 DAP-055, pp. 49-138. Final report submitted to the U.S. Bureau of Reclamation, Upper Colo. Region, Salt Lake City, in compliance with Contract No. 8-07-40-S0562.

Kane, Allen E., Nancy J. Hewitt, Joel M. Brisbin, Patrick Hogan, Gary A. Brown, Steven D. Emslie, J. Holly Hathaway, Frank C. Leonhardy, William A. Lucius, and Roger A. Moore
1981 Field manual. Dolores Archaeological Program Technical Reports DAP-011. Final report submitted to the U.S. Bureau of Reclamation, Upper Colo. Region, Salt Lake City, in compliance with Contract No. 8-07-40-S0562.

Kidder, Alfred V.
1927 The Southwestern archaeological conference. Science 66:489-491.

Kidder, Alfred V., and Samuel J. Guernsey
1919 Archaeological explorations in northeastern Arizona. Bureau of American Ethnology Bulletin 65.

Kingery, Hugh E., and Walter D. Graul (editors)
1978 Colorado bird distribution latilong study. Colorado Field Ornithologists in cooperation with Colorado Division of Wildlife, Denver.

Kohler, Timothy A.
1983 Grass Mesa Archaeological Locality overview, 1980. Dolores Archaeological Program Technical Reports DAP-119. Final report submitted to the U.S. Bureau of Reclemation, Upper Colo. Region, Salt Lake City, in compliance with Contract No. 8-07-40-S0562.

Kohler, Timothy A., William D. Lipe, Mary E. Floyd, and Robert A. Bye, Jr.
1981 Modeling wood resource depletion in the Grass Mesa Locality. Dolores Archaeological Program synthetic report, 1978-1981 DAP-055, pp. 252-270. Final report submitted to the U.S. Bureau of Reclamation, Upper Colo. Region, Salt Lake City, in compliance with Contract No. 8-07-40-S0562.

Leonhardy, Frank C., and Vickie Clay
1982 Geology of the Dolores Project area. Dolores Archaeological Program Technical Reports DAP-050. Final report submitted to the U.S. Bureau of Reclamation, Upper Colo. Region, Salt Lake City, in compliance with Contract No. 8-07-40-S0562.

Lipe, William D.
1981 An approach to modeling Dolores area cultural change: A.D. 650-950. Dolores Archaeological Program synthetic report 1978-1981 DAP-055, pp. 668-706. Final report submitted to the U.S. Bureau of Reclamation, Upper Colo. Region, Salt Lake City, in compliance with Contract No. 8-07-40-S0562.

Marshall, Michael P., John R. Stein, Richard V. Loose, and Judith E. Novotny
1979 Anasazi communities of the San Juan Basin. Public Service Company of New Mexico, Albuquerque.

Martin, Paul S., and John Rinaldo
1939 Modified Basket Maker sites, Ackmen-Lowry area, southwestern Colorado, 1938. Field Museum of Natural History Publication 444, Anthropological Series 23:305-499.

McKenna, Peter
1981 A Chacoan primer: village excavations in Chaco Canyon 1973-1978. Ms. on file, Chaco Center, National Park Service, Albuquerque.

McNitt, Frank
1966 Richard Wetherill: Anasazi. University of New Mexico Press, Albuquerque.

Morris, Earl H.
1939 Archaeological studies in the La Plata District, southwestern Colorado and northwestern New Mexico. Carnegie Institution of Washington 519:1-298.

Powell, Shirley, and Anthony L. Klesert
1980 Predicting the presence of structures on small sites. Current Anthropology 21:367-369.

Reed, Erik K.
1956 Types of village-plan layouts in the Southwest. In Prehistoric settlement patterns in the New World, edited by Gordon R. Willey. Viking Fund Publications in Anthropology 23:11-17.

Smith, R. L.
1974 Ecology and field biology (second ed.). Harper and Row, New York.

Thomas, Edwin N.
1968 Maps of residuals from regression. In Spatial Analysis, edited by B. J. L. Berry and D. F. Marble, pp. 326-352. Prentice-Hall, Englewood Cliffs.

Unwin, D.
1975 An introduction to trend-surface analysis. Concepts and Techniques in Modern Geography 5. Geo Abstracts, University of East Anglia, Norwich.

Whitten, E. H. T.
1975 The practical use of trend-surface analyses in the geological sciences. In Display and analysis of spatial data: NATO advanced study institute, edited by J. C. Davis and M. J. McCullagh, pp. 282-297. John Wiley and Sons, New York.