

ARCHAEOLOGICAL RECONNAISSANCE IN WHITE SANDS NATIONAL MONUMENT



by Peter L. Eidenbach and Mark Wimberly
with contributions by Terry Knight

**ARCHAEOLOGICAL RECONNAISSANCE
IN WHITE SANDS NATIONAL MONUMENT, NEW MEXICO
1978**

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ABSTRACT

Human Systems Research has conducted a preliminary evaluation of archaeological resources along the western boundary of White Sands National Monument. The purpose of this evaluation is to: 1) provide WSNM and National Park Service with management information on the location, extent and significance of cultural properties within a sample of the portion of the Cooperative Use Zone of the National Monument with the highest potential for adverse effect; 2) make recommendations as appropriate to the National Register of Historic Places; 3) provide basis for future scientific research and popular interpretation programs which might be appropriate for the National Monument.

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FOREWORD

The work reported in this publication is the result of two separate investigations undertaken for the National Park Service, White Sands National Monument. The largest of these undertakings (and most recent) concerns field reconnaissance and preliminary archaeological assessment of cultural resources within the Bajadan Community along the western boundary of the national monument. This ecological unit is somewhat distinct from other units within the monument. Vegetation and land form within the unit are more directly related to the footslopes of the San Andres Mountains and formations running north and south along the margins of the Tularosa Basin. It is also distinct from the formations and ecological units associated with the gypsum dunelands, characteristic of the major portions of the national monument. Thus, human adaptations evidenced in the Bajadan Community are more comparable to archaeological remains found throughout the general region, while archaeological evidence reported within the second section of this report is as unique as the gypsum dunes themselves.

In the second section of this report, we have presented the results of archaeological reconnaissance along the Parabolic Dune margins. This ecological unit is considered the leading edge, and active portion of the dune field for which the monument was named. HSR (1973b) has previously reported the results of this research, but only a limited number of copies of this report were originally made. Because of the great significance of these remains to any understanding of past human use of the national monument, they have been summarized for inclusion in this work. It is hoped that in this manner the data concerning cultural resources presently known to exist within the monument will be more broadly available to appropriate management agencies. Further, by presenting the results of these two surveys, the need for further work in the unexplored areas of the monument should become obvious. Recommendations concerning this need, and an outline of general procedures and priorities which should be considered in such a program, have been outlined in the final chapter.

ACKNOWLEDGEMENTS

As in the case of any archaeological field report, completion of this one is the result of cooperation between a great many individuals and institutions. The authors wish to express their appreciation first to the two major agencies responsible for administration of the land involved. These are the National Park Service, White Sands National Monument, and the Department of the Army, White Sands Missile Range. From NPS, we especially wish to thank Mr. Ron Ice, Regional Archaeologist, and Mr. Jim Thomson, past Superintendent of White Sands National Monument, both of whom developed the original research plan and facilitated the research. Also, we express our appreciation to Mr. Donald Harper, current Superintendent of the monument. At White Sands Missile Range, we gratefully acknowledge the assistance and support of Mr. Felix Sedillo, Director of Facilities Engineering, who provided necessary maps and access permits for entrance to those areas of the Monument which were more easily reached by crossing WSMR. We also appreciate the assistance of Mr. Henry Cedillo of Range Security in approving our activities within the Missile Range on a daily basis. At the Museum of New Mexico, Laboratory of Anthropology, we thank Mr. Stewart Peckham for his assistance in relationships with WSMR.

Mr. Hoover Wimberly of /H Breeding and Training Stables provided the horses and necessary equipment for the horseback portions of both the surveys reported here. A great many hours and dollars were saved through his generosity.

Mrs. Renetta Friesen and her husband Dick, spent many hours running back and forth between the Dona Ana County Courthouse and the Otero County Courthouse, as well as to the records of the Tularosa Basin Historical Society and the Rio Grande Historical Collections (Austin Hoover, Director, thank you).

We also thank Terry Knight for the many hours of comparative ceramic study, most of which were without remuneration, in addition to the fine job she accomplished during the fieldwork and preliminary analysis.

Photography for this report is by the authors in the case of the Bajada work, and by Mr. G.F. Crabtree, HSR Staff Photographer, in the case of the Parabolic Dune work.

Illustrations were prepared by Mr. Ernest Shearin and the authors. Layout and typesetting of the final report was done by Gail Wimberly of Composing Services.

I – THE BAJADAN COMMUNITY

INTRODUCTION

National Park Service personnel have reported a concentration of ceramic materials in two locations along the west boundary of White Sands National Monument (see WSNM dated March 1967, *Notes on the Area Archaeological Theme* and *Catalogue of Artifacts*, in the collections of the Park Naturalist, WSNM). In a preliminary survey (*Evaluation of the Archaeological Potential of White Sands National Monument*, NPS Contract Number CX700030220) assessing the archaeological resources of WSNM, Human Systems Research (1973b) reported two site locations in these previously identified areas:

- 1) Section 6, Township 17S, Range 5E--
the Northwest corner of the Monument;
- 2) Section 5, Township 19S, Range 5E--
the Southwest corner of the Monument, the Lucero Lake Site.

In a report prepared for University of Oklahoma Biological Survey for inclusion in the Draft Environmental Statement for the Department of the Army, White Sands Missile Range (*Cultural Resources Affected by the Cooperative Agreement between the Department of the Army, WSMR and National Park Service*, WSNM, June 1974), HSR again reported the presence of these two known sites and suggested the evaluation of these and any similar locations within the same setting.

On November 18 and 19, 1975, HSR accompanied a field party consisting of Mr. Tom Merlan, New Mexico State Historic Preservation Officer, Mr. Ron Ice, Regional Archaeologist, NPS, and Mr. Jim Thomson, Superintendent of WSNM, in a review of the sites recorded during the preliminary evaluation (HSR 1973b). This review was undertaken for the purpose of determining the significance of recorded sites and compiling recommendations for the National Register of Historic Places. Although recommendations concerning several site types in other locations on the monument have been formulated (see Section II of this report), it was decided at the time of the field review that, because of the scale of the prehistoric sites noted on the western boundary, further field research would be required to arrive at determination. Following is the report of that research.

THE SETTING

In the *White Sands Natural Studies Plan* (Sumner 1969), six major biotic and physiographic community units have been mapped. These community units were utilized in the original field sample conducted during the 1973 HSR--NPS reconnaissance. Sumner's (1969 Resource Base Map) *Bajadan Community* occurs along the extreme western edge of the monument on the broad, sloping plain at the foot

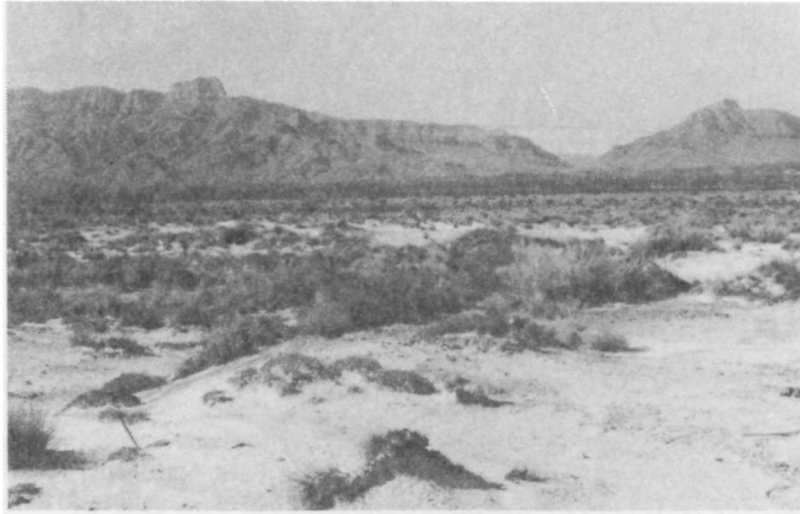


Photo 1: The Bajadan Community along the footslopes of the San Andres Mountains.

of the San Andres Mountains. It is characterized by: a) creosote; b) mesquite, which grows in large hummocks of wind-blown granitic sand that has been compacted around the roots and basal portions of the plants; and, c) four-wing saltbush. Approximately 22 square miles of WSNM lands lie within this community.

The alluvial benches of the Bajadan Community support a low biotic diversity. The attraction of this to a broadly based hunting and gathering adaptation (i.e., early Archaic and much later Apachean groups) would be minimal.

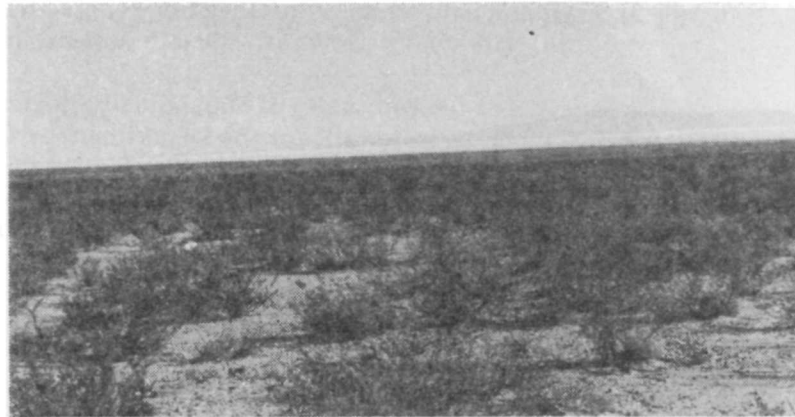


Photo 2 (above) and 3 (below): The barren alluvial slopes of the Bajadan Community support a sparse cover of desert shrubs.



However, proximity of high energy runoff waters from the nearby San Andres Mountains, and the presence of a limited amount of potential agricultural land (Maker, et. al., 1972), suggest that this area would far exceed the surrounding formations in the ability to support developing sedentary communities that were based at least partially on agriculture.

Further, the ecotone between the alkali flats and salt marshes of Lake Lucero and the bajadan benches, which occurs along the eastern edge of the community, provides an additional resource area of potential value to prehistoric peoples. Only two sections of this community have been preliminarily exam-

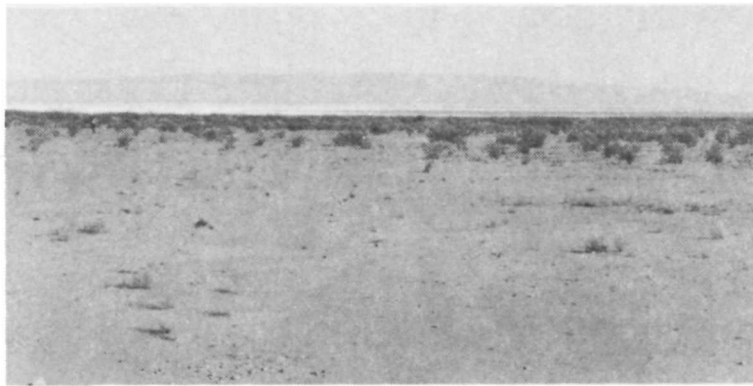


Photo 4: Dry winds actively erode open sandy areas in the bajada's barren soils.

ined for the presence of archaeological resources (HSR 1973b). This non-random portion of the original reconnaissance sample was directed at examining the locations where National Park Service personnel have previously recorded prehistoric cultural material. Nothing is known of the archaeological potential of the other approximately 20 sections in this community within the national monument. It



Photo 5: Snow-capped Sierra Blanca peak dominates the distant horizon fifty miles northeast of the study area.

also important to note that the Bajadan Community continues west and both north and south of the national monument on lands administered by the Department of the Army, White Sands Missile Range. Portions of the Lucero Lake and Huntington sites at both locations above, in fact, extend onto the Missile Range property (see Maps 1 and 3 through 8).

AVAILABLE WATER

The Bajadan Community is comprised of a variety of arid desert soils receiving from 7 to 13 inches of precipitation annually. Permeability of these soils varies greatly from as low as 0.06 inches per hour to a maximum of 20 inches per hour. Available Water Capacity, the ability of a soil to hold water, however, is consistently low, with a maximum of 0.19 inches per inch. Thus, most precipitation either penetrates rapidly, becoming unavailable to all but those desert plants with deep tap roots (like mesquite, creosote and yucca), or runoff is rapid, allowing little time for penetration before water escapes to the lakebed at the lowest elevations.

Upslope runoff from the east face of the San Andres Mountains is very intermittent and rapid. The mountain face is quite steep and drainages are short, resulting in a somewhat violent contribution of available water from the mountains to the bajada. This rapid runoff poses a major erosion threat or limitation for agricultural use of the bajada. Evidence of extensive sheet and channel erosion is noticeable throughout the area.

One large upland (major) drainage, Andrecito Creek, flows across the Bajadan Community within White Sands National Monument. Today, this creek is highly intermittent, but its broad channel testifies to substantial flow in the past.

Table 1

(data from *Neher & Bailey, 1976*)

Soils of the

Bajadan Community

<u>SYMBOL</u>	<u>MAPPING UNIT/ SOIL SERIES</u>	<u>ORDER</u>	<u>SUB-GROUP</u>	<u>SLOPE</u>	<u>MEAN ANNUAL PRECIP. (INCHES)</u>	<u>FROST FREE SEASON</u>	<u>PERMEA- BILITY (IN/HR)</u>
DU	DUNELAND--DONA ANA COMPLEX						
	1--Duneland			5--75%	7--10	190--210	6.3--20.0
	2--Dona Ana	Aridisols	Typic Haplargids	1--4%	8--10	190--210	0.6--2.0
DY	DUNELAND--YESUM COMPLEX						
	1--Duneland			5--75%	7--10	190--210	6.3--20.0
	2--Yesum	Aridisols	Typic Gypsiorthids	0--5%	8--10	190--210	0.6--2.0
GU	GYPSUM LAND, LEVEL			0--15%	7--9	190--210	- - - -
MA	MARCIAL--UBAR ASSOCIATION						
	1--Marcial	Aridisols	Typic Camborthids	0--1%	8--10	190--205	0.06--0.2
	2--Ubar	Aridisols	Typic Camborthids	<1%	8--10	190--205	0.06--0.12
MG	MIMBRES--GLENDALE ASSOCIATION						
	1--Mimbres	Aridisols	Typic Camborthids	0--3%	8--10	190--205	0.2--2.0
	2--Glendale	Entisols	Typic Torrifluvents	0--3%	8--10	190--205	0.2--0.6
NT	NICKEL--TENCEE ASSOCIATION						
	1--Nickel	Aridisols	Typic Calciorthids	1--55%	8--13	185--205	0.2--0.6
	2--Tencee	Aridisols	Typic Paleorthids	1--35%	8--13	185--205	0.6--2.0
OB	ONITE--BLUEPOINT--WINK ASSOCIATION						
	1--Onite	Aridisols	Typic Haplargids	0--3%	8--10	190--210	2.0--6.0
	2--Bluepoint	Entisols	Typic Torripsamments	1--4%	8--10	190--210	6.0--20.0
	3--Wink	Aridisols	Typic Calciorthids	0--3%	9--10	190--210	2.0--6.0
SP	SONOITA--PINALENO--ALADDIN ASSOCIATION						
	1--Sonoita	Aridisols	Typic Haplargids	1--9%	9--12	185--210	0.6--2.0
	2--Pinaleno	Aridisols	Typic Haplargids	1--9%	9--12	185--210	0.6--2.0
	3--Aladdin	Mollisols	Torriorthentic Haplustolls	1--15%	9--12	180--210	2.0--20.0

<u>AVAILABLE WATER CAPACITY (INS/IN)</u>	<u>CAPABIL. SUBCLASS</u>	<u>VEGETATIVE GROUP</u>	
0.06--0.08 0.15--0.19	VIIc	3	SAND GRASSLANDS AND DUNES 1--Sand Hills: mesquite, four-wing saltbush, sand dropseed, long leaf ephedra, mesa dropseed 2--Sandy: spike dropseed, four-wing saltbush, winterfat, mesquite, mesa dropseed, tobosa, black grama
0.06--0.08 0.10--0.12	- - -	4	GYPSUM GRASSLANDS AND DUNES 1- . . . Torry ephedra, four-wing saltbush, mesquite, hoary rosemarymint 2--Gyp Flats: alkali sacaton, four-wing saltbush, mesquite, gyp grama
- - - - -	VIIIc	6	INTERMITTENT LAKES AND LEVEL GYPLAND -- iodinebush (few)
0.09--0.12 0.10--0.12	VIIc	2	SALT FLATS 1--Salt Flats: inland saltgrass, alkali sacaton, tobosa, 2--Salt Flats: four-wing saltbush, vine mesquite
0.13--0.19 0.12--0.19	VIIc	1	CLAY GRASSLANDS 1--Clayey: alkali sacaton, tobosa, four-wing saltbush 2--Clayey: creosotebush, burrograss
0.07--0.08 0.04--0.10	VIIc	8	SEMIDESERT SHRUBS 1--Limy: creosotebush, American tarbush, 2--Limy: mesquite, mariola parthenium
0.06--0.13 0.06--0.09 0.08--0.12	VIIc	3	SAND GRASSLANDS AND DUNES 1--Deep Sand: giant dropseed, mesa dropseed, spike dropseed, sand sagebrush 2--Sand Hills: mesquite, four-wing saltbush, sand dropseed, longleaf ephedra, mesa dropseed 3--Deep Sand: giant dropseed, mesa dropseed, spike dropseed, sand sagebrush
0.08--0.11 0.03--0.11 0.06--0.11	VIIc	7	FOOT SLOPE GRASSLANDS 1--Loamy: black grama, blue grama 2--Gravelly: black grama, blue grama, sideoats grama 3--Sandy: black grama, four-wing saltbush, sand sagebrush

SOILS

Soils in the Bajadan Community and the neighboring vicinity are derived from the nearby San Andres Mountains, the gravelly piedmont slope, and the alluvial outwash on the basin floor. Large, gradually sloping, sparse grassland and rolling eolian dunes are characteristic of most of the area. With few exceptions, all the local soils are hot, arid, and many are strongly calcareous. Annual production is low and modern native plants are primarily desert species adapted to this arid environment. The major soil formations in the survey area are described in Table 1. Table 2 offers broad interpretations of the archaeological potential of soil Great Groups represented.

It is clear that current conditions preclude agriculture. Mean precipitation is too low to support any but the hardiest desert dwellers. The highly calcareous nature of many of the soils would render them useless even under increased precipitation. The generally sandy texture of these soils also poses a severe erosion hazard to any land modifying activity, including agriculture. Nonetheless, isolated areas of soils with *high* agricultural potential are distributed along the foot of the piedmont in the vicinity of 4,000 feet elevation. If climatic conditions were less arid, with an increase in annual precipitation, cultivation of selected soils would be highly productive (see Soils Map, p. 24).

Table 2

ARCHAEOLOGICAL INTERPRETATIONS OF THE SOIL GREAT GROUPS IN THE BAJADAN COMMUNITY, WSNM

Haplargids: These soils are recently developed, have a clay horizon, but are arid and hot. Agricultural potential is poor to good if sufficient water is available.

Gypsiorthids: A high percentage of gypsum and salts in these soils preclude agriculture. Depending upon availability of water and physiographic position, a considerable variety of native biota may be expected.

Camborthids: Normally, the complete lack of development in these soils (i.e., low organic content) precludes agriculture. However, if sufficient water is available, *Camborthids* often produce well. They have been used primarily for grazing during the historic period, and are a likely site for aboriginal exploitation of wild species.

Torrifluvents: These soils are commonly sub-irrigated and agricultural potential is high. A large variety of native species may be expected and production is high.

Calciorthids: These poorly developed desert soils have a high calcium content and a low percentage of organic material. These soils have poor agricultural potential due to their alkaline character.

Paleorthids: Poorly developed, older soils, with low organic content. Often a petrocalcic horizon is present. Agriculture is not feasible.

Torripsamments: These hot, dry, sandy soils have good agricultural potential if sufficient water is available. They are a likely site for the exploitation of wild species adapted to an arid, sandy environment.

Haplustolls: Typically, ustolls are grasslands. Depending upon availability of water, they may be woodland or bosque. These soils are likely to have been cultivated and grazed. They commonly produce a large variety of native species.

VEGETATIVE FORMATIONS

The Bajadan Community and its environs lie within the Lower Sonoran Life Zone, characterized by hot desert conditions with low and uncertain rainfall. The Holdridge System (1947) would classify the area as including *Desert*, *Desert Scrub*, *Grassland* or *Dry Scrub*, and *Thorn Scrub*. The Soil Conservation Service study of the area (Neher & Bailey 1976) classifies mapping units and soil series into seven classes with estimated production as follows:

MODERN ESTIMATED TOTAL ANNUAL YIELD

	<u>(lbs/acre) Air Dry</u>
1. Intermittent Lakes & Level Gypland	little or none
2. Salt Flats	300-700
3. Gypsum Grasslands and Dunes	200-600
4. Sand Grasslands and Dunes	300-700
5. Clay Grasslands	300-600
6. Foothlope Grasslands	400-800
7. Semidesert Shrubs	100-400

Mesquite and four-wing saltbush occur extensively and represent major ediole resources for aboriginal populations. A variety of native grasses occur. These have offered a resource for humans as well as grazing animals during historic times. Some evidence indicates that today's sparse conditions may in part be due to recent (past 100 years) overgrazing during drought and subsequent erosion of the denuded surfaces (see Historic Use of the Bajadan Community).

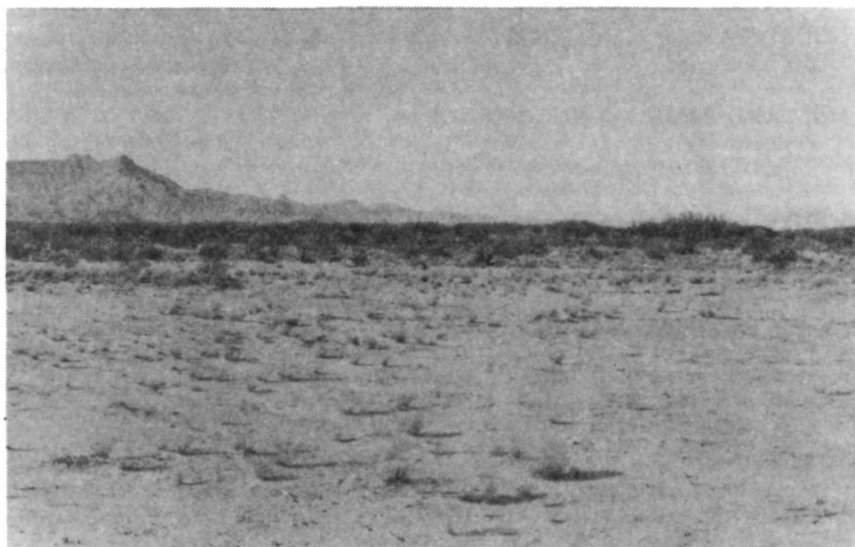


Photo 6: Semidesert shrubs give way to sandy grasslands and dunes along the lower edge of the bajada.

II – HUMAN RESOURCES IN THE BAJADAN COMMUNITY

Table 3
EDIBLE PLANTS WITHIN WSNM
(Based on WSNM 1969; HSR 1973b)

AMARANTH FAMILY (<i>AMARANTHACEAE</i>)	
Redroot Amaranth	<i>Amaranthus retroflexus</i>
CASHEW FAMILY (<i>ANACARDIACEAE</i>)	
Skunkbush Sumac	<i>Rhus trilobata</i>
MILKWEED FAMILY (<i>ASCLEPIADACEAE</i>)	
Broadleaf Milkweed	<i>Asclepias arenaria</i>
CACTUS FAMILY (<i>CACTACEAE</i>)	
Nipple Beehive Cactus	<i>Coryphantha macromeris</i>
Flaming Torch Hedgehog	<i>Echinocereus triglochidiatus</i>
Desert Prickly Pear	<i>Opuntia engelmannii</i>
Tree Cholla	<i>Opuntia imbricata</i>
Desert Christmas Cholla	<i>Opuntia leptocaulis</i>
GOOSEFOOT FAMILY (<i>CHENOPODIACEAE</i>)	
Pickleweed	<i>Allenrolfea occidentalis</i>
Four-wing Saltbush	<i>Atriplex canescens</i>
COMPOSITE FAMILY (<i>COMPOSITAE</i>)	
Wheeler Thistle	<i>Cirsium wheeleri</i>
Common Sunflower	<i>Helianthus annuus</i>
Thelesperma	<i>Thelesperma megapotamicum</i>
GOURD FAMILY (<i>CUCURBITACEAE</i>)	
Buffalo Gourd	<i>Cucurbita foetidissima</i>
MUSTARD FAMILY (<i>CRUCIFERAE</i>)	
Pepperweed	<i>Lepidium montanum</i>
Small-flowered White Mustard	<i>Lepidium alyssoides</i>
JOINTFIR FAMILY (<i>GNETACEAE</i>)	
Torrey Ephedra	<i>Ephedra torreyana</i>
Longleaf Ephedra	<i>Ephedra trifurca</i>
GRASS FAMILY (<i>GRAMINEAE</i>)	
Little Bluestem	<i>Andropogon scoparius</i>
Sixweeks Threawn	<i>Aristida adscensicnis</i>
Indian Rice grass	<i>Oryzopsis hymenoides</i>
Alkali Sacaton	<i>Sporobolus airoides</i>
Spike Dropseed	<i>Sporobolus contractus</i>
Mesa Dropseed	<i>Sporobolus flexuosus</i>
Giant Dropseed	<i>Sporobolus giganteus</i>
PEA FAMILY (<i>LEGUMINOSAE</i>)	
Indian Rushpea	<i>Hoffmanseggia densiflora</i>
Honey Mesquite	<i>Prosopis juliflora</i>

Table 3 (Continued)

LILY FAMILY (<i>LILIACEAE</i>)	
Broadleaf Yucca	<i>Yucca baccata</i>
Narrowleaf Yucca	<i>Yucca elata</i>
LOASA FAMILY (<i>LOASACEAE</i>)	
Blazing Star	<i>Mentzelia integra</i>
Desert Mentzelia	<i>Mentzelia multiflora</i>
Blazingstar	<i>Mentzelia pumila</i>
FOUR O'CLOCK FAMILY (<i>NYCTAGINACEAE</i>)	
Desert Four O'Clock	<i>Mirabilis multiflora</i>
BUCKTHORN FAMILY (<i>THAMNACEAE</i>)	
Knifefleaf Condalia	<i>Condalia spathulata</i>
WILLOW FAMILY (<i>SALICACEAE</i>)	
Rio Grande Cottonwood	<i>Populus wislizenii</i>
POTATO FAMILY (<i>SOLANACEAE</i>)	
Wolfberry	<i>Lycium berlandieri</i>
Pale Wolfberry	<i>Lycium pallidum</i>
Torrey Wolfberry	<i>Lycium torreyi</i>
CATTAIL FAMILY (<i>TYPHACEAE</i>)	
Narrowleaf Cattail	<i>Typha angustifolia</i>
Common Cattail	<i>Typha latifolia</i>

Mesquite: Honey mesquite (*Prosopis juliflora*) is widely distributed in the Bajadan Community along lower mountain piedmonts throughout the Tularosa Basin. Undoubtedly, this single species represents the major native food resource available along the base of the mountains. The flat, slightly curled seed pods of the mesquite occur in clusters, maturing to a bright red and cream color throughout the hottest months of the summer. The elevational range of this desert shrub is wide, occurring from 4,000 feet along the floor of the basin to 7,000 feet in the steep upper canyons. The ripe pods of the mesquite contain a number of flat, rectangular seeds with a sweet, mealy coating high in food value. The use of mesquite beans as a staple, an emergency food source, and a buffering resource in early agricultural societies is widely documented in both the archaeological and ethnographic literature (Bohrer 1970; Castetter and Opler 1936; Harrington 1967; HSR 1973a).

The dry mesquite pods can be successfully stored for a full year and consumed as needed. Pods and seeds are commonly pounded or ground into meal which can then be utilized in a variety of ways; including a fermented drink resembling beer, and sun-dried cakes.

Direct evidence for the use of mesquite during the prehistory of the general area was found at Fresnal Shelter in the Sacramento Mountains, an Archaic summer campsite dating from 3615 years B.P. to about A.D. 100 (HSR 1973a). At Fresnal Shelter, broken pods, seeds, and other plant parts of the mesquite occur in abundance throughout the deposits. The use of mesquite by the Mescalero Apache is also well documented by Basehart (1960).

AGRICULTURAL PRODUCTION

The major limitation to successful agricultural production in an arid environment is the availability of water. During aboriginal occupations of the Bajadan Community on the western edge of WSNM, available water for cultivation was limited to:

1. rainfall, which now averages about 10 inches annually; and
2. runoff from the nearby mountain slopes. At present, this source is highly intermittent.

Paleoclimatic data indicate periods of substantially more moist conditions in the past. Aboriginal agricultural production is likely to coincide with these periods of increased moisture (Wimberly and Rogers 1977:444).

Present production along the alluviums and piedmont of the San Andres is highest in bottomlands of intermittent drainages, ranging 2,000 to 3,000 pounds of air dry material per acre annually. Production in grasslands and dunes is substantially less, on the order of one-tenth of bottomland production. An overall increase in annual production results from more moist conditions.

Annual production in the bajadan area, under current conditions, is summarized by physiographic units and the communities they support (see *Vegetative Formations* in Section I). The range in annual production shown approximates changes due to modern climatic fluctuation. An estimate* of production under unusually (i.e., exceeding modern climatic parameters) dry and unusually wet conditions may be made by comparisons with other areas:

	<u>Lbs. air dry material/acre</u>
Nevada Desert 5" annual precipitation	162
Oklahoma--Nebraska Tall Grass Prairie 22--33" annual precipitation	3,971

If climatic conditions along the western edge of WSNM were comparable to present conditions in the Plains, with approximately twice the present precipitation [as is suggested by Van Devender's data (1976) from the Hueco Mountains], then we would expect comparable levels of production in the grasslands, as well as heavy runoff flooding of bottomlands and reduction in their productivity. Under more moist conditions such as these, selected alluvial soils in grassland communities would be capable of a high level of agricultural productivity. More moist conditions would result in greater, and less intermittent mountain runoff which may have been utilized as a source of additional irrigation water.

*Accuracy of these estimates is reflected by a comparison of short grass grassland in the Tularosa Basin (8--10 inches annual precipitation, annual production 200--700 lbs/acre) with short grass grassland in Wyoming (annual precipitation 13 inches, annual production 614 lbs/acre (all comparative data from MacArthur and Connell, 1966:174).

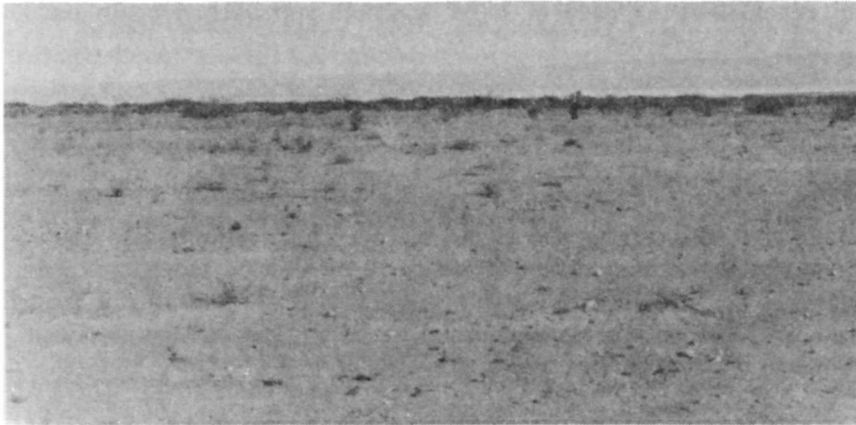


Photo 7: Barren, sandy flats within the bajada may be the remnants of prehistoric fields.

With sufficient moisture, a number of soils in the bajada could achieve high levels of agricultural productivity. Experiments conducted (HSR 1973b) near La Luz (in the Bajadan Community on the opposite side of the basin from WSNM) with a modern variety of Chapalote maize, indicate a yield of up to 360 kilograms of shelled kernels per acre under irrigated conditions.

GRAZING

Unquestionably, vegetation patterns in some areas of southern New Mexico have changed in the last 100 years of human occupation. York and Dick-Peddie (1969) argue that the introduction of cattle and consequent overgrazing reduced desert grasses, allowing the invasion of mesquite and creosote bush. Their argument is based upon field note entries from the early New Mexico land surveys and includes data from the Tularosa Basin. Although their generalization may be true of many areas, the stability and extent of the Bajadan Community along the western shores of Lake Lucero is well documented in similar records. Today, as in the historic past, the bajada is a desert shrubland. Perennial shrubs dominate the landscape visually while a variety of annuals, including desert grasses, comprise the understory. The production of these grass and forb species depends directly upon the annual precipitation. The extent of overgrazing in the Lake Lucero bajada cannot be accurately estimated, but climatic conditions are well documented and adequately explain the frequent mention of "good grass" in many of the historic period field note entries.

Examination of annual precipitation records from El Paso (mean annual precipitation 7.89 inches) and Fort Stanton (mean 18.07 inches), during the period of early land survey, reveals a series of unusually moist years. Most early civil surveys in the basin were conducted during or directly following these periods.

<u>Year</u>	<u>Annual Precipitation</u>	
	<u>El Paso</u>	<u>Ft. Stanton</u>
1856	21.81	16.81
1857	-	28.70
1858 (Lively, Clements surveys)	5.00	18.76
1859	4.83	23.81
1860	-	13.65
1880	14.37	-
1881 (Cheney survey)	18.17	-
1882	8.27	6.78
1883	12.92	-
1884 (Biggs, Lauphton surveys)	18.30	23.50
1885	7.31	12.57

The maximum reached by El Paso in 1884 was not approached again until 1905 when 17.80 inches were received.

The consistency with which aboriginal Indian sites dating within the past 1,000 years and mesquite are associated (a fact pointed out by York and Dick-Peddie 1969) clearly indicates the stability of the Bajadan Community in at least the Tularosa Basin. Maps of the mesquite and creosote zones along the west shore of Lake Lucero, made in 1911 during geological survey (Meinzer and Hare 1915: Plate II), show essentially the present distribution of these species. Both mesquite and creosote form broad bands along the lower mountain slope and are far from being the "small pockets" which York and Dick-Peddie suggest as characteristic prior to the introduction of cattle in the historic period.



Photo 8 (above) and 9 (below): The mesquite and creosote along the margins of Lake Lucero have dominated the arid bajada for at least seventy years.



Examination of land survey field notes in the immediate vicinity of Lake Lucero reveal what is probably a more accurate portrayal of the west central portion of the basin than the cases selected by York and Dick-Peddie. Township 20 South, Range 5 East lies five miles south of Lake Lucero and extends from the Tularosa Basin floor up the slopes of the San Andres to the peak of Goat Mountain, 7,176 feet.

Township 20S, Range 5E.

General Description:

The western portion of this Twp. is high, rough, rocky and mountainous. Some indications of Mineral—the eastern portion slopes to the east. The Ojo San Nicholas in Sec. 4 is the only water in the Twp. Soil is 2d and 3d rate—mesquite and Soap weed abound. There is a good growth of Grama grass in many parts.

—William F. Cheney

U.S. Deputy Surveyor

Field Notes, May 12, 1881

In ungrazed condition, many open areas in the bajada undoubtedly support a good grass crop during unusually moist periods, like those coincidental with the land surveys. The real range damage, however, is due to overgrazing in conjunction with an extreme degree of annual variability in precipitation. Variability in annual range production allows continual use by only a minimum of animals. Occasional years of high production apparently encouraged expansion of the historic period herds. The consequence of a typical dry period (1908—1910) forced wholesale relocation of large numbers of stock to new range.

Production during a moist period is mirrored in the published cattle shipment entries:

Cattle Shipments:

James Baird of the DIZ ranch, San Andres Mts. delivered 3 cars of 1's and 2's here Monday to W.T. McIntire, a Kansas City buyer. The delivery was 80 1's and 40 2's and 3's. They were shipped to the Lee Line Stock Co. K.C.

—Alamogordo Weekly Journal

May 12, 1905

Annual precipitation recorded in Alamogordo indicates above average (10.10 inches) conditions in 1905 (19.52 inches).

Precipitation decreased steadily during the next few years, and by 1908 the range in Lake Lucero bajada had been severely reduced.

The year of 1908 was a particularly dry one and grass was poor in most of the Tularosa Basin. It was not long after Pat Garrett's death that cattleman Jim Baird found that there was not enough grass to properly support all of the more than 2,500 cattle on his range between the San Andres mountains and the western end of the White Sands.

--Mullin, 1969, p.48



Photo 10 (left) and 11 (below): This abandoned windmill, dated 11/37, lies on a small private land claim which could no longer be traced in the county records.

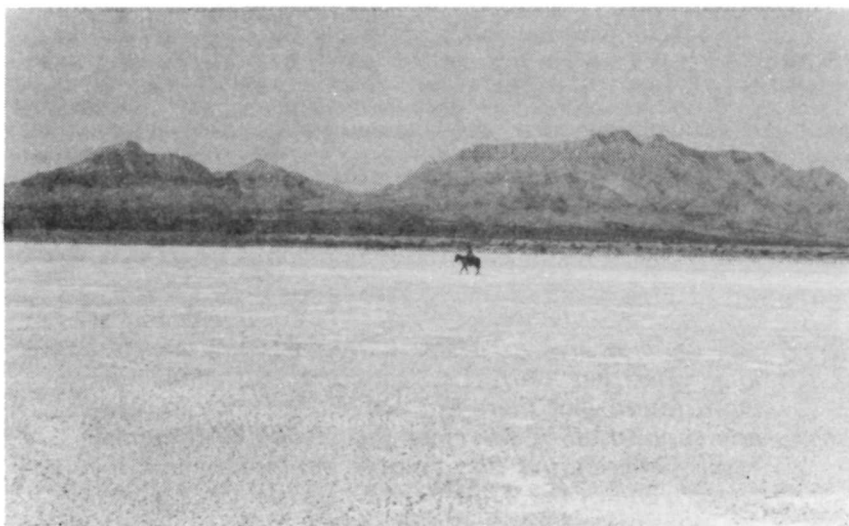
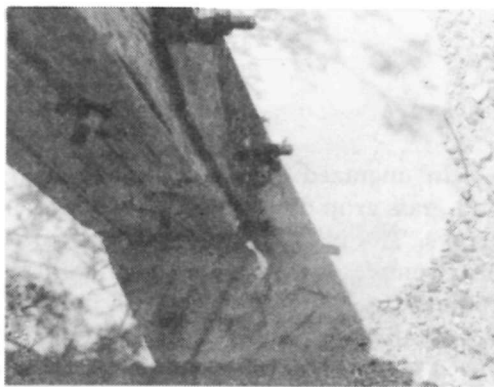


Photo 12: The alkali lakebed itself supports no vegetation.

III – HISTORIC USE OF THE BAJADAN COMMUNITY

CONDITION OF THE ENVIRONMENT DURING HISTORIC TIMES: AN ANECDOTE FROM THE NOTORIOUS ATKINSON LAND SURVEYS

York and Dick-Peddie (1969) have utilized general environmental descriptions contained in land survey field notes to document their thesis that the typical desert species, mesquite and creosote, have extensively invaded former grasslands during the last century. Their field note citations in the Tularosa Basin, however, pertain to townships twelve or more miles south of the study area. In order to examine the accuracy of their general assertions for the Bajadan Community bordering the west boundary of WSNM, copies of original field survey notes for this area were obtained from the Bureau of Land Management.

Most of the Tularosa Basin floor was surveyed and subdivided during the tenure of Henry M. Atkinson, Surveyor General of New Mexico from 1876 to 1884 (Westphall 1965:Map 4:164). At that time, General Land Office policy limited lands eligible for survey, giving priority to agricultural, irrigable, timber and mineral lands, as well as exterior townsite boundaries and private land claims. Grazing lands were not included. Frequent irregularities in Atkinson's administration were due to abuses of the special deposit system adopted by Congress 1862 and interpreted by the General Land Office as authorizing the survey of a township upon the basis of one settler's application. Westphall notes, *The result was that frequent applications were made for the survey of a township by one settler who might be a non-settler* (1965:25). Regulations were not tightened until 1882 and surveyors commonly secured work on easily surveyed land (like the basin floor) through collusion and false application. Surveys of subdivision boundaries along the west boundary of WSNM were conducted during 1881 and 1882, prior to and simultaneous with passage of tighter regulations. Not surprisingly, more than one firm of surveyors were involved.

Township 20 South, Range 5 East was subdivided first. It is the only example for which original and final homestead certificates are noted (Westphall 1965: Maps 8 and 9:168–9). This township contains San Nicholas Spring, a prominent and reliable source of fresh water in an arid, alkaline area. The south boundary lies along New Mexico Correction Line 4CS. The details and general description contained in the field notes of William F. Cheney, U.S. Deputy Surveyor, agree remarkably well with modern surveys, physiography, and the locations of both San Nicholas Spring and Goat Mountain. Undoubtedly, *this* survey was actually performed. Cheney earned his maximum wages repeatedly climbing Goat Mountain:

*The cor. to secs 17, 18, 19, 20
Land very rough, rocky mountainous—
Some cedar timber
— I claim maximum rates on this mile.
—William F. Cheney
Field Notes
May 12, 1881*

Two months later, a second survey firm obtained a contract for the subdivision of townships directly north of T20S, R5E, just surveyed by Cheney. William M. Manning of Thomas & Manning refers directly to Cheney's survey and, presumably, had studied or obtained a copy of those notes, a standard survey practice. Manning was a stamp pad addict with a standardized stamp entry form for each step of township subdivision survey. While this makes his notes easier to read than Cheney's longhand, it quickly reveals a variety of inconsistencies. Townships 17, 18, and 19 South, Range 5 East, constitute the western edge of WSNM. Manning's field notes conclude with the following general descriptions:

*Township 17S General Description.
Range 5E The Land of this Township is open and
Rolling. The Soil is Sandy and 4th Rate.
The Twp. contains No Timber. The Ranch
of P. Trujillo is in Sec. 15. A dense under-
growth of mesquit covers the greater part of
this Twp.*

—Sept. 8, 1882

*Township 18S General Description.
Range 5E The Land of this Township is open and
Rolling. The Soil is Sandy and Fourth
Rate, producing in many places grass of
an inferior quality. This Township contains
No Timber. H.C. Little's Ranch is Situated
in Sec. 4. The greater part of this Twp. is
covered with an exceedingly dense under-
growth of Mesquit.*

—August 28, 1882

*Township 19S General Description.
Range 5E The Land of this Twp. is Rolling and brok-
en, with a Fourth Rate Soil which is sandy
in many places, and consequently produces
but little vegetation. No Timber grows in
this Twp. J.S. Chavez Ranch is Situated on
line bet. Secs. 5 & 6.*

—August 18, 1882

In his chaining notes, Manning frequently uses a stamped line entry: *Dense growth of Mesquit*. When these section corners are plotted, the alleged distribution of dense mesquite extends across the alkali flat and the bed of Lake Lucero! Although one can see those massive physiographic features from anywhere in the townships surveyed, Manning makes absolutely no mention of them nor the beds of selenite crystal he should have repeatedly encountered. Upon even closer examination of Manning's notes, fictitious roads are encountered. No historic record of any kind corroborates the three ranches Manning refers to. In short, it seems likely that the specified subdivision survey was never performed despite sworn affidavit to the contrary. All three of these township surveys are probably representative of the abuse mentioned by Westphall. False settlement applications were made as the basis for future claims of grazing lands. Collusion on the part of the surveyor was obviously necessary, and we can only speculate as to where Manning employed his ink pad and battery of stamps. Likely, it was cool, dark and thirst quenching.

THE LUCERO RANCH -- LAWMAN'S RETREAT

Sometime prior to 1904, when the floor of Lake Lucero attracted a flurry of placer mining claim activity, Estevan Lucero established boundaries on the southwest quarter of Section 32, Township 18 South, Range 5 East (see Map 3). Estevan submitted a Homestead Claim on this 160 acre tract, later known as the North Well, and was granted a patent by Teddy Roosevelt, then President, in 1907. He and his brothers, Filipe and "J. R." (whose signature appears on concrete work at the North Ranch), continued improvements on this property and on their two ranches to the south. During this period, J.R. was Sheriff of Dona Ana County, and in 1898 served as probate clerk. On February 7 of that year, J.R. was unsuccessful at confiscating the personal property of one Pat Garrett as judgment on a seven year old debt to the Bank of Commerce (Metz 1974:278). What little property Garrett still owned was already mortgaged to Martin Lohman and W. W. Cox. The *Las Cruces Citizen*, February 25, 1905, notes that, *Sheriff J. R. Lucero returned from a trip to his ranch in the San Andreas Mts. Wednesday*. In 1906, the courts finally decided against Garrett and this time J.R. successfully took possession of Pat's ranches and stock and auctioned these off to the highest bidder, the Albuquerque Bank of Commerce, for one thousand dollars (Metz 1974:279).

In 1911 or 1912, at the close of a prolonged drought, O.E. Meinzer of the U.S.G.S., visited the Lucero ranches on an investigation of the water resources in the Tularosa Basin. His description indicates that the North Lucero Well had, *two dug wells about 65 feet deep, which yield water that is too salty for human use and that should be given to horses with caution* (Meinzer and Hare 1915:258). Even so, these salty wells were of such significance during those years that Meinzer lists them as *Watering Places on Routes of Travel*. Permanent water was scarce anywhere in the Tularosa Basin, and especially so along the forbidding east slopes of the San Andres.

By 1908, Filipe had joined his brother, J.R., as a lawman and, as Deputy Sheriff of Dona Ana County, he accepted the surrender of Wayne Brazel, self-confessed killer of Pat Garrett, on February 29 (Metz 1974:292).

In 1913, Estevan and his wife Petra filed a Warranty Deed, granting 5/6th interest in the North Ranch Property to his brothers and sisters. At that time, Filipe was Sheriff of Dona Ana County and one daughter, Ana, was married to a gentleman named Reinhart. J.R. continued to work on the North Ranch property at least until 1916 when he scribed his signature with a flourish on a newly stuccoed concrete water trough at the North Ranch.

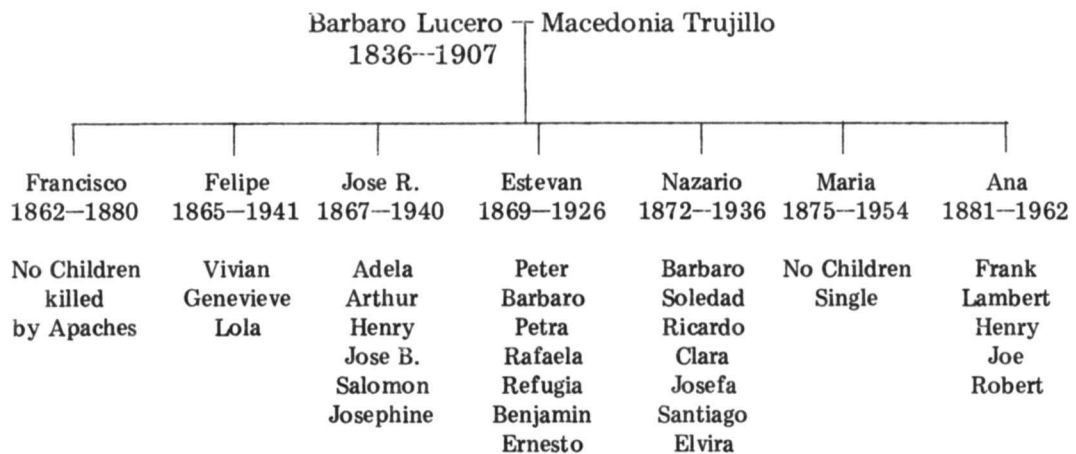
In 1940, after J.R.'s death, Filipe consolidated the ownership of the North Well and both ranches via Quit Claim Deeds from his two sisters and from his brothers' children. Eventually, ownership of the North Well passed to the NPS and the property became part of White Sands National Monument. The North and South Ranch are included in White Sands Missile Range.



Photo 13: A lone rider from the HSR survey party crosses the dry lakebed, which remains unchanged.

Little remains today of the Lucero Ranches, once a quiet retreat across the mountains for two Dona Ana County Sheriffs. But the Lucero name is preserved in the area, commemorating one family among many who had persevered along the shore of the great white playa lake which occupies the lowest elevations of the Tularosa Basin.

THE LUCERO FAMILY From Janos, Mexico*



* Lucero geneology supplied by Herman W. Beckett, husband of Jose R.'s granddaughter Isabell.

THE GREAT GLAUBERITE GRAB

At the turn of the last century, rumor and speculation about the mineral wealth of the Tularosa Basin were running rampant. In 1897, Charles B. Eddy, conducting a party of eastern capitalists on a tour of the basin, visited White Oaks on the east side of the basin and Sunol, or Gold Camp (claims owned by A.B. Fall), along the eastern slopes of the San Andres Mountains on the west side of the basin (Sonnichsen 1973:148--9). At the time, Eddy and his brother John were deeply involved in the promotion of Alamogordo and the railroad north from El Paso. Although interest in desert mineral resources remained high, most claim activity was limited to mountain locations until 1904.

Then, within a matter of seven months, more than 10,400 acres of Lake Lucero and the alkali flats had mineral rights claimed by more than 114 people in 65 separate applications.

The first series of these placer claims were all named *Borax Escondida* and numbered in sequence: 1 through 39. These claims covered the entire main lakebed and shoreline and, Listed locators included John A. Eddy and H.S. Anderson who became Secretary and President, respectively, of the Southwestern Exploration Company when the claimants incorporated.

The second group of claims were located on the northern extension of the lakebed and named to match the sympathies of their 83 listed claimants: *Honest Injun, Taciturn, Marion, Eckley, Lubricator, Kentucky, Hoosier, Michigan, Clyde, Good Luck, Happy Hooligan, Indiana, Express, Eagle, Opportunity, Hermosa, Empire, Winchester, Just Us Boys, and Texas*. James Baird, whose ranch lay immediately northwest, was included as a claimant along with his brother Eugene.

The third set of claims in 1904, closing this short period of activity, demonstrates a more continental tone: *France, Japan, Darwin, Humbolt, Bismark, Kant, Lincoln, Anna, and Moltke*. In contrast to previous claimants, these locators included a surprising number of Germanic surnames with only two individuals of Spanish descent involved in this flurry of activity.

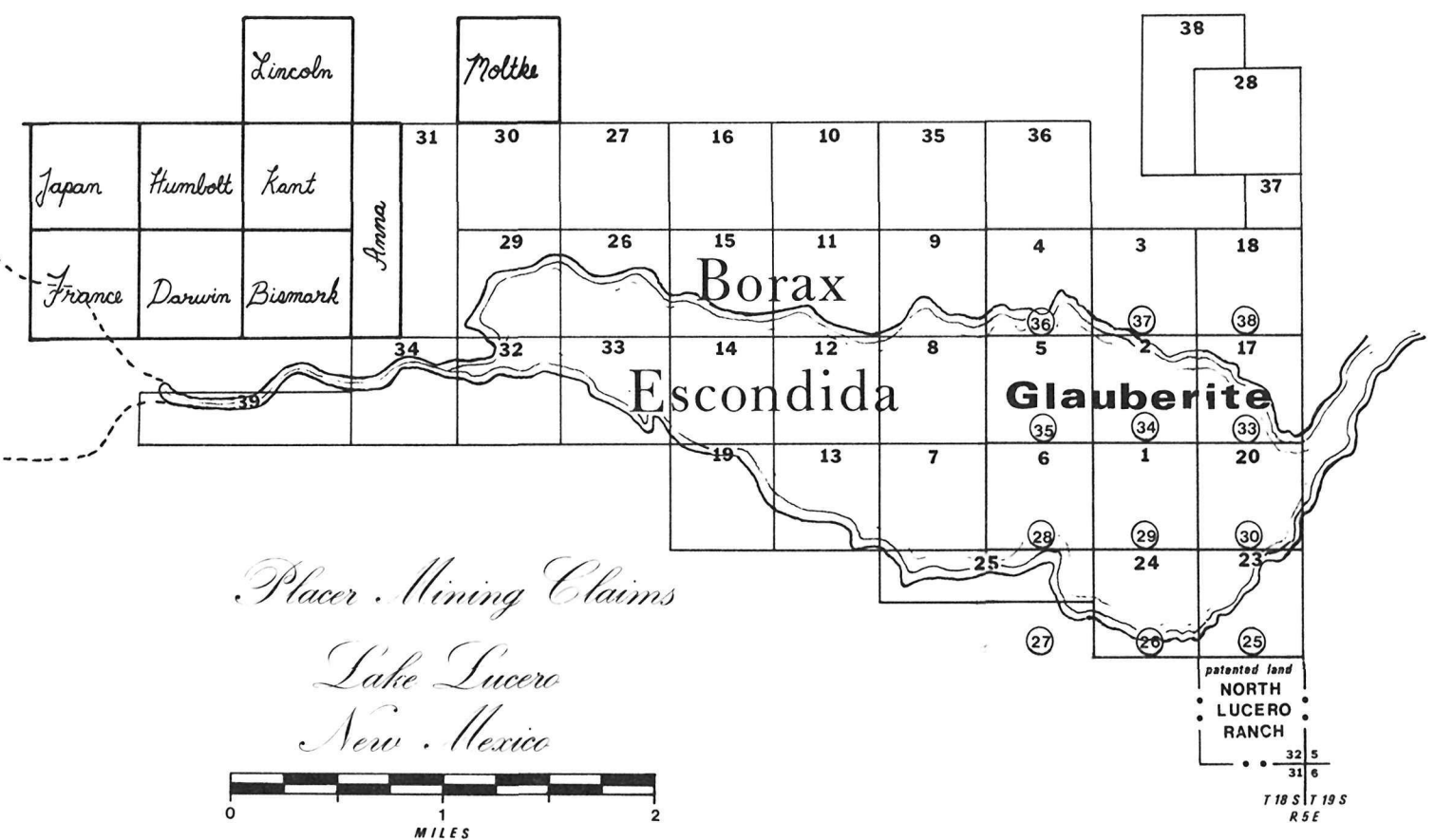
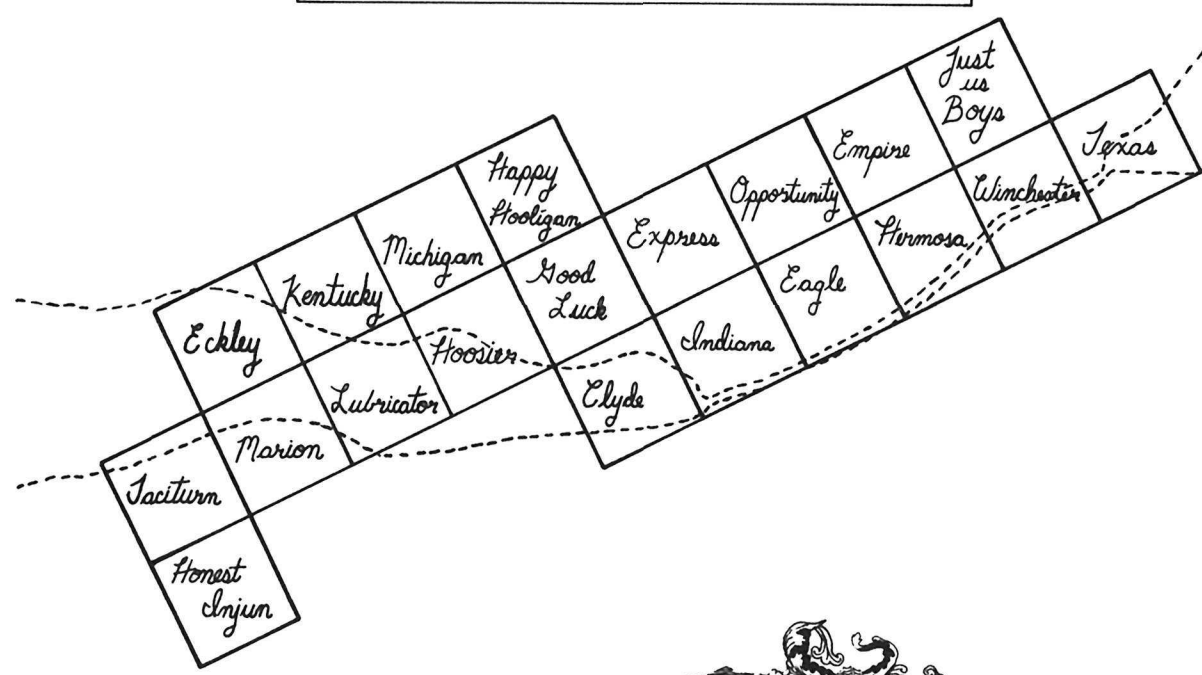
Although some locations show Proof of Labor in succeeding years, few improvements were made and apparently no actual mining of any kind was carried out. Most of these claims were allowed to lapse.

In 1911, interest in the lake was again strong enough to produce placer claims. These, the *Glauberite Placer Claims*, were filed by new locators on portions of the lapsed Borax Escondida Claims and to the south of the lake. Again, no further activity in the form of Proof of Labor or actual mining is evidenced by County documents.

A search of local newspapers for the period reveals no explanation of all this activity. At that time, the area was empty save for a few small ranches. Water was scarce and usually of poor quality. The minerals suggested by the names *Borax Escondida* and *Glauberite* do not seem to justify the degree of interest demonstrated by the 1904 and 1911 claims. Borax deposits are rare worldwide, but usually large. No borax occurs in the Lake Lucero vicinity. Glauberite, or Glaubers Salts, are, in fact, nothing more than pure gypsum, a mineral most common in the white sands and purest in the dunes to the east rather than in the lakebed. In fact, no minerals considered especially valuable or rare, either at the turn of the century or today, occur in the immediate vicinity of Lake Lucero.

Claims established during 1904
 series 1: borax escondida 1-39
 series 2: honest injun, texas, ect.
 series 3: france, japan, ect.

Claims established during 1911
 series 4: glauberite 1-40
 (claims south of lake not shown)



IV -- ARCHAEOLOGICAL RECONNAISSANCE OF THE BAJADAN COMMUNITY

The Bajadan Community occupies the piedmont slopes and alluviums at the base of the mountain ranges forming the Tularosa Basin. Although the plant communities and soils on both the east and west side of the basin are basically similar, slight physiographic differences may have substantially affected the locations of human populations. This is especially true of the late ceramic periods, post A.D. 1100.

In contrast to the east (or Sacramento Mountains) side of the basin, the west side drains abruptly down the mountain slopes and across the bajada rather than onto a long, flat, alluvial flood plain. Thus, runoff water enters almost directly into the alkali flats. This lack of a flood plain high in agricultural potential is slightly offset by the presence of considerable bodies of potential agricultural lands within and along the lower edges of the bajada, but the lower relative acreage of good soils on the west side undoubtedly have affected the population density through time.

The morphology, or actual physiographic structure of the San Andres Mountains, also imposes slightly more strict constraints on the potentials for human population density. In the Sacramentos to the east, major canyons draining large upland areas issue onto the basin floor in a regular pattern at approximately two mile intervals. In the case of the San Andres, major canyons originating from the upland valleys issue onto the bajada at three to four mile intervals, and in a much more irregular pattern. In addition, upland rainfall (because of lower elevation) is much less in the San Andres and, thus, runoff is less substantial. The canyons of the San Andres are quite steep and rocky, therefore some of the runoff differences may be offset by this factor.

Along the west side of the national monument, four drainage situations contribute runoff waters to the Bajadan Community. From the north, these are: 1) the combined drainages of Lost Man and Deadman Canyons; 2) Andrecito Canyon; 3) Camp Canyon and the minor water courses on the northeast side of San Andres Peak; and 4) the combined drainages of Ash and Salt Canyons. Archaeological resources of substantial size are associated with each of these, although toward the northern end of the monument the major portions of the archaeological materials appear to occur slightly higher in elevation than the western boundary of the national monument.

The area included in the Bajadan Community within the national monument is large, between 22 and 25 square miles (remote sensing or extremely extensive ground survey would be required to determine the exact area). Funding for this project was limited. Considering the limits of the funding base then, the archaeological reconnaissance was structured to: 1) gain specific information concerning the known archaeological resources in the northwestern and southwestern corners of the national monument; and 2) evaluate the potential for occurrence of other archaeological resources within the Bajadan Community of the national monument.

In order to minimize conflict with the testing programs of White Sands Missile Range, the majority of field evaluation requiring movement over large areas of the western portion of the Cooperative Use Zone of the monument, and portions of the bordering areas of White Sands Missile Range, was conducted during the December 1977 to January 1978 break in military operations.

The field study was carried out in two phases. In the first phase, two Project Archaeologists and an Archaeological Field Assistant conducted archaeological reconnaissance during a seven-day horseback/camp survey of the bajada within the national monument and immediately adjacent areas. This survey was accomplished by spacing the three mounted field personnel at approximately 300 meter intervals, beginning at Section corners (or, if not found, compass and topographic location). In this manner, by successive sweeps, approximately four square miles were preliminarily explored per day.

It must be emphasized that this survey was strictly of a preliminary nature and in no way should be considered as an inventory of the total cultural resources. Attention was given to benches along the major drainage draws crossing the bajada within the monument. In addition, the sweep along the eastern boundary of the bajada was oriented to the bench edge and beach lines of the lakeshore, rather than a north-south compass direction as was the case for the inland portions of the bajada. However, intensity of coverage along the bench edge was not increased nor was intensity increased in the areas where sites were encountered. Therefore, approximately the same low intensity coverage was extended over the entire area. In areas such as the vicinity of Andrecito Creek, where several sites were recorded by this low intensity method, it is probably reasonable to expect a high density of sites under inventory or intensive survey conditions.

A statement of actual site density within the Bajadan Community, based upon this survey, would be unreliable. However, a density of at least 0.5 sites per square mile is indicated by this low level coverage. This suggests that density figures from the bajada of the Three Rivers area (35 miles northeast) of 2.5 sites per square mile probably would not be out-of-line as an estimate for the monument.

During the second phase, within a five day period, the HSR field crew conducted a sample of the density of cultural materials on the large Lucero Lake site and compiled a map of the density sample locations and site features. In addition, a 1.5 meter deep by 3 meters long by 1 meter wide test pit was excavated in a previously disturbed location near a high surface density of cultural materials. Core samples were taken at twenty locations, generally extending to a depth of 1 meter. One sample through a sand dune was extended 2 meters. In general, cultural material and small fragments of charcoal did not extend below 20 centimeters in depth. Larger items of cultural material (i.e., fire-cracked rocks, ground stone, etc.) did not occur below 3 to 5 centimeters below the surface.

During a succeeding five day period, the Ceramics Consultant, Terry Knight, analyzed ceramic samples on the site and the HSR field crew conducted ground stone and lithic tool samples and compiled descriptive information concerning site features. On the fifth day for the ceramics consultant in the field, four other ceramic sites were visited and descriptions of ceramics were compiled at these locations. During a final field day, Project Archaeologists visited historic site locations and confirmed mapped soil associations with site locations.

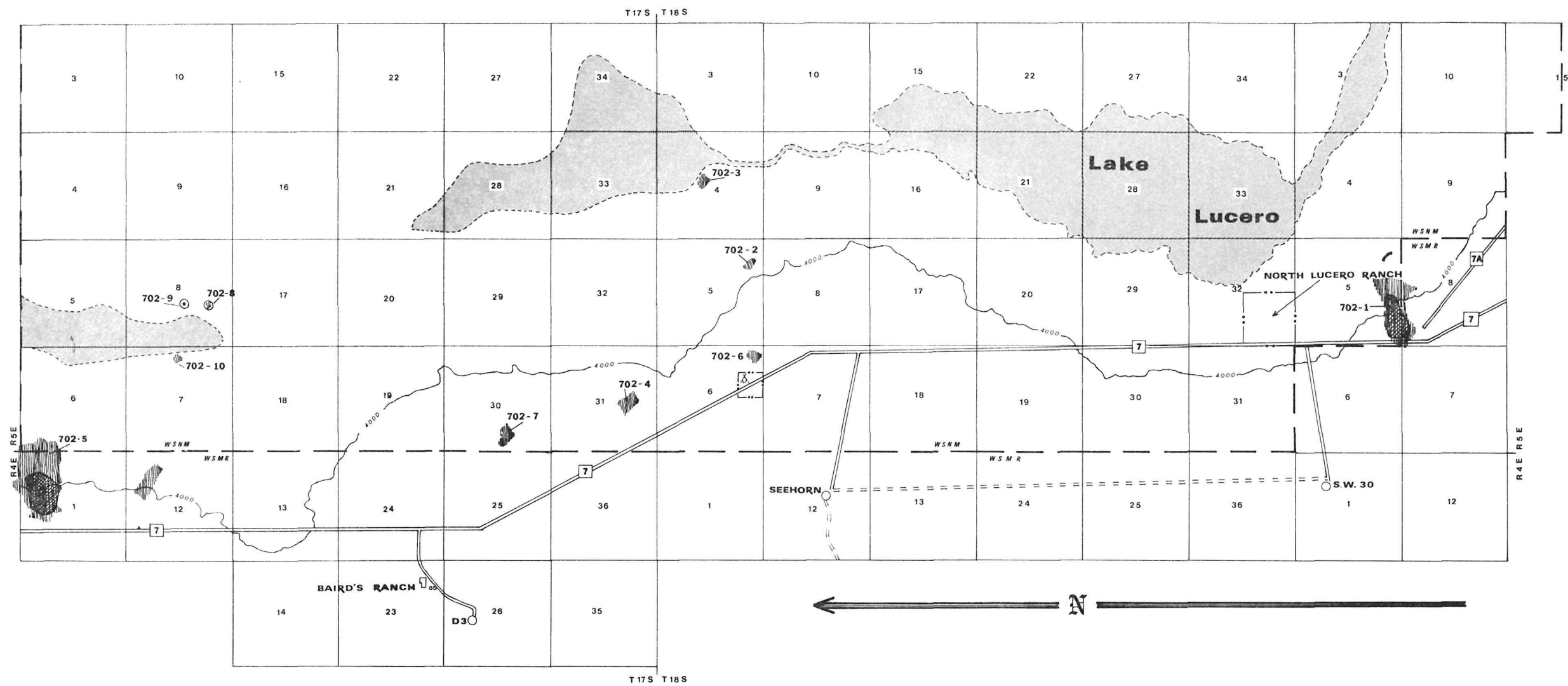
Following is a list and discussion of the results of this preliminary reconnaissance.

Table 4

**INVENTORY OF ARCHAEOLOGICAL SITES
LOCATED DURING RECONNAISSANCE OF THE BAJADA -- WSNM**

<u>Site No.</u>	<u>UTM 13SCG Location</u>	<u>Period</u>	<u>Type</u>	<u>Approximate Size (m²)</u>	<u>Elevation (feet)</u>	<u>CLD* (x/m²)</u>
702-1	617180	ceramic	large village	167,000	4050	96
702-2	646264	ceramic	ceramic lithic scatter	3,000	3990	13
702-3	657272	late archaic	hearth & lithic scatter	1,000	3910	<1
702-4	622281	ceramic	possible field area	50,000	4025	<1
702-5	612372	ceramic	large village	420,000	4000	177
702-6	629264	ceramic	small early village	1,000	4025	<1
702-7	618301	ceramic	hearths	500	4050	<1
702-8	638345	archaic	hearth	50	3910	<1
702-9	638349	unknown	isolated artifacts	10	3910	<1
702-10	631350	unknown	hearth	50	3920	<1
702-11	611358	ceramic	possible field area	50,000	4000	<1

* see definition on page 30



Section Map of the
Bajadan Community
Lake Lucero, WSNM
including portions
of
Doña Ana Co.,
New Mexico

-
- The map displays the Lake Lucero area with various land use designations: GU (Guadalupe), DY (Dry Lake), MA (Marsh), DU (Dry Lake), OB (Open Barren), NT (Natural), TK (Tule), SP (Sagebrush), and MG (Mudflat). The map includes a north arrow and a scale bar. Specific points of interest are marked with numbers 702-1 through 702-10. The map also shows roads, including a dashed line labeled 'WSNM' and a solid line labeled 'R4E, R5E'. The map is bounded by T 17 S and T 18 S, and R 4 E and R 5 E.



V
THE
LUCERO
LAKE
SITE

Photo 14: The WSMR powerline marks Route 7 where it skirts the western edge of the Lucero Lake Site.

<i>Site No:</i>	HSR 702-1 LA 21162	<i>Elevation:</i>	4050 ft. 1234 m
<i>Location:</i>	13SCG617180	<i>CLD:</i>	95.81/m ²
<i>Site Size:</i>	167,245 m ² 128,146 m ² , or 77% lie within WSNM 39,099 m ² , or 23% lie within WSMR	<i>Age:</i>	1250 A.D.

Ownership: This location straddles the boundary between WSNM and WSMR.

Vegetation Type: Grasslands, Desert Shrubland.

Soil Type: Camborthids and Torrifluvents.

Slope and Aspect: 1%—ENE. This site lies on a shallow alluvial slope above the present (and Pleistocene) lakeshore.

Physiographic Setting:

The Lucero Lake Site occupies a broad, almost flat area of clay grasslands and low, scattered sand dunes, just above the west shore of Lake Lucero. The site is bordered along the northerly edge by a large arroyo flowing toward the northeast. To the west, the San Andres escarpment rises sharply from a short, rocky piedmont slope. To the southwest, Ash Canyon cuts deeply into the mountains, affording a watershed larger than most along the east slopes of the San Andres.

Site Description:

A large pueblo village along the west shore of Lake Lucero, an intermittent salt lake in the Tularosa Basin, Dona Ana County, New Mexico. No definite evidence of architectural structures appears on the surface but scatters of firecracked rock and gravel strongly suggest remnants of adobe wells reduced by the extensive erosion of the site surface.

FIELD METHOD – THE LUCERO LAKE SITE

The intensive surface survey of the Lucero Lake Site commenced with a check of section lines and monument boundary markers. The apparent boundaries of the site were then located and plotted. A square grid of sample points, 50 meters apart on lines N-S and E-W, were then located within the site and marked with aluminum identification tags and wire flags. Cultural Litter Density samples were tabulated at each 50 meter grid point (see Tables 4 and 5). These CLD samples represent a complete inventory of *all* culturally modified materials within a one circular meter area. For convenience and accuracy, these areas were laid out as circles (see Photos 15 and 16). This data was then plotted on the site map, clarifying the actual site boundaries. Isobars reflecting ceramic densities were drawn and two areas of extreme concentration became apparent. Both of these areas were distinctly visible on the surface and coincided with extensive surface scatters of small fire-cracked rock fragments and gravels intermixed with cultural material. These areas had the appearance of broad, low mounds and suggested eroded remnants of structures. These features were mapped, but their nature remained enigmatic. Exactly what the surface remains represented could only be investigated by subsurface testing. Initially, the shallow arroyo cut associated with the vehicular trail cutting through the middle of the site was investigated. Selected locations were excavated to a vertical profile in the arroyo bank. Strata of adobe soils bearing traces of charcoal were apparent, but no evidence of any structure was located. The mounds themselves had to be investigated directly. This stage of the testing took two forms; a more extensive trench at the edge of one of the mounds, and auger testing of the others.

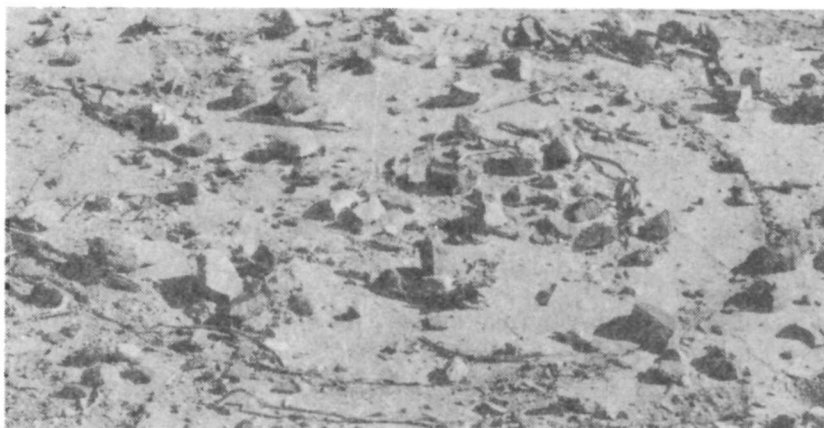


Photo 15:
CLD Sample
Point 0-3
Total CLD/meter²
101



Photo 16:
CLD Sample
Point 3-5
Total CLD/meter²
257

Table 5
SUMMARY DATA: CULTURAL LITTER DENSITY SAMPLE
LUCERO LAKE SITE (50 meter Grid Sample)

Sample Point	Total CLD	Fire-cracked Rock	Chipped Stone	Ground Stone	Plain Brown Ware	Decorated Brown Ware	Plain White Ware	Decorated White Ware	Hammer-stone	Remarks and Identifiable Artifacts
0-2	17	9	3	0	5	0	0	0	0	
0-3	101	53	14	2	30	0	1	0	1	one drilled brown-ware sherd
0-4	143	77	24	0	39	0	1	1	1	
0-5	118	62	8	0	47	1	0	0	0	
0-6	16	0	3	0	13	0	0	0	0	
0-7	38	17	0	1	18	0	0	2	0	
1-1	64	28	16	0	20	0	0	0	0	
1-2	104	20	22	4	56	0	0	0	2	
1-3	79	42	9	3	25	0	0	0	0	
1-4	258	86	31	5	121	5	5	5	0	one projectile point
1-5	207	112	13	1	76	1	2	1	1	one large mammal tooth fragment
1-6	122	30	15	0	77	0	0	0	0	
1-7	80	59	3	4	14	0	0	0	0	
2-1	66	27	5	6	28	0	0	0	0	
2-2	160	132	2	5	20	0	0	0	1	
2-3	186	107	3	7	69	0	0	0	0	
2-4	185	78	5	0	101	0	0	0	1	
2-5	243	105	5	2	131	0	0	0	0	
2-6	73	5	4	1	60	0	0	3	0	
2-7	158	54	12	5	84	0	0	3	0	
2-8	116	28	4	0	83	0	0	1	0	
2-9	28	14	1	0	13	0	0	0	0	
3-1	11	0	2	0	9	0	0	0	0	
3-2	104	25	19	0	60	0	0	0	0	
3-3	132	43	20	0	68	1	0	0	0	
3-4	141	24	11	1	105	0	0	0	0	
3-5	257	78	17	0	162	0	0	0	0	
3-6	166	16	11	1	136	0	0	1	1	one perforated brownware sherd
3-7	53	20	6	1	26	0	0	0	0	
3-8	116	34	14	1	66	1	0	0	0	one corrugated brownware sherd
3-9	123	41	8	0	73	0	1	0	0	
3-10	137	63	17	3	50	1	0	3	0	
3-11	56	3	6	0	46	0	0	1	0	
4-1	4	0	0	0	4	0	0	0	0	
4-2	33	21	2	0	10	0	0	0	0	
4-3	4	4	0	0	0	0	0	0	0	
4-4	51	17	7	0	27	0	0	0	0	
4-5	21	2	1	0	18	0	0	0	0	
4-6	49	19	4	0	26	0	0	0	0	
4-7	28	15	0	0	12	1	0	0	0	
4-8	32	16	0	0	14	1	1	0	0	
4-9	66	25	6	0	35	0	0	0	0	
4-10	136	23	12	2	91	0	2	6	0	
4-11	129	13	10	0	98	0	3	5	0	
5-10	102	19	5	1	70	0	2	5	0	
5-11	38	14	5	0	17	0	0	2	0	
6-10	13	4	1	0	8	0	0	0	0	one evap. milk can
6-11	35	5	1	0	27	0	0	2	0	
Total:	4599	1689	387	56	2388	12	18	41	8	
	37%	8%	8%	1%	52%	0.3%	0.4%	0.9%	0.2%	



Photo 17:
South profile of
the main test
trench revealed
evidence of ro-
dent activity,
but no strati-
graphy.

MAIN TEST TRENCH: The mound chosen for further testing is near the vehicular trail running E-W through the site, and has been disturbed by a surface blade cut. It also exhibited evidence of previous hand excavation. It was felt that investigation of this area would do the least damage to intact site deposits. The trench (in grid bounded by points 3-4 N, 9-10 E) extended three meters from the edge of the blade cut past the disturbed area, into the edge of undisturbed materials, and was one meter wide. Excavations extended beyond areas of recent disturbance, reaching a depth of one meter. Adobe strata bearing traces of charcoal, similar to those in the arroyo bank, could be discerned to the depth of about 20 centimeters, but evidence of any structure in the form of adobe walls, subsurface excavations, pits, etc., was lacking. Further excavation was beyond the budgeted scope of the project.



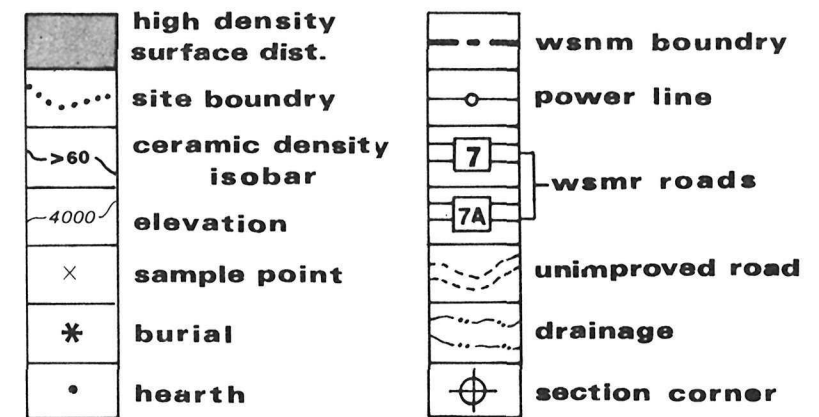
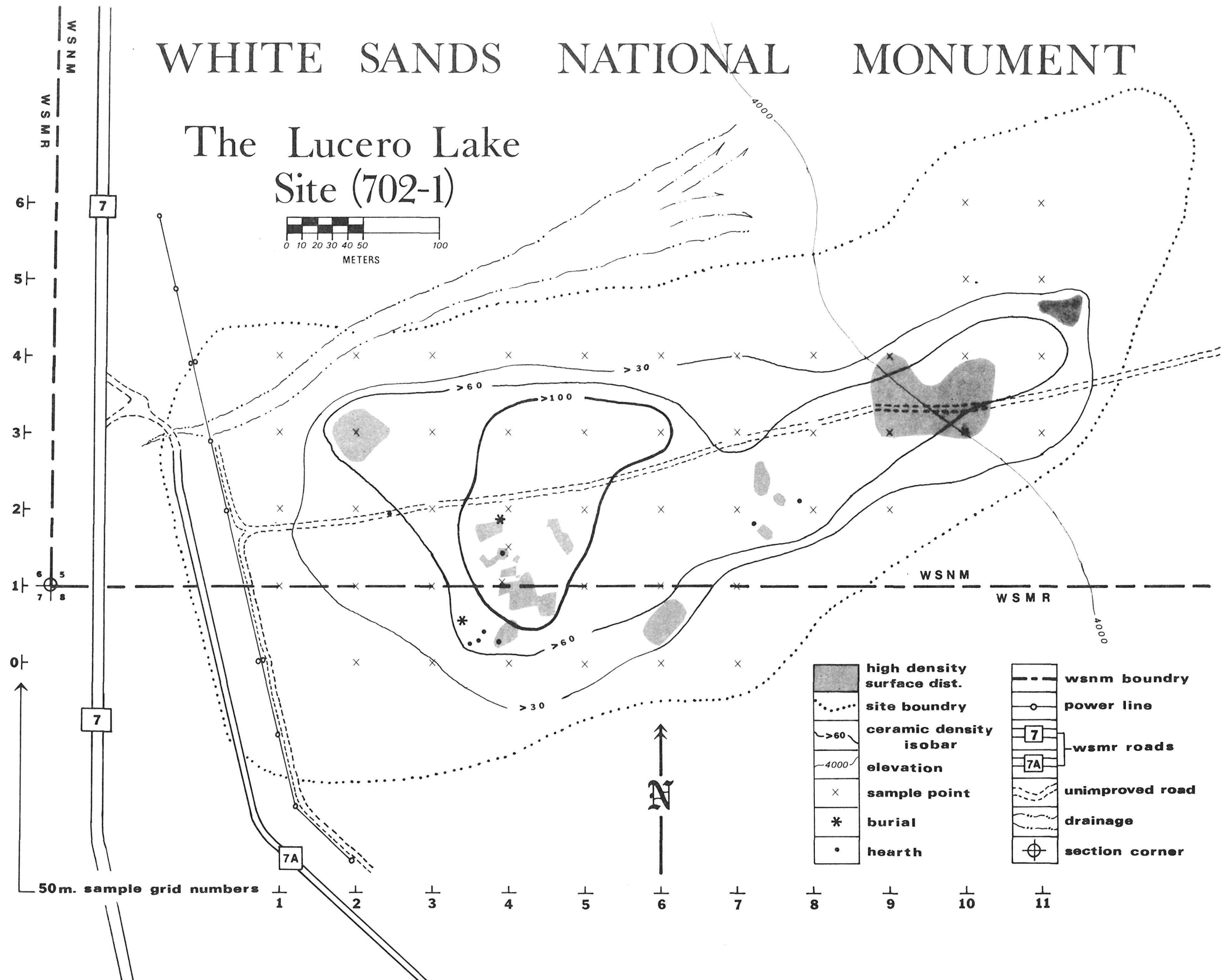
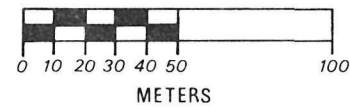
AUGER TESTING: Other mound-like features, especially those with high Cultural Litter Densities, were tested with a soil auger to delineate any soil features which might indicate structural features within the site. Again, strata were essentially the same as that revealed in the trench.

In short, no evidence of the types or locations of any houses or other architectural features were detected during limited test excavation. The Lucero Lake Site is quite large, however, and may still contain architectural features which remained undetected in this limited survey. Testing did indicate that extensive surface erosion has occurred in some areas, and two burials only partially exposed indicate that at least portions of the original deposits remain. Extensive excavation is not warranted at this time and additional investigation of the Lucero Lake Site, and other similarly large surface concentrations seems most feasible using a combination of archaeological testing and remote sensing methods.

Photo 18: Adobe soils with traces of charcoal are probably typical of the subsurface deposits at the Lucero Lake site.

WHITE SANDS NATIONAL MONUMENT

The Lucero Lake Site (702-1)



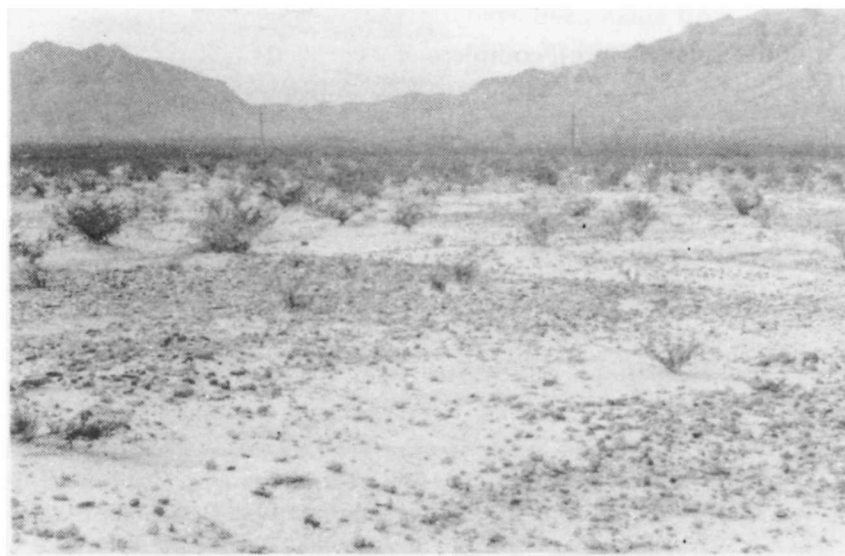
50m. sample grid numbers

**COMPARISON OF CULTURAL LITTER DENSITIES
AT THE LUCERO LAKE SITE AND THE McCLUNEY SITE**

	<u>Lucero Lake</u>	<u>McCluney*</u>
Areal Size:	167,245 m ²	540,000 m ²
Elevation:	4000 ft.	4545 ft.
Mean Cultural Litter Density:	96 items/m ²	89 items/m ²
Percent:		
Fire-cracked Rock	37%	0
Chipped Stone	8%	25%
Ground Stone	1%	0.4%
Plain Brownware	52%	56%
Decorated Brownware	0.3%	9%
Plain Whiteware	0.4%	2%
Decorated Whiteware	1.1%	7%



Photo 19 (above) and 20 (below): Scatters of fire-cracked rock and gravel have an artificial appearance and may represent the remains of structures.



* The McCluney (or Hatchet) Site (HSR 502-11) is a very large Mogollon village at the center of the first alluvial terrace where Three Rivers Creek enters the basin. This village probably consisted of a large number of pithouse clusters (McCluney 1962; Wimberly and Rogers 1977:143).

ANALYSIS OF GROUND STONE MATERIALS LUCERO LAKE SITE

Analysis of Cultural Litter Density data indicates that ground stone materials constitute approximately one percent of the culturally modified materials on the site. Visually, large grinding stones appear quite common on the site but, in fact, these examples are sparsely distributed. Local inhabitants, collectors and WSMR personnel all report removal of large numbers of intact grinding implements from the site, a practice which has continued for many years and in all likelihood occurs today. Consequently, materials suitable for analysis were generally limited to fragments and unobtrusive items.

Two areas of high density were examined and all identifiable specimens of ground stone were recorded. Almost all items were in fragmentary condition. Sample areas A and B measured 50 meters x 50 meters, 2500 square meters each in area.

Area A, bounded by grid locations 1--3, 1--4, 2--3, and 2--4, yielded 73 identifiable ground stone items, a density of approximately three items per 100 square meters.

Area B, bounded by grid locations 2--7, 2--8, 3--7, and 3--8, contained 44 identifiable items, a density of less than two items per 100 square meters.

<u>Form</u>	<u>Area A</u>	<u>Area B</u>
Mano (handstone), complete	5	5
Mano - fragmentary	<u>18</u>	<u>14</u>
Total Manos	23	19
Grinding Slab (Metate), complete	0	1
Grinding Slab - fragmentary	<u>31</u>	<u>18</u>
Total Grinding Slabs	31	19
Pestles, complete	3	0
Stone Balls, complete	12	6
Stone Balls - fragmentary	<u>4</u>	<u>0</u>
Total Stone Balls	16	6
Total Identifiable Specimens	73	44

MANOS

Manos are defined as hand-held grinding implements used against another basal grinding surface (metate). Specimens examined at the Lucero Lake Site are of two distinct forms:

1. *One Hand Manos*, so-called because of their smaller size and circular or ovoid shape; and
2. *Two Hand Manos*, which are larger and generally rectangular in shape.

One Hand Manos

A total of six specimens were examined. Of these, three were from Area A and three from Area B. Two of the examples from Area A were roughly square in shape while the remaining four were generally circular in shape.

SIZE: Both square and circular examples were comparable in size.

	<u>Number</u>	<u>Range</u>	<u>Mean ($\bar{x}$)</u>	<u>Std. Dev.</u>
Length	6	7.5–11.0 cm	8.9 cm	1.2 cm
Width	5	7.0– 9.5 cm	7.8 cm	1.0 cm
Thickness	6	3.0– 6.0 cm	4.1 cm	1.0 cm



Photo 21 (above) and 22 (right): Two examples of one hand manos from the surface sample.

TEXTURE: Five examples were medium to coarse in texture. One example was medium-fine in texture.

OTHER FEATURES: Extensive grinding of all four edges was evident on one of the square shaped, one hand manos. Another example (limestone, circular in shape) had a small pecked depression on the face opposite the grinding surface.

NO. OF GRINDING SURFACES: Five examples had only one grinding surface with extensive use. One example, from Area B, had extensive grinding use on both faces. Grinding surfaces were flat to slightly convex in profile.

MATERIAL: All examples appear to have been made from local materials present in nearby mountain formations. Three were made from dark gray metamorphosed sandstone, two from granite, and one from limestone.



Two Hand Manos

Twenty examples of complete and fragmentary manos of this type were examined in Area A, sixteen in Area B. Of these, only three in Area A and three in Area B were complete. Cross-sectional shape and number of grinding surfaces in this type of mano usually reflect progressive changes resulting from the extent of grinding use (Eidenbach, n.d.). As wear continues, the original cross-sectional shape, rectangular with parallel grinding surfaces, is modified to a trianguloid form with divergent grinding surfaces. Ultimately, this continued wear results in a triangular form as shown in the figure on page 37.

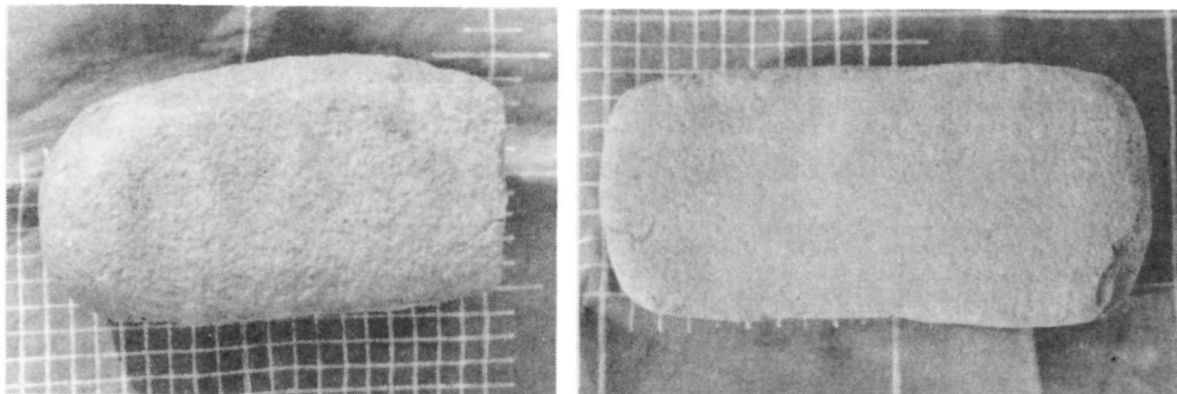
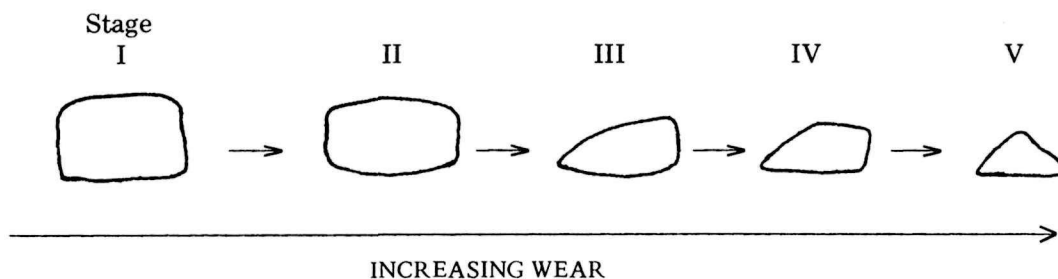


Photo 23 and 24: Two hand manos may have one or two initial grinding surfaces. An unusual surface is shown at left.

SIZE: Since most specimens were fragmentary, only a portion of the sample could be used for computation of any particular characteristic.

	<u>Number</u>	<u>Range</u>	<u>Mean ($\bar{x}$)</u>	<u>Std. Dev.</u>
Length, Manos (all stages of wear)	5	11.0 -- 18.5	14.1	2.9
Width, Manos (all stages)	21	6.0 -- 12.0	9.1	1.7
Stage I	5	7.0 -- 11.0	8.4	1.6
Stage II	17	6.0 -- 12.0	9.0	2.1
Stage III	3	8.0 -- 9.0	8.7	0.6
Stage IV	all too fragmentary to obtain width			
Stage V	none in sample—isolated examples noted on site			
Thickness, Manos (all stages)	28	2.5 -- 9.0	4.9	1.6
Stage I	3	4.5 -- 6.0	5.2	0.8
Stage II	21	2.5 -- 9.0	4.8	1.7
Stage III	3	3.5 -- 5.0	4.2	0.7
Stage IV	1	4.0	4.0	---
Stage V	none in sample—isolated examples noted on site			

CHANGES IN CROSS-SECTION OF MANOS DUE TO WEAR



SHAPE: Almost all examples of two hand manos examined were sub-rectangular or *loaf shaped* in overall form. One example, a Stage II from Area B, was blocky and triangular in overall form. One mano fragment from Area B may have been ovoid in shape. Cross-sectional shapes, rectangular to triangular, were generally typical of wear stages (see above figure). One case, however, from Area A, was square in cross-section and exhibited extensive grinding use on all four faces.

GRINDING SURFACES: Generally, grinding surfaces were slightly convex in cross-sectional profile. In four cases, all Stage II wear, one face was convex and the opposite one flat. Stage I manos are distinguished by presence of grinding wear on only one face while Stage II and III show grinding on both faces.

MATERIALS: All two hand manos in the sample appeared to be made out of locally available materials.

metamorphosed sandstone:	16	limestone:	2
granite:	17	quartzite:	1

TEXTURE: Texture of two hand manos in this sample is generally a reflection of type of material. Limestone and sandstone examples are generally fine to medium, and granites medium to coarse.

fine texture:	1	medium to coarse:	5
fine to medium:	6	coarse:	10
medium:	13	very coarse:	1

EDGE TREATMENT: Nineteen specimens in this sample showed edge modification in the form of pecking and/or grinding. No edge grooves occurred on any of the two hand manos.

GRINDING FACETS: Ground facets on ends adjacent to grinding surfaces were noted in thirteen cases. These small facets usually result from use of the mano on a trough type, rather than a slab type, metate.

OTHER FEATURES: One example had an end slightly pointed; a second example had substantial pounding wear on one end.

GRINDING STONES (Metates)

Grinding stones are the basal stones which rest on the ground while manos are manipulated on their surface in crushing and grinding operations. In the Southwest, two major forms are common: the slab metate, with a flattened surface and no rim; and the trough metate, distinctly concave with an enclosing rim. Stone bowls or *mocajetes*, with an hemispherical concavity, are also reported.

All specimens examined in the Lucero Lake Site sample were fragmentary. Consequently, it was difficult to distinguish fragments of bowls from trough metates. Although at least a few seemed to be from bowls, no clear distinction could be drawn in this sample and data on all concave forms were considered together. Those cases which might have been bowls will then be reconsidered separately.

In all, 52 fragments were examined; 31 from Area A and 21 from Area B, three of which could be reconstructed to form a complete grinding stone of slab form.

<u>Area A</u>	<u>Area B</u>
Slab fragments with one grinding surface: 19	Slab fragments with one grinding surface: 9
Slab fragments with two grinding surfaces: 4	Slab fragments with two grinding surfaces: 4
Trough fragments: 8	Complete slab with two surfaces: 1 (in 3 frags.)
	Trough fragments: 5



Photo 25: An isolated grinding stone typical of others located during the survey.

GRINDING SLABS WITH ONE SURFACE

This type was most common in this sample. Since all examples were fragmentary, no complete length and width could be recorded. Most fragments appeared to include corners of the original form. Original shapes were probably square to rectangular; some examples were irregular with little modification other than on the grinding surface.

THICKNESS: The following provides data on the thickness of the 28 specimens in the sample.

Range (cm)	Thickness	
	Mean ($\bar{x}$) (cm)	Std. Dev. (cm)
2.0 — 11.0	5.5	2.0

MATERIAL: One-surface grinding slabs were made from a variety of locally available materials including gray to brownish-red sandstones, grayish-white to light pink granites, gray limestone, and mica schist.

	metamorphosed sandstone: 10	
sandstone:	3	limestone: 5
granite:	9	schist: 1

TEXTURE:	<u>Area A</u>	<u>Area B</u>
fine:	4	4
fine-medium:	8	0
medium:	1	1
medium-coarse:	0	1
coarse:	0	2
very coarse:	6	1

The above texture data suggests two modes were utilized: fine textured materials, sandstones and limestones; and coarse, hard materials, primarily granites.

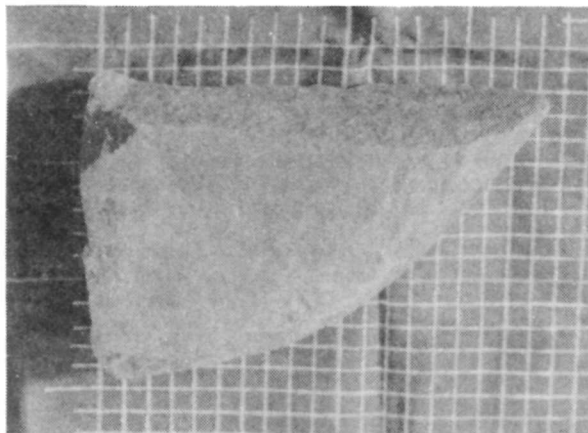


Photo 26: Slab forms of grinding stones were often thin and easily broken.

CROSS-SECTIONAL SHAPE: The profile of the grinding surface (i.e., profile of the width dimension of the complete object, the profile of grinding surface perpendicular to the axis of the grinding motion and the length) was classified when possible.

slightly convex:	1	slightly concave:	18
flat:	4	concave:	3

OTHER FEATURES: Occasional examples of slabs with one grinding surface showed some modification of the opposite surface in the form of pecking and grinding. In three cases, edges had been pecked and ground. One example from Area B showed pounding wear on one pointed end and appears to have been used as an occasional pestle, as well as grinding stone.

GRINDING SLABS WITH TWO SURFACES

One complete example in three matching fragments was examined in Area B. This specimen was square in shape, made of gray limestone, and fine in texture. Both grinding surfaces were flat in cross-section. This was the only case where full dimensions were measurable. Length 17 cm; width 17 cm; thickness 5 cm.

Eight other fragments of this two-surface type were examined, four from Area A and four from Area B. In shape these slabs were probably square to rectangular or ovoid. Again, most included an original corner.

THICKNESS: The following provides data on the thickness of the 8 specimens in the sample.

Range (cm)	Thickness	
	Mean ($\bar{x}$) (cm)	Std. Dev. (cm)
2.5 -- 7.0	4.4	1.6

MATERIAL: All examples were made of local materials. A noticeable difference between Area A and Area B is evident, however; all four specimens from Area A were sandstone while three from Area B were granite and one limestone.

TEXTURE: The sandstone specimens from Area A were very fine (1), fine-medium (2), and medium coarse (1). The three granite examples from Area B were all very coarse in texture; the limestone example was fine.

CROSS-SECTIONAL SHAPE: Profiles of grinding surfaces occur in the following combinations:

both surfaces flat: 4 one flat, one slightly concave: 4

CONCAVE GRINDING STONES -- Trough Metates

All specimens of this type were fragmentary. Commonly, they represented a corner of an originally rectangular to ovoid shape. Three cases may, in fact, have been from hemispherical bowl forms. These three are sharply concave and have rounded rather than flat rims, and much thinner bottoms.

A total of 13 examples were examined; eight from Area A and five from Area B. All examples were much too fragmentary to record representative dimensions.

MATERIAL: All examples appeared to be made from local materials including a light gray to tan sandstone (1), dark gray to brown sandstone, and a dark gray to white granite (8).

TEXTURE:

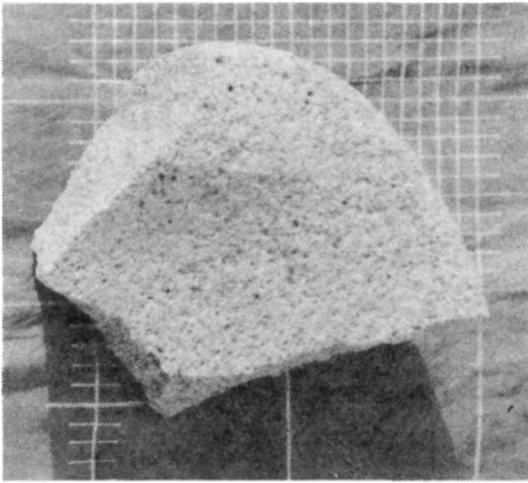
fine:	1	medium-coarse:	4
fine-medium:	3	coarse:	1
medium:	1	very coarse:	3

RIMS: Four examples had flat ground rims, a feature typical of a common form of deep profile, Southwestern metate.

		<u>Range (cm)</u>	<u>Mean ($\bar{x}$) (cm)</u>	<u>Std. Dev. (cm)</u>
Rim Width	4	4.0 — 9.0	6.0	2.2

CROSS-SECTIONAL PROFILE: Schematic cross-sectional profiles of concave grinding stones (see figure on p. 42) demonstrate two and possibly three distinct forms:

1. shallow trough;
2. deep trough with flat rim; and
3. thin bottomed, steeply concave, bowl-like forms.



Photos 27, 28 and 29: All examples of trough metates on the Lucero Lake Site were fragmentary, preventing a detailed analysis of their form.

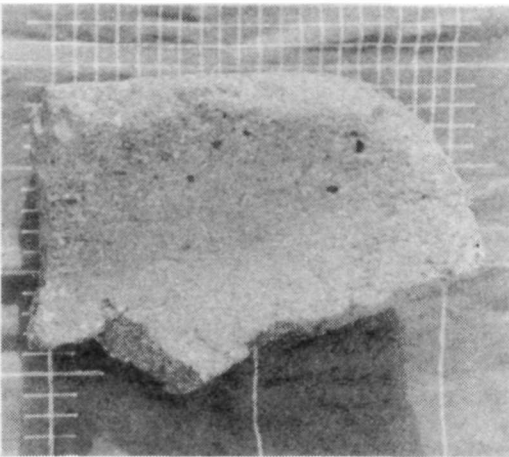
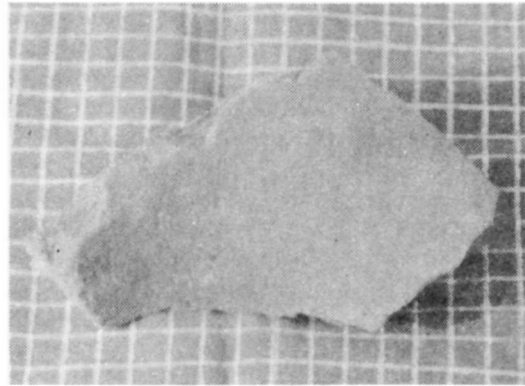
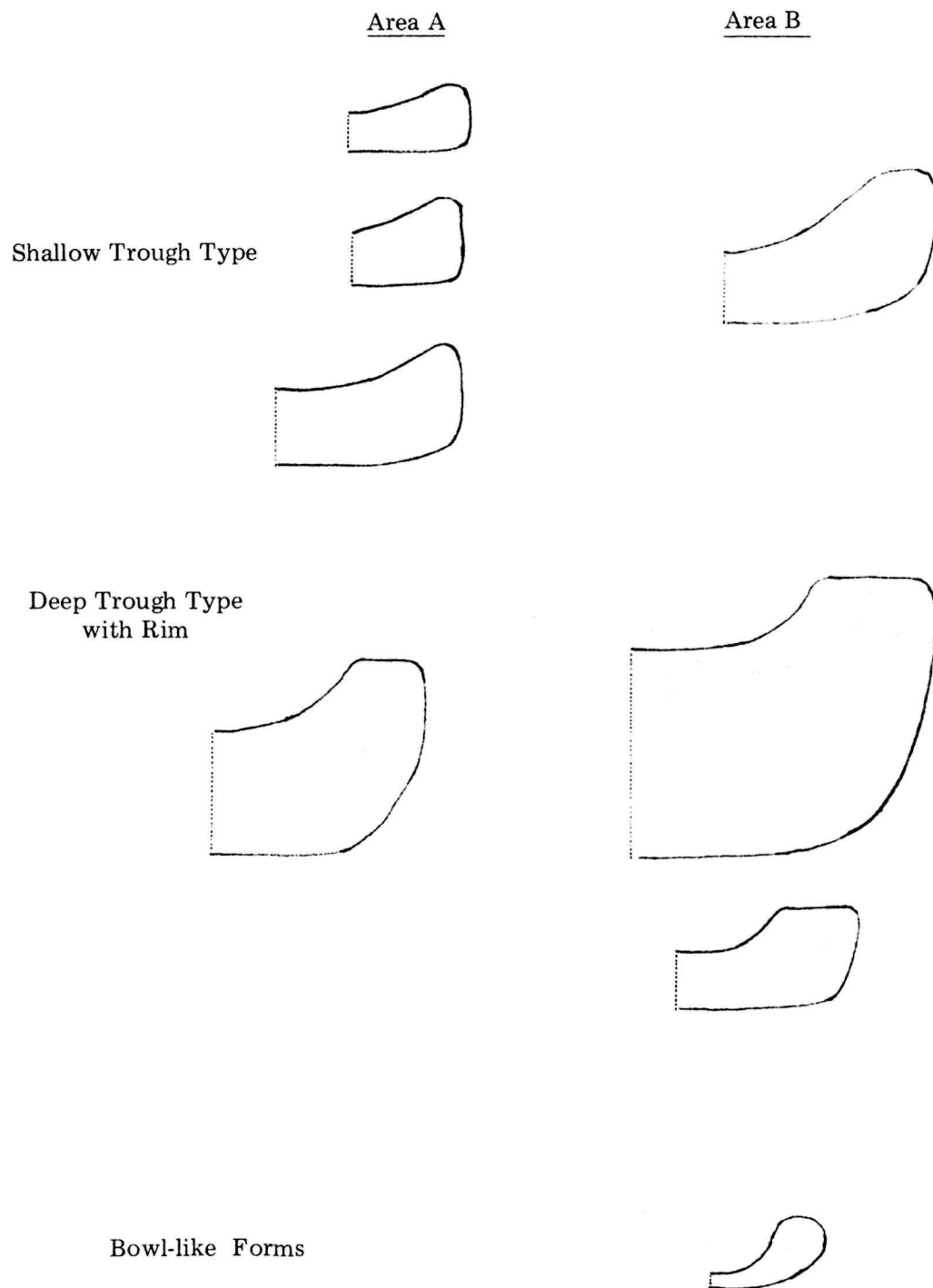


Figure 1
SCHEMATIC CROSS SECTIONS
 of
CONCAVE GRINDING STONES

Scale: 1 cm = 5 cm



PESTLES

Pestles are massive hand-held implements for pounding and crushing. Three pestles were identified in the ground stone sample, all from Area A. All three were blocky, triangular in shape, rectangular in cross-section. Each example had one pointed and one flattened end. All three were complete.

	<u>Number</u>	<u>Range (cm)</u>	<u>Mean ($\bar{x}$) (cm)</u>	<u>Std. Dev. (cm)</u>
Length	3	19 – 28	24.7	4.9
Width	3	11 – 12	11.7	0.6
Thickness	3	7 – 9	8.3	1.1

MATERIAL AND TEXTURE: Both larger examples were made from local, grayish-brown, metamorphosed sandstone. The smaller specimen was fine-textured, gray limestone.



Photo 30:
These pestles are massive and show a minimum of modification from their original form.

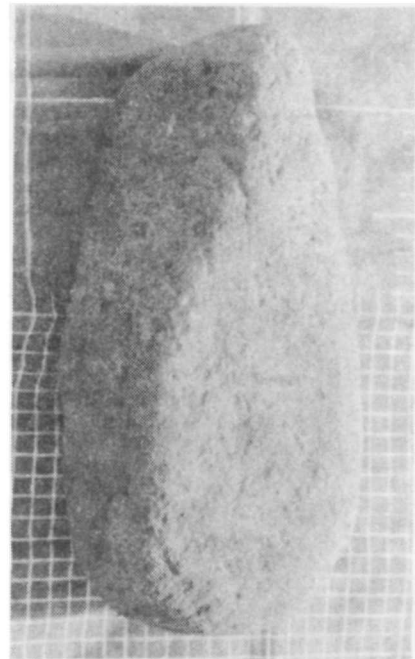


Photo 31:

STONE BALLS

Stone balls, spherical, fist-sized cobbles which show varying degrees of hard pounding wear, are noted as common on ceramic sites in the Tularosa Basin (Lehmer 1948:53). As wear progresses, these tools assume a distinct spherical form. Sixteen examples were recorded in Area A, six in Area B. Eighteen examples were complete, four were fragmentary. Shapes range from blocky, irregular chunks to near spherical.

SIZE: Estimated mean diameter was recorded for each example.

<u>Number</u>	<u>Range (cm)</u>	<u>Mean ($\bar{x}$) (cm)</u>	<u>Std. Dev. (cm)</u>
22	5.0 — 12.0	7.7	1.8

MATERIAL: A variety of locally occurring materials were used for stone balls.

chert:	11
basalt:	4
limestone:	4
quartzite:	2
quartz:	1

DEGREE OF WEAR: The extent of wear, generally obvious as crushing of the surface due to heavy pounding, was noted in three very broad categories:

initial wear: 8 cases medium wear: 12 cases advanced wear: 2 cases

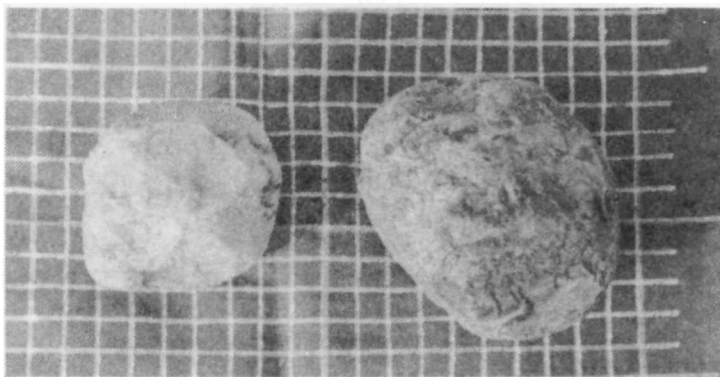
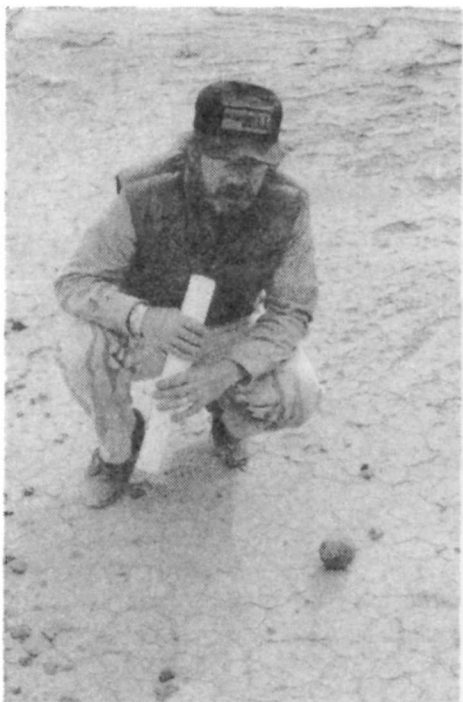


Photo 32 (top right), 33 (left) and 34 (bottom right): Stone balls of various sizes were a fairly common occurrence on the site surface.

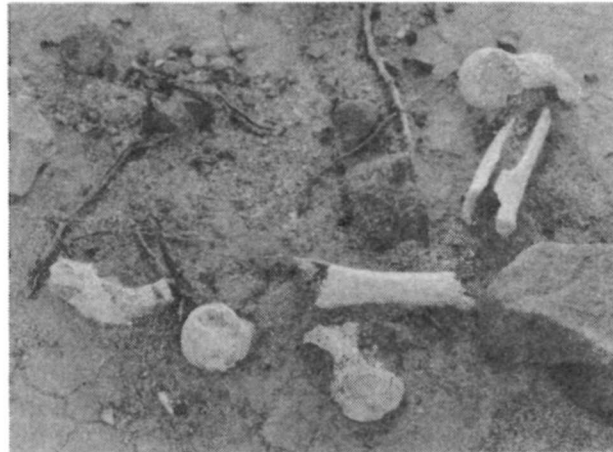
BURIALS

The exposed and eroded remains of two human burials were located in the vicinity of high density Area A. The first, or Burial No. 1 located within national monument boundaries, consists of a broad scatter of small fragments of bone washed downslope. Remnants of one exposed femur mark the original location.

Burial No. 2 is slightly less eroded and the remains of portions of the pelvic girdle, including proximal ends of both femurs, are evident at the surface. This example lies within Missile Range boundaries.

Although both examples are in very poor condition, orientation of the exposed bones suggest that they may have been buried in a flexed position, either upright or on the back. If this is in fact the case, then almost all of the remains have been exposed and eroded away. Both examples were probably interred in subsurface pits, and their condition is consistent with the eroded nature of the site surface. Neither showed any signs of cremation.

Photo 35: This exposed burial shows portions of pelvis and upper leg bones, indicating substantial erosion of the site surface.



EVIDENCE OF EROSION

Evidence of recent erosion, especially in the form of small channel cutting, is apparent on the surface of the site and WSMR aerial photos clearly demonstrate that this cutting is due to outwash from diversion ditches upslope from the roadbeds of Route 7 and 7A, that pass through drainage conduits below the road.

In addition to this channel cutting, the deflated surface of the site, and frequent, shallow rills with concentrations of size sorted cultural materials, testify to extensive sheet erosion of the entire site. Slightly higher, mound-like features seem to have fared somewhat better, but strong prevailing winds and a lack of ground cover have exposed the site to soil removal through wind action.

Some of the low sandy dunes scattered at the periphery of the site appear to contain cultural materials in a higher position than the present site surface, but these may represent remnants of an earlier erosional surface which have been redeposited and locally stabilized while more exposed surfaces have continued to erode.

The extensive size of the Lucero Lake Site precludes any on-the-ground determination of the true extent of these erosional processes at this time.



Photo 36: The easterly portions of the Lucero Lake site are generally barren and artifact density is light.

PRESERVATION

Sheet and channel erosion have already caused substantial damage to the deposits at the Lucero Lake Site. Although this erosional process has been in progress since the site was abandoned, some evidence, including WSMR aerial photography, indicate that current land use and drainage facilities associated with Route 7 may have greatly accelerated the process. Rates of active cutting of erosion channels, especially the one caused by the vehicle track across the site, should be assessed immediately and necessary preventive measures taken. In any erosion prevention program, however, great care must be exercised so that cultural deposits are not inadvertently damaged.

Unauthorized vehicular activity in the vicinity of the Lucero Lake Site still continues. Since portions of the site lie within the Missile Range, posting of monument boundaries will not adequately protect the complete site. A cooperative program to facilitate preservation of this site, between WSMR and WSNM, is strongly urged. Although fencing often attracts attention to archaeological sites, encouraging further unauthorized thefts of cultural materials, this possibility should be seriously considered in this case.



Photo 37: Central and western portions of the site have a light cover of creosote. Exposed roots document a substantial amount of recent erosion.

VI – CERAMIC ANALYSIS OF SURFACE SAMPLES FROM SITES IN THE BAJADAN COMMUNITY, WSNM

By Terry Knight

INTRODUCTION

In 1948, Donald Lehmer proposed a new addition to the Mogollon Culture, termed *The Jornada Branch* of the Mogollon. Lehmer's geographical boundaries include quite a large area. The northern extension would reach beyond Carrizozo, New Mexico. The boundary to the south would lie somewhere below Villa Ahumada, Chihuahua. To the west the area extends roughly to the eastern slopes of the Black Range, and to the east it reaches to the eastern slopes of the Sacramento Mountains (Lehmer 1948:10). This area is basically defined by the brownware pottery style used by prehistoric peoples of southern New Mexico and northern Mexico.

Until recent years, the area was only occasionally visited by archaeologists. The early works of Mera (1935) have, of necessity, served as both cultural atlas and chronology. Lehmer's study added detail in several instances to the previous works. However, a standard phase/stage organization of the archaeological data restricts interpretation and limits research questions.

Michael Marshall (1973) clarified this taxonomic problem by dividing the local variations of the Jornada Mogollon into *Regional Expressions*. Four expressions were adopted. These expressions are divided into three phases based on agricultural, architectural and ceramic development. Each expression is divided into three phases of development; roughly corresponding to a pithouse, transitional, and surface structure (Marshall 1973:49-120). The ceramic inventory of both *native* and *intrusive* wares is considered diagnostic of each phase, as listed below. Each ceramic type is listed in order of dominance.

EL PASO EXPRESSION:

Mesilla Phase: El Paso Brownware, Western Mogollon wares.

Dona Ana Phase: El Paso Brownware, El Paso Bichrome, El Paso Polychrome, Mimbres Black on White, Chupadero Black on White and Three Rivers Red on Terracotta.

El Paso Phase: El Paso Polychrome, El Paso Brownware, Three Rivers Red on Terracotta, Chupadero Black on White and Playas Red.

SOCORRO EXPRESSION:

San Marcial Phase: Jornada Brownware, San Marcial Black on White, Mogollon Red on Brown, Alma Plain and San Francisco Red.

Early Socorro Phase: Jornada Brownware and Socorro Black on White.

Late Socorro Phase: Pitoche Brownware, Socorro White ware, Lino Gray, Escavada Black on White, Wingate Black on Red and Chupadero Black on White.

LINCOLN EXPRESSION:

Early: Jornada Brownware, San Andres Red on Terracotta and Mimbres Boldface Black on White.

Middle: Jornada Bichrome, Jornada Polychrome, Jornada Brownware and Three Rivers Red on Terracotta.

Late: Lincoln Black on Red, Ochoa Brownware, El Paso Polychrome, Glaze I Red, St. Johns Polychrome, Chupadero Black on White, Gila Polychrome and some Chihuahuan wares.

CEDERVALE EXPRESSION:

Early: Jornada Brownware, Lino Gray, San Marcial Black on White and Alma Plain.

Middle: No sites have been excavated.

Late: Corona Brownware, a plain brownware, Chupadero Black on White, Los Lunas Smudged and Zuni Glaze ware.

Ideally, the ceramics from any given site should tie in with a specific Expression and Phase. Unfortunately, the area of the Jornada Mogollon is so large and so little research has been done that exact Phase definitions seldom apply.

LUCERO LAKE SITE HSR 702-1

METHODOLOGY

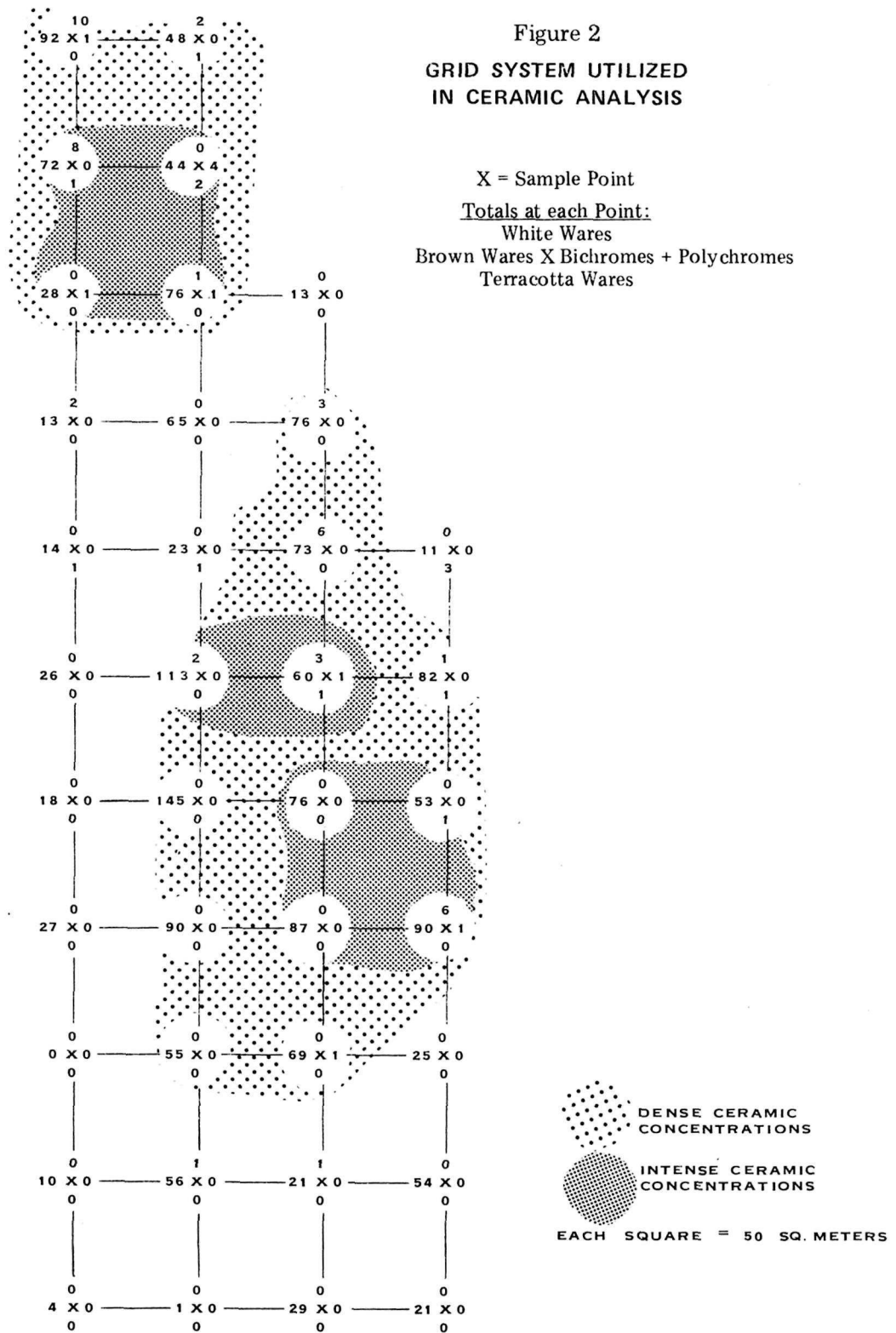
One week of in-field analysis was allotted for ceramic study at sites located by HSR field crew. Four days of this study were expended at HSR 702-1. The study sample consisted entirely of surface sherds. Owing to the short amount of field time, and the huge area of artifact density, sampling points were set up along the grid system which had been previously laid out by the HSR crew. The area of the site is 750 meters by 350 meters. The grid was laid in 50 meter squares with a stake marking each grid corner. At each stake a circular sample one meter in area was selected for ceramic analysis. Within this meter area circle all sherds, regardless of size, were recorded. Sherds were first sorted into types and then divided into five major categories:

1. jars
2. bowls
3. degree of surface smoothing
4. presence or absence of a carbon streak
5. rim shape

When applicable, intentional smudging, the quality of polishing, and surface erosion were also noted for each sherd.

Some painted or corrugated sherds were included in these one meter sample areas; many, however, were not. Since these wares are important as temporal indicators, all painted or corrugated wares that could be found on the surface were analyzed and recorded (Figure 2 illustrates the grid system and the sherd totals for each meter circle). It is important to note that judgements were made in the field without the aid of a microscope or a Munsell Color Chart. The sherds were broken and analyzed with a 10X hand lens.

Figure 2
GRID SYSTEM UTILIZED
IN CERAMIC ANALYSIS



ANALYSIS RESULTS

A total of 2268 sherds was considered in the ceramic study of HSR 702-1. Of these sherds, 112 were painted or corrugated wares found *outside* the meter sample points. These are listed in Figure 3, but are *not included* in the tabulations below.

Of the remaining 2157 sherds, 97 percent belonged to three brownware types, 0.44 percent belonged to two painted brownware types, 0.39 percent belonged to two painted terracotta types, and 2.1 percent belonged to two painted white ware types. Figure 4 lists the totals and percentages.

BROWNWARE

JORNADA PLAIN

Distribution: North of Carrizozo, New Mexico to north of Kenna, New Mexico. South to Villa Ahumada, Chihuahua. West to the New Mexico/Arizona State line. East of the New Mexico/Texas State line, up to 150 miles east of El Paso, Texas.

Type Site: LA 2000. Penasco Bend, Hope, New Mexico. Scattered from the type site westward to Lake Valley, situated at the eastern foot of the Black Range, including examples in the Tularosa Basin. Lower Jornada del Muerto and as far south as the Mexican border near the Portillos Mountains west of El Paso, Texas.

Temporality: Ca. A.D. 900—1350. No comment can be made except to say that this pottery type occurs at a site occupied about A.D. 1350 (Breternitz 1966: 78).

Derivation: Alma Plain?

Paste: Soft, granular, and friable. Color ranges from light brown to black depending upon the amount of original carbon content and the degree of firing. Black carbon streak common. Paste in area of Lea County Archaeological Survey contains ash-carbon and small particles of muscovite.

Temper: A profusion of medium grained, angular quartz and limestone fragments (same as El Paso Brownware but somewhat finer). Because of fineness and polish, the temper shows on the surface less often than in El Paso Brownware.

Temper in the area of Lea County differs: medium angular to sub-rounded fragments of anhydrite and quartz, and fine to very fine rounded, wind-blown sand grains. Inclusions from large to medium in size, very light colored, opaque, and usually angular (contains no limestones or carbonates).

Surface Finish: Semi-polished. Considerable variation in degree of smoothing. Smoothed by wiping and rubbing, often with striations. Final finish polished, giving appearance of a *float*. Unweathered sherds always show the effects of polishing, though varying in degree from fairly glossy to perfunctory. This brownware typically exhibits a smoothed polished finish on both the exterior and interior surfaces. This differs from El Paso Brownware which is rarely polished.

Figure 3

**PAINTED WARES LOCATED
OUTSIDE OF SAMPLE AREA**

Types	TOTAL	Jars	Rims	Bowls	Rims
Mimbres Classic B/W	33	1	0	32	7
Chupadero B/W	44	33	3	11	2
El Paso Bichrome	1	1	0	0	0
El Paso Polychrome	5	4	1	1	0
Playas Red	3	2	0	1	1
San Andres Red/Terracotta	8	6	2	2	0
Three Rivers Red/Terracotta	1	0	0	1	0
Red Slipped Redware	7	2	0	5	3
Reserve Indented Corr.	3	3	0	0	0
Reserve Plain Corr.	1	1	0	0	0
Tularosa Patterned Corr.	1	1	0	0	0
Mogollon Corr. Brownware	3	3	0	0	0
Wingate Black/Red	2	0	0	2	0
TOTALS	112	57	6	53	13

Figure 4

**TOTAL SHERD COUNT AND PERCENTAGES
FROM THE 41 SAMPLE AREAS AT HSR 702-1**

Types	Bowls	Rims	Carbon Streak	Vessel Percentage	Jars	Rims	Carbon Streak	Vessel Percentage	TOTAL Site Numbers	TOTAL Site Percentages
Jornada Brownware	140	3	105	14%	891	31	603	86%	1031	48%
El Paso Brownware	7	0	6	2%	431	15	248	98%	438	20%
San Andres Plain	26	1	16	4%	594	18	366	96%	620	29%
Mimbres Black/White	34	2	—	97%	1	0	—	3%	35	1.6%
Chupadero Black/White	2	0	—	18%	9	0	—	82%	11	.5%
El Paso Bichrome	2	0	—	20%	8	3	—	80%	10	.4%
El Paso Polychrome	0	0	—	0	1	1	—	100%	1	.04%
San Andres Red/Terracotta	6	3	—	86%	1	1	—	14%	7	.3%
Three Rivers Red/Terracotta	2	0	—	100%	0	0	—	0%	2	.09%
Reserve Corrugated	0	0	—	0	1	0	—	100%	1	.04%
Wingate Black/Red	1	1	—	100%	0	0	—	0	1	.04%
TOTALS	220	10	127		1937	69	1217		2157	100.01%

Vessel Walls: The vessel walls of Jornada Brownware are generally somewhat thinner than those of El Paso Brownware.

Vessel Forms: Bowls and Jars:

Jars: Jars predominate. Jars of various sizes, usually rather large, up to 20 inches in height. Rounded-bottomed vessels with surmounting necks that all appear to be short in relation to the body dimension. Olla rims are simple and direct with no appreciable flare. The rim edge may be slightly rounded or nearly flat. The rims of Jornada ollas differ from those of El Paso Brownware which characteristically possess widely flared rims, usually having thickened lips.

Bowls: Bowls infrequent. Shallow bowls with direct rims and deep bowls with incurved rims.

Remarks: The fine temper, polished surface, and direct unflared rims all serve to distinguish Jornada Brownware from its relative El Paso Brownware.

The absence of limestone or carbonates and the presence of mica in the brownware material recovered and described by the Lea County Archaeological Society (1963) lead Runyan to suggest a local variant of the ware defined near Hope, New Mexico by Jennings (1940).

EL PASO PLAIN BROWN

El Paso Brownware comprised 20 percent of the site sample. It was distinguished from Jornada Plain Brownware primarily on the basis of surface character and rim form. Following is the description of El Paso Brown as found in the *Technical Manual* (HSR 1973a). This is drawn from the description by Lehmer (1948:94) and includes additional information from Brand (1935).

Distribution: North of Carrizozo, New Mexico to north of Kenna, New Mexico. South to Villa Ahumada, Chihuahua. West to the New Mexico/Arizona State line. East to the New Mexico/Texas State line.

Temporality: Ca. A.D. 900—1350.

Derivation: Alma Plain?

Paste: Soft, granular, and friable. Color ranges from medium brown to light brown to black, and varies considerably within a single vessel. Outside core wall brown to light ochre red. Core center varying from gray to black depending upon original carbon content and degree of firing.

Temper: Angular fragments of limestone and quartz ranging up to 1.5 millimeters in diameter. Best distinguished by the size and profusion of temper.

Surface Finish: No slip, smoothed. Considerable variation in degree of smoothing. Occasional striated areas indicate obliteration of coils by brushing with coarse grass during manufacturing. Fire clouds common. Temper visible on surface.

Vessel Wall: Range 2 to 9 millimeters. Average 5.2 millimeters.

Designs: None. A few specimens exhibit gouging, punching and incising.

Vessel Forms: Bowls and Jars.

Remarks: El Paso Brown material from the Lea County area differs in that the paste contains mica flakes and does not contain limestone.

A third type of Plain Brownware comprised 29 percent of the sample total. A similar pottery has been described in the past as a Plain Three Rivers Redware. This designation was based on variations of sherd colors. Duller samples would indicate Jornada Brown, while brighter samples would be considered undecorated fragments of San Andres Red on Terracotta, Three Rivers Red on Terracotta, or Lincoln Black on Red vessels (Wimberly and Rogers 1977:401). The following Munsell color variations are those given for the Plain Three Rivers Redware:

In Hue -- from 2.5YR to 10YR

In Value -- from 5 to 7

In Chroma -- from 2 to 8.

Although the term Plain Three Rivers Redware includes a wide range of color variation, it indicates a predominance of shades of terracotta. Among the sherds at HSR 702-1, very few were of a shade of terracotta. In fact, the majority of these sherds ranged from tan-gray to buff, including light yellow brown, yellow brown and a very light reddish brown. Carbon streaking was prevalent. Some sherds were fired to a medium gray. Referring to a Munsell Color Chart, the surface variations of this Plainware from HSR 702-1 are as follows:

In Hue -- from 2.5YR to 10YR

In Value -- from 6 to 7

In Chroma -- from 2 to 3.

These sherds are closest in appearance to the plain portions of San Andres Red on Terracotta. However, for reasons that follow, they will be referred to as San Andres Plainware in this report. The San Andres Red on Terracotta description below is E.B. McCluney's revision of Mera and Stallings original (McCluney 1962: 49-54).

SAN ANDRES RED ON TERRACOTTA

Distribution: The northern Tularosa Basin east of the Rio Grande between the Capitan and San Andres Mountains, ten miles south of Alamogordo and north to the vicinity of Corona, New Mexico.

Type Site: Hatchet Site (290T-3, University of Colorado), northern Tularosa Basin, near Three Rivers, Otero County, New Mexico.

Temporality: Ca. A.D. 1100-1300.

Paste: Constructed by coiling. Fired in an oxidizing atmosphere. Color--dark reddish-brown (Munsell 2.5YR 3/4) to a light red (Munsell 2.5YR 6/8). Carbon streak light gray (Munsell 7.5YR 7/0) to black (Munsell 7.5YR 3/0).

Temper: Predominantly quartz sand with occasional feldspar and traces of mica. Texture--medium coarse. Color--white (Munsell 5YR 8/1) to light reddish-brown (Munsell 5YR 6/3). Shape--rounded.

Walls: Strong. Thickness, 5-7 mm. Fracture—sharp to slightly crumbling.

Surface: Color—brown (Munsell 7.5YR 5/4) to light reddish-brown (Munsell 5YR 6/3). Exterior frequently colored to a light gray (Munsell 2.5YR 6/0) in firing. Interiors and exteriors usually finely floated giving the effect of a very thin wash. Surface is highly polished after paint application. Polishing streaks clearly visible on most of the San Andres specimens. Firing clouds common on exterior. Hardness 5 (MOH hardness scale).

Forms: Deep and shallow bowls, narrow and wide mouthed jars and pitchers (Colton 1953:Fig. 11:45).

Rims: IE9 (Colton 1953:Fig. 10:44). Straight and direct concave toward the interior of the vessel. A noticeable thickening occurs about 2.5 mm below the rims of the deep bowl sherds.

Paint: Iron. Color ranges from a dark reddish-brown (Munsell 2.5YR 3/4) to a light red (Munsell 2.5YR 6/8). Paint is permanent but tends to appear fugitive due to its thinness. Tendency for brown paste to show through paint decoration.

Decoration: Predominant element is the crude, wide line drawn under the rim, usually on the interior of the vessel. The wide lines radiate downward from the decorated rim and terminate above the bottom of the vessel. The width of the lines varies from 0.5 cm to 0.8 cm. Occasionally the radiating lines are drawn obliquely from the rim. Joining of the lines may occur below the rim to produce squares, triangles or diamonds (scrolls, solid triangles and hatching are rare design elements on San Andres pottery). The lip of the rim is consistently painted red as is the lip interior and/or exterior. Pitcher necks are usually solid red with an extension of the paint over the top of the handle (see Figure 4:G).

Comparisons: San Andres resembles the later Three Rivers Red on Terracotta and probably existed as a somewhat parallel ware, according to Mera and Stallings (1931:4). However, the latter's temper is more sparse and decoration is confined to use of the narrow line element. Scrolls and saw-tooth lines are common design elements. The paint used on Three Rivers Red on Terracotta is thicker and there is more careful execution of line work. The base color is more of an orange red and the vessel walls are slightly thinner. Fracture is sharper with little crumbling. Only deep and shallow bowl forms are known.

Cultural Associations: The Three Rivers and San Andres Phases of the Northern Jornada Branch of the Mogollon (Lehmer 1948:88-89). However, this association is tentative and, like the temporal stage, may be subject to change at a later date in the research.

Remarks: The stratigraphic occurrence of San Andres Red on Terracotta sherds indicates an ancestral position to Three Rivers Red on Terracotta, which verifies the indications recognized by Mera and Stallings in 1931 (pp. 4-5).

Although this plainware sample may represent the unpainted portions of a San Andres Red on Terracotta variant, several points argue against this assumption. HSR 702-1 has not been excavated, so the total number of sherd types is not known. However, the sherd count for the sample does not indicate that all of these San Andres sherds are from Red on Terracotta vessels. San Andres Red on Terracotta makes up a mere .3 percent of the sample, while San Andres Plain makes up 29 percent. McCluney's description indicates that the painted design covers most of

the vessel surface; there should be more painted sherds to go with the large number of unpainted sherds.

McCluney also states that rim paint is constantly found; none of the rim sherds in this sample were painted. Furthermore, he describes the surface as being highly polished (over the paint) with polishing streaks clearly visible on most specimens. The majority of sherds from HSR 702-1 exhibited no polish; however, when polish was present it was streaky to lustrous. This argues that the *San Andres* vessels at HSR 702-1 may have been intentionally left plain, possibly serving the same purpose as the Plain Jornada and El Paso Brownwares. Further, since San Andres Red on Terracotta is polished after the paint is applied, the lack of polish on *San Andres* sherds at HSR 702-1 indicates that these vessels were not painted and so were never polished.

Following Colton and Hargraves' publication (1937:19-22) of *The Rules for Naming Pottery Types and Wares*, San Andres Plain is differentiated from the Red on Terracotta by the lack of paint and polish. This is a greater distinction than is made between Jornada Plain and Jornada Bichrome in which one is painted and the other is not, although both are characteristically polished.

The name San Andres Plain fulfills the geographical and descriptive requirements as well as indicating a highly probable relationship with San Andres Red on Terracotta. In light of the above factors, San Andres Plain is described as follows.

SAN ANDRES PLAIN

Synonyms: None, other than previous inclusion under the term Plain Three Rivers Redware.

Distribution: Observed at five sites near the San Andres Mountains and White Sands National Monument in south central New Mexico (see p. 68).

Type Site: HSR 702-1, Dona Ana County, Tularosa Basin, New Mexico.

Temporality: Ca. A.D. 1000-1200+? Undated other than by association with Mimbres Black on White, Chupadero Black on White, Wingate Black on Red, El Paso Polychrome, Playas Red, Three Rivers Red on Terracotta, El Paso Brown and Jornada Brown.

Paste: Construction—coil and scrape. Fired in an oxidizing atmosphere with occasional examples of reducing atmosphere. Color—tannish-gray to buff, light yellowish-brown, occasionally gray. Carbon streaking predominant.

Temper: Predominantly quartz sand with occasional feldspar, mica and other inclusions, generally rounded.

Walls: Strong, 5-7 mm in thickness. Fracture—sharp to slightly crumbling. Approximating 5 on the MOH scale.

Surface: Color—tannish-gray to buff, yellowish-browns, occasionally gray. Munsell—Hue, 2.5YR to 10YR; Value, 6-7; Chroma, 2-3. Interior and exterior well smoothed. Treatment—no paint, predominantly no polish although some examples exhibit very light streaky to lustrous polish.

Vessel Form: Type site, predominantly jars, few bowls. *Note:* at HSR 702-1, 594 jar sherds were recorded (96 percent), 26 bowl sherds recorded (4 percent). It must be remembered that this is a somewhat subjective quantification based on interior/exterior treatment variations.

Rim Forms: Direct, occasionally tapered or flattened.

Paint and/or Decoration: None.

Comparisons: San Andres Plain strongly resembles San Andres Red on Terracotta, but is more yellow in color and lacks polish or paint. Jar forms predominate in the Plain, whereas McCluney (1962:53) states that only bowl forms are known in the Red on Terracotta. San Andres Plain is vaguely similar to Three Rivers Red on Terracotta, but tempering materials are coarser, vessel walls are thicker and less well compacted, and color variations are buff-yellow-browns, rather than red-terracotta-browns.

MINOR POTTERY TYPES

CORRUGATED BROWNWARES

Corrugated brownwares appear to be very scarce at HSR 702-1. Only one piece of Reserve Plain Corrugated was recovered from the sample areas. Several other Mogollon corrugated types were found outside of the sample areas. These are listed in Figure 3.

EL PASO BICHROME AND EL PASO POLYCHROME

These painted brownware types constitute 0.44 percent of the sample total. Below are descriptions of each type as taken from the *Technical Manual* (HSR 1973a).

EL PASO RED ON BROWN AND BLACK ON BROWN

El Paso Bichrome styles are uncommon. These types are considered as forerunners of El Paso Polychrome. Indications are that these styles had an extremely short period of existence (i.e., A.D. 1000–1100). El Paso Red on Brown is decorated with red oxide iron, while El Paso Black on Brown is decorated with black carbon paint. Los Tules is the type site for the El Paso Bichrome styles.

EL PASO POLYCHROME

Temporality: Ca. A.D. 1100–1350. Indigenous and intrusive association A.D. 1310–1347. There is no evidence for the beginning date of El Paso Polychrome; however, the tree-ring evidence is in agreement with Hawley's (1950) statement that it lasted until A.D. 1350 (Breternitz 1966).

Derivation: El Paso Red on Brown and El Paso Black on Brown.

Paste: Grayish-brown to black. Contains much carbon material. Color of paste varies according to the proportion of original carbon content and the degree of firing. Very friable. Outsides of core are brown to light ochre red. Core center gray to black.

Temper: Sand, fine to coarse. Grains of mica are often present.

Surface Finish: Decorated surface was floated or coated with a thin wash of brown to light red clay. Surface is crudely smoothed by wiping or rubbing. Jar interiors often have rough striations.

Paint: Mineral (red oxide) and black organic pigments. Red iron paint is deep maroon to light red and is quite fugitive.

Designs: Decorations are black over red, red over black, and black and red on a brown base. Both black and red paints are thin, the red often having the appearance of a wash, and is very fugitive looking. Designs are crude and paint often runs. Alternating lines of black and red, massed colors, and stepped designs are common. On jars, the designs are confined to the upper half of the exterior. Jar rims are painted red with a black band encircling the interior lip. On bowls, the interior surface is decorated or burnished. Rims are painted red. Interior band may be alternating horizontal zones of black and red while border lines are in black.

Vessel Forms:

Bowls: Deep and round bottomed. Some sherds show vertical walls. Rims are flat and slightly rounded and usually direct.

Ollas and Jars: Wide mouths. Round or flat bases. Handled and unhandled. A variety of shapes, commonly a wide body and a constricted neck recurving to a flaring rim. Rim wall may be uniform or thickened. Rim edges may be round or flat.

Ladles: Rare.

THREE RIVERS RED ON TERRACOTTA

Three Rivers Red on Terracotta constitutes 0.09 percent of the sample total. Following is a description of this type as taken from the *Technical Manual* (HSR 1973a).

Temporality: The tree-ring evidence is insufficient to comment on the beginning date, but there is a suggestion that it lasts until about A.D. 1350 (Breternitz 1966).

Derivation: San Andres Red on Terracotta.

Paste: Medium-hard to hard. Fine, uniform terracotta color. Occasional carbon streak. Often grayish-brown sherd exteriors and terracotta interiors.

Temper: Fine-grained sand. Occasional flakes of biotite and grains of hematite, and rarer rounded grains of quartz. In many of the sherds a dark, shiny, grainy material occurs. This material may be either augite or hornblende. In the oxidized portions of the sherds, the hematite fires to a reddish-brown. In the reduced portions, the hematite appears brownish-black with only a tinge of red.

Surface Finish: The interior of bowls and the exterior of bowls and jars were polished and floated, with no slip.

Paint: Iron oxide, sometimes somewhat fugitive. Ranges in color from red to red/purple to a definite purple.

Designs: Narrow line style. The lines varying from 1 mm to 3 mm in width. Two to four parallel narrow lines, small solid triangles along narrow lines, and spiral lines.

THE WHITE WARES

Chupadero Black on White and Mimbres Classic Black on White together comprised 2.1 percent of the sample. The presence of these sherds at HSR 702-1 indicates a possibility of some type of relationship with areas both northeast and northwest of the site. Mimbres Classic Black on White is found to the west of the Jornada del Muerto and throughout the mountain area of the Black Range.

Chupadero Black on White is found to the east of the Jornada del Muerto. It ranges from southern Torrance and eastern Socorro Counties to northeast of the Jornada del Muerto and south of Estancia Valley, New Mexico. It continues south into the Sacramento Mountains, and through the Tularosa Basin. Its type site is Gran Quivira, New Mexico (HSR 1973a).

The presence of these two types is not surprising due to the location of the site. Mimbres Boldface Black on White appeared on sites west of the Sacramento Mountains at approximately the same time as Jornada Brownware reached its period of development (Mera 1943:13). When Mimbres Boldface began its decline, Mimbres Classic Black on White began to appear in larger numbers in these southern brownware areas (Mera 1943:14). This is interesting since few Mogollon ceramics are found in this area from pre-Mogollon Period V. This may in some way coincide with the extinction or exodus of the Mimbrenos who originated the Mimbres Classic Black on White pottery (Mera 1943:8). Those same Mimbrenos who lived in the area of the Mimbres drainage vanished sometime after A.D. 1150.

Chupadero Black on White came into existence around A.D. 1150. It became quite common throughout the northern section of the Tularosa Basin. When its presence in this sector was firmly established, it quickly spread into the southern brownware areas. The spread southward of Chupadero Black on White and El Paso Polychrome, and the northward spread of Three Rivers Red on Terracotta, seems to have coincided during the period of wide distribution of their respective developments.

A variant of Chupadero Black on White, Casa Colorado Black on White, was found at HSR 702-1, but for purposes of this report is not discussed in detail. Casa Colorado is identical to Chupadero except the undecorated surface is smoothed rather than striated.

MIMBRES CLASSIC BLACK ON WHITE

Temporality: A.D. 1113+ — 1347. There is no good evidence for determining the beginning date of Mimbres Black on White, but it apparently persisted until sometime after A.D. 1250 (Breternitz 1966:86).

Paste: Friable, containing a large amount of fine to medium fine quartz sand temper. This occasionally contains specks of black sand (magnetite) from stream beds. The paste fires from a light gray to a gray-black. It may also fire to a soft, red brick color.

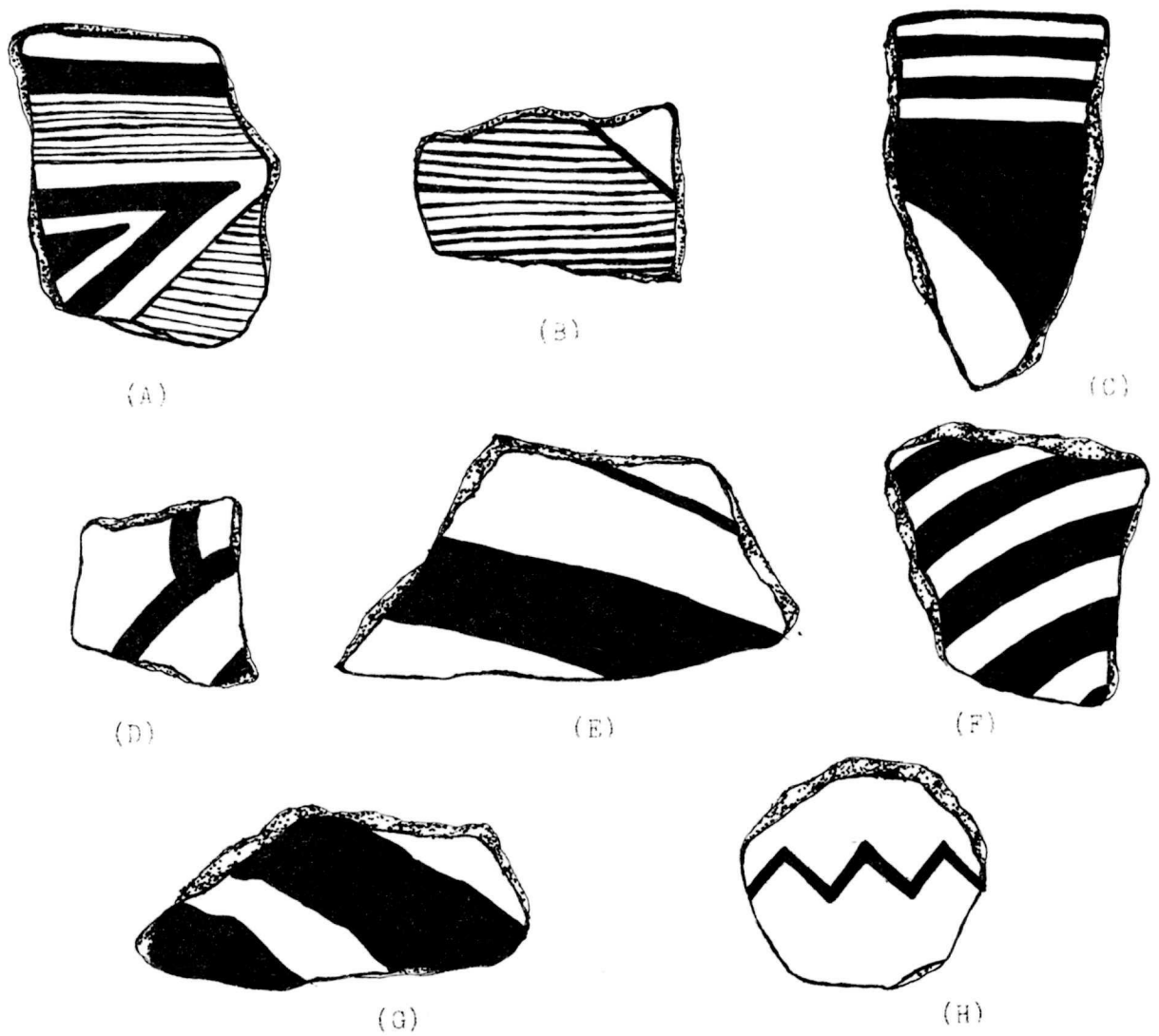


Figure 5
ILLUSTRATIONS OF SEVERAL PAINTED WARE TYPES

(A) (B) and (C) are Mimbres Classic Black on White
 (D) (E) and (F) are Chupadero Black on White
 (G) is San Andres Red on Terracotta
 (H) is Three Rivers Red on Terracotta

Slip: Often a flat white, occasionally a dead cream in color. It is applied to a smooth, stone-rubbed surface and may run over the rim onto the exterior surface.

Paint: Iron. Most often black, but can blend from black to red as a result of firing conditions.

Polish: Outsides and insides have been well smoothed with a polishing stone. On the decorated surface, polish is generally restricted to the painted areas.

Decoration: Characterized by accurate fine-line brush work in both geometric and naturalistic styles. Rims are painted. Multiple parallel borders are common near the rim. There is no exterior surface decoration. Positive and negative drawings are common together with pictures of animals and insect life (see Figure 5:A, B and C).

CHUPADERO BLACK ON WHITE

Temporality: Late Pueblo III into Pueblo IV. Chupadero Black on White begins at A.D. 1150 and lasts until at least 1400 with tree-ring evidence strongest between A.D. 1250 and 1400 (Breternitz 1966:72). Smiley, Stubbs and Bannister (1953:58) indicate an end date of A.D. 1675, although this later date is probably for Tabira Black on White, a derivative of the earlier Chupadero.

Derivation: Chaco II, Socorro Black on White (?).

Paste: Fine gray, well-fired, uniform in color.

Temper: Small dark particles of stone, crushed potsherd, dark stone, perhaps crushed sand and andesite as in the later Tabira type.

Surface: Decorated surface smoothed, unevenly slipped gray-white and polished. Exterior of bowls and interior of jars roughly striated. Occasional bowls with broad corrugations on the exterior.

Paint: Black iron based pigment, often oxidizes to reddish-brown.

Designs: Hatched and solid lines opposed. Careless draftsmanship. Borders of heavier lines. Rims often painted solid. Use of broad black lines and the alternating use of solid and hatched elements. Dotting between heavy lines is often used (see Figure 5:D, E and F).

Remarks: Variant—Casa Colorado Black on White (Mera 1935). Identical with Chupadero Black on White except that the undecorated surface is smoothed rather than the typical rough, striated surface of Chupadero. Southern Chupadero is, in general, *superior* to that made further north.

OTHER MISCELLANEOUS POTTERY TYPES AT HSR 702-1

This category represents only 0.17 percent of the sherds from the meter sample area. One sherd of Wingate Black on Red, one sherd of Reserve Plain Corrugated, and two sherds of Three Rivers Red on Terracotta were analyzed. Dates and type description references for these types follows.

Wingate Black on Red:

A.D. 1047 to 1200 (Breternitz 1966:102). Type description — Colton and Hargrave 1938:118.

Three Rivers Red on Terracotta:

A.D. 1150 to 1300 (Breternitz 1966:97). Type description — Human Systems Research 1973a (see Figure 5:H).

Additional sherds of these types were seen throughout the site, as well as a few other types not recovered in the sample areas. Presence of these other types was recorded to aid the date estimate for the site. These types include:

Playas Red, Incised and Plain variants:

A.D. 1100 to 1600. Date and type description — Rinaldo 1974:147-160.

Reserve Indented Corrugated:

Ca. A.D. 1050 to 1250. Date and type description — Rinaldo and Bluhm 1956:159.

Reserve Indented Smudged Corrugated:

Ca. A.D. 1050 to 1250. Date and type description — Rinaldo and Bluhm 1956:159-161.

Tularosa Patterned Corrugated:

Ca. A.D. 1050 to 1250. Date and type description — Rinaldo and Bluhm 1956:169.

All of these types were widely dispersed within an area of dense brownware concentration. The presence of these types indicates at least some contact with the Chihuahua area, the Western Mogollon area, the Eastern Three Rivers area and the Northwestern White Mountain Redware area. The nature and extent of this contact cannot be estimated.

VESSEL RIM CHARACTERISTICS

Rim shape is of growing importance in identification of the Jornada Mogollon brownwares. In many instances surface sherds comprise the majority, or total, of the ceramic assemblage from Jornada Mogollon sites. These sherds are often so eroded that distinguishing characteristics such as paint or polishing marks are obscured or obliterated.

Brownware types, such as El Paso, El Paso Polychrome, Jornada Brown, San Andres Red on Terracotta, San Andres Plain, and Three Rivers Red on Terracotta have very similar rim types. However, some general distinctions can be made, and in the written descriptions of each type inferences are given. Combining these generalizations with the other visible attributes on a collection of sherds aids a field worker in reaching more accurate *type* decisions. A brief description of the rim forms of each of these brownware types follows, with illustrations of the rim forms found at HSR 702-1 (Figure 6).

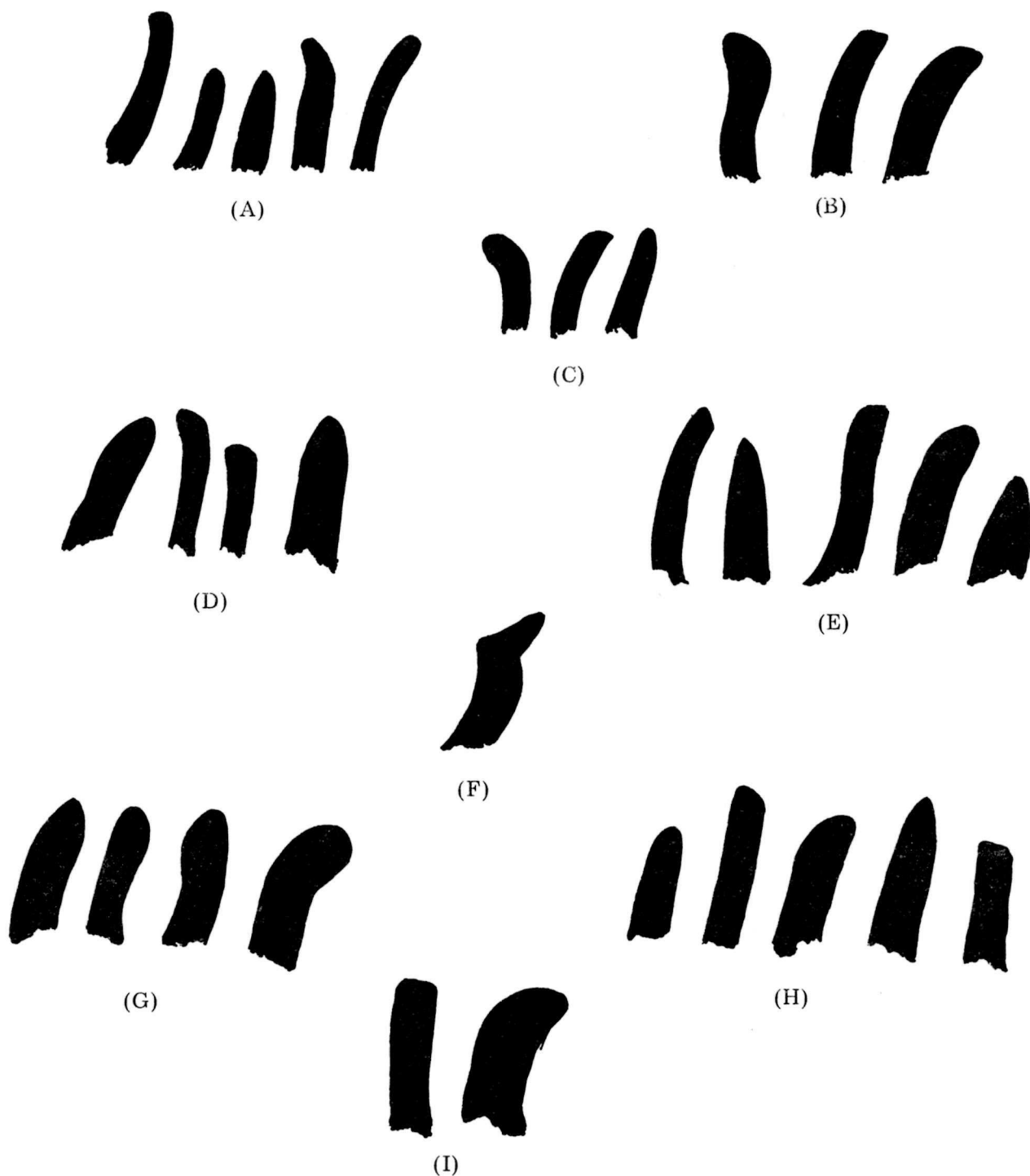


Figure 6
RIM FORMS COMMON TO HSR 702-1

(A) Mimbres Classic Black on White; (B) Chupadero Black on White; (C) Red Slip-ped Red Ware; (D) El Paso Brownware; (E) Jornada Brownware; (F) Wingate Black on Red; (G) El Paso Bichrome and Polychrome; (H) San Andres Plainware; (I) San Andres Red on Terracotta.

EL PASO BROWN

This pottery type is described as having a direct rim. It is associated primarily with round bottomed jars without necks (Lehmer 1948). A constriction at the mouth is almost always noted. Rims are almost always direct, or direct with a pinched top. Only occasionally are thickened rims found (Whalen 1977).

EL PASO POLYCHROME

Lehmer (1948) states that El Paso Polychrome has either simple direct, thickened direct, or everted jar rims. Whalen (1977) holds that a constriction occurs most often at the vessel neck, rather than at the mouth, and that the lip is most often flared. Field recording at HSR 702-1 indicates that a rounded, somewhat everted rim, or a slightly flared thick rim is common.

JORNADA BROWN

Rims are unspecialized and direct. Almost all of these come from jars that seem to have short necks in relation to their body dimensions (Mera 1943). The edge of these rims (the lip) may be slightly rounded or nearly flat (HSR 1973b). Examples from HSR 702-1 included some thinned at the lip, and some mildly everted rims.

SAN ANDRES RED ON TERRACOTTA

The rims are straight and direct, concave toward the interior of the vessel (Colton 1953). A noticeable thickening occurs about 2.5 mm below the rim of deep bowl sherds. Examples from the area of HSR 702-1 include a direct rim and mild flare rim.

SAN ANDRES PLAIN

Examples from HSR 702-1 include direct rounded, direct pinched, direct flattened, and some direct rims with rounding to one side.

THREE RIVERS RED ON TERRACOTTA

The vessel forms for this type include bowls and ollas. The bowls are generally shallow with round bases and direct flat rims. The ollas predominantly have wide mouths, low necks, broad shoulders and direct rims (HSR 1973b). Slightly incurved, flattened rims have been noted in the bowls, and a slightly everted jar rim is also possible (Southward, IN Bussey, et al., 1976). No Three Rivers rims were found at HSR 702-1.

SUMMARY AND CONCLUSIONS

HSR 702-1 is difficult to fit into Marshall's taxonomic system as described in the *Technical Manual* (HSR 1973a). No occupation structures have as yet been found, so the dating of the site is left to the ceramic inventory. Unfortunately, this inventory is: 1) 97 percent Plain Brownware sherds; and 2) the leading *local* type (Jornada Brown) and the two leading intrusive types (Mimbres Classic and Chupadero Black on Whites) do not fit together in any expression so far named, although they do overlap in time (see Figure 7). Perhaps future research in the vicinity of HSR 702-1 will prove the need for an additional expression to suitably describe the intermediate position of this site between the El Paso Expression and the Lincoln Expression, both on the basis of artifact types and geographical location.

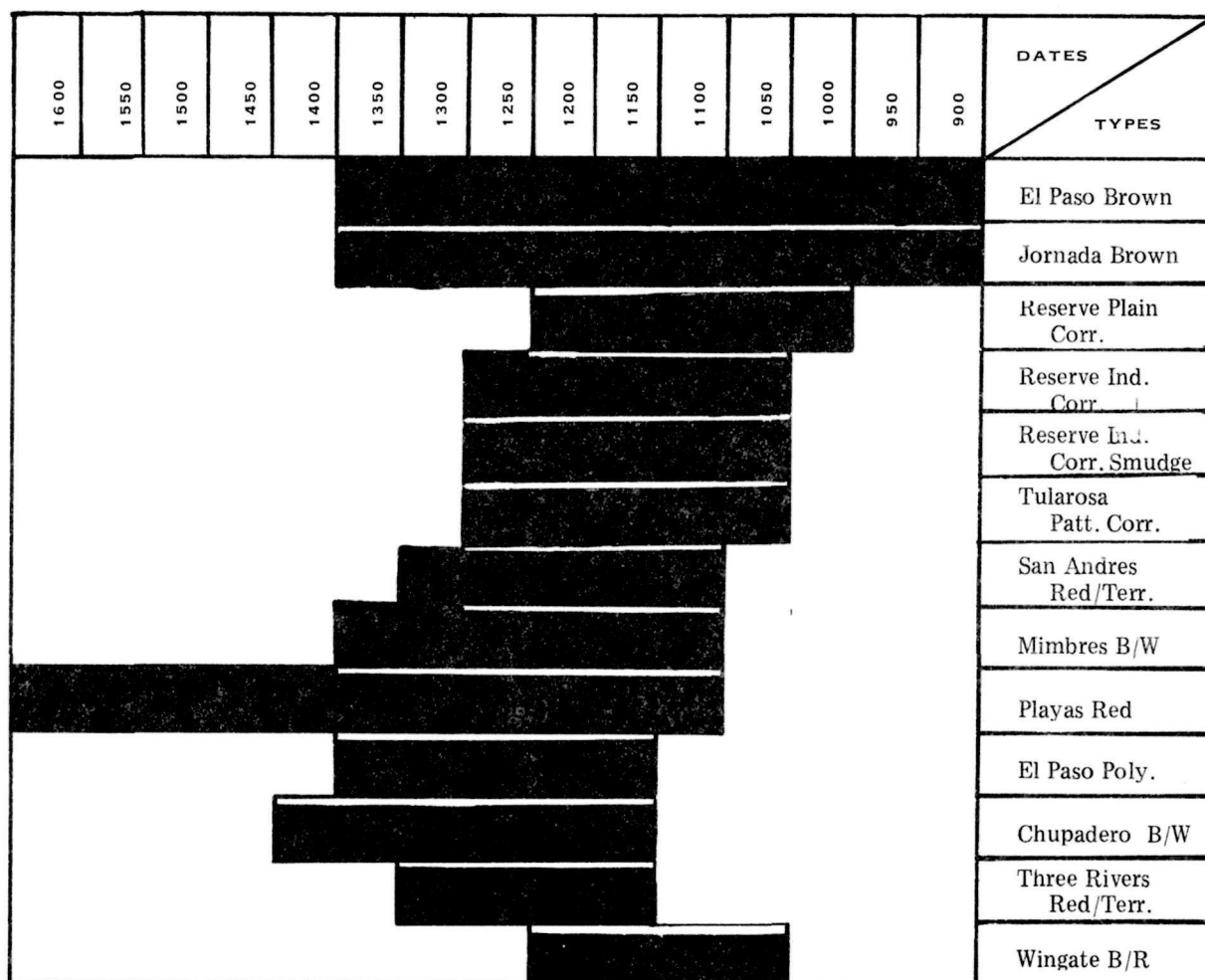


Figure 7
 DATED POTTERY TYPES
 OCCURRING AT HSR 702-1

Until that possibility is more thoroughly explored, several alternatives are listed below:

1. Perhaps this site is most closely related to the Dona Ana Phase of the El Paso Expression, dating roughly between A.D. 1100 and 1200. This would account for the presence of the Mimbres Classic sherds. However, there is an abundance of Jornada Plain and San Andres Plain rather than the El Paso Brownware that should go with a Dona Ana Phase site;
2. Perhaps HSR 702-1 is more closely related to the Middle Phase of the Lincoln Expression. This would also date approximately A.D. 1100 to 1200. Jornada Plain is the dominant type but few, if any, Jornada painted wares occur; possibly due to the influence of nearby El Paso Expression sites (see Appendix B to Ceramic Section) evidenced by the presence of the El Paso Brownwares at HSR 702-1;
3. Or, perhaps this was a temporary occupation area based on a seasonal economic activity. The people who came could have been from any number of sites in the vicinity. This would account for the diversity in the ceramic assemblage. People from a more eastern area could have brought their predominantly Jornada tradition with them, and into contact with the more El Paso Expression oriented people of the immediate area, thus resulting in the mix observed at HSR 702-1.

It is important to note that these suggestions are speculative at best and may in no way represent the *truth* concerning this site.

At any rate, referring again to Figure 6, an educated guess based on the ceramic types found at HSR 702-1 would place the occupation between A.D. 1100 and 1250 — the accepted dates for all the pottery types found at HSR 702-1 being within this range.

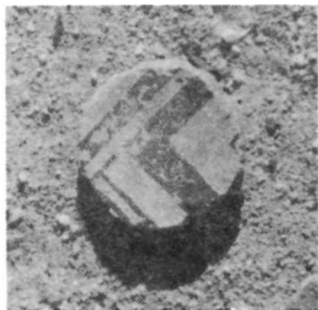
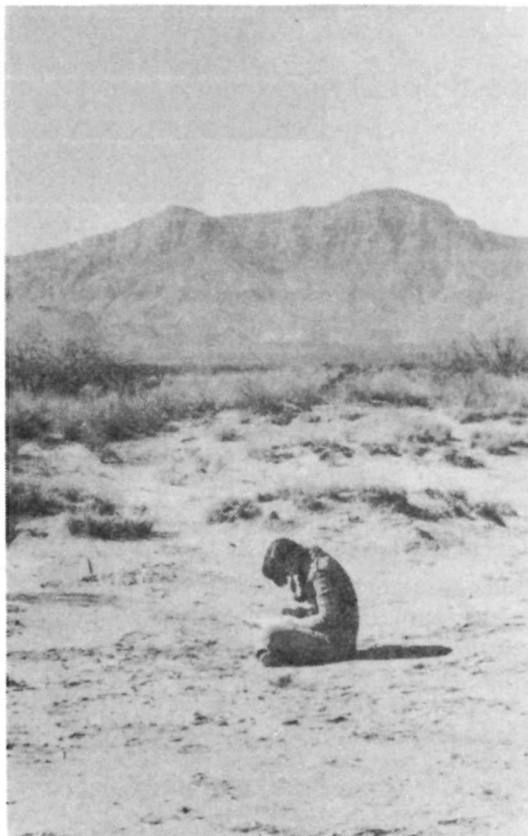


Photo 38 (above): Sherd disks were fairly common on the site.

Photo 39 (right): The ceramic analysis, conducted on-site, was based on the CLD sample materials.



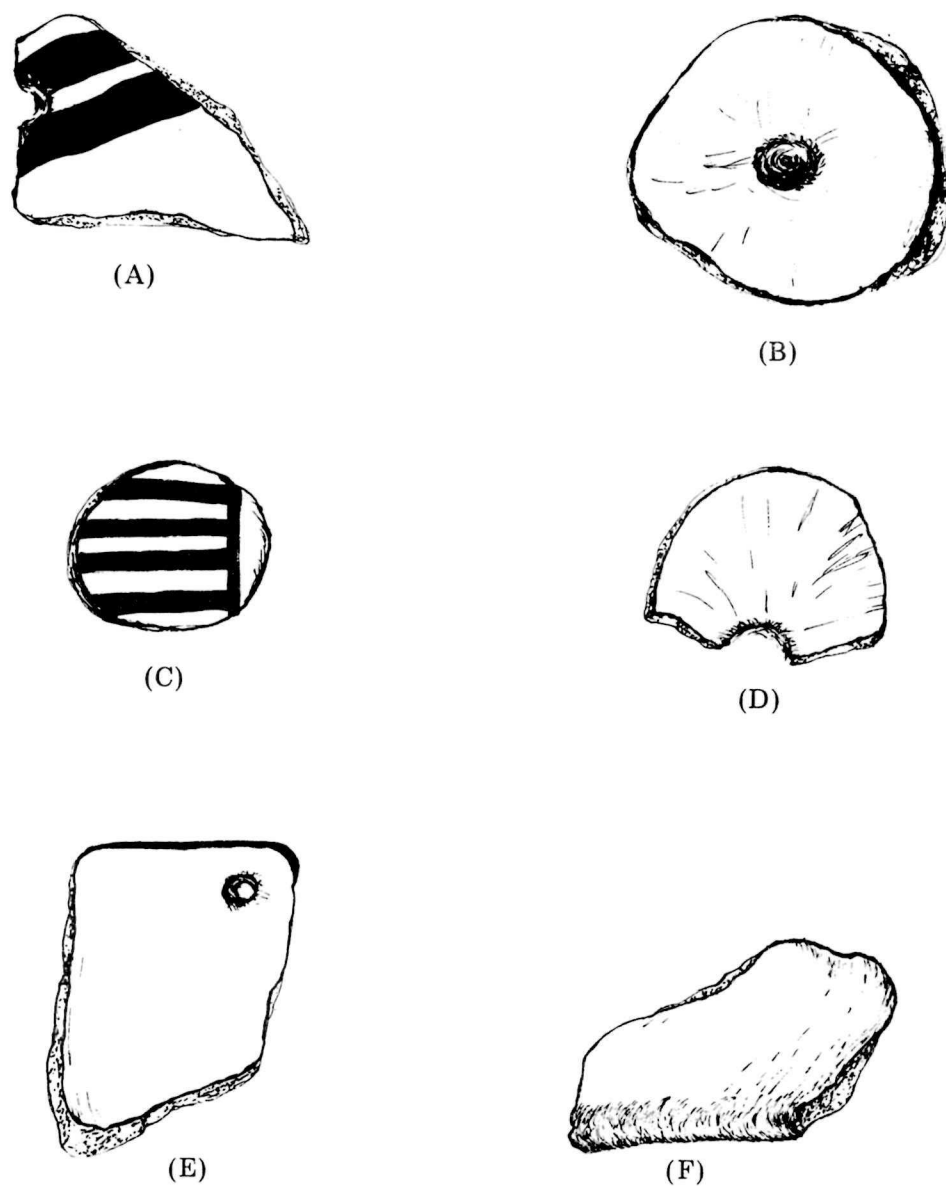


Figure 8

**ILLUSTRATION OF SIX WORKED SHERDS
FOUND AT HSR 702-1**

(D and F were located in the sample areas, the others were not)

- (A) San Andres Red on Terracotta with half a drill hole;
- (B) El Paso Brownware with drill hole. Hole was never completed, and does not penetrate sherd;
- (C) Mimbres Classic Black on White disk (approximate size);
- (D) El Paso Brownware with half a drill hole;
- (E) Playas Red rim with drill hole;
- (F) El Paso Brownware with one intentionally smoothed side.

SUMMARY OF SURFACE EVIDENCE AT FOUR NEARBY SITES

Four sites north of HSR 702-1 were quickly searched to see if any ceramic correlations could be drawn. Each of these sites was much smaller than HSR 702-1. They also lacked the high ceramic density characteristic of the larger site.

HSR 702-2

Ten random sample areas, one circular meter in area, were selected for analysis. Sherd count was as follows:

	<u>Bowl</u>	<u>Rims</u>	<u>Jar</u>	<u>Rims</u>
Jornada Brownware	3	—	13	—
El Paso Brownware	—	—	2	—
San Andres Plain	6	—	42	3 (direct)
Terracotta wares	—	—	3	—
Red Slipped ware	<u>1</u>	—	<u>—</u>	—
	10		60	

Three painted sherds were found on the site but were not in the meter sample areas. These were two San Andres Red on Terracotta jar sherds and one El Paso Bichrome jar rim.

Due to a lack of time, the other three sites were not systematically sampled; however, an effort was made to record the surface ceramic types.

HSR 702-3

An intensive survey of the site located only two sherds. These were San Andres Plain jar sherds.

HSR 702-4

This site includes a fairly dense ceramic scatter. No actual count was made but the following types were found: Jornada Brownware, San Andres Plainware, El Paso Brownware, Chupadero Black on White, and Mimbres Black on White (in apparent order of decreasing density).

HSR 702-5

Description of this site is incomplete at best. It was examined at dusk and no collection was made. All painted sherds that could be found were recorded.

	<u>Bowl</u>	<u>Rims</u>	<u>Jar</u>	<u>Rims</u>
Mimbres Black on White	16	5 (direct)	—	—
Chupadero Black on White	1	—	1	—
San Andres Red on Terracotta	2	1 (direct)	—	—
Wingate Black on Red	<u>—</u>	—	<u>1</u>	—
	20		2	

This site also contained Jornada Brownware, San Andres Plain, El Paso Brownware, and a few sherds of Terracotta. On the basis of this brief analysis, this site seems to relate closely in ceramic types to HSR 702-1.

OTHER SITES IN SOUTHERN NEW MEXICO

To provide a basis for comparison, four excavated sites were chosen for summary inclusion. These were picked because of possible similarities in function as small economic activity centers.

THE BRADFIELD SITE (Lehmer 1948)

Location: Lower Tularosa Basin, east of Las Cruces, near the present location of White Sands Missile Range Headquarters. It is on flat land in the basin floor, a few miles east of the Organ Mountains outwash plain.

Description: One 16 room adobe pueblo and a midden were excavated.

Pottery:

El Paso Polychrome	94.4%
Chupadero Black on White	0.49%
Smudged Corrugated (local)	0.25%
Three Rivers Red on Terracotta	0.5%

Along with: Gila Polychrome, Agua Fria Glaze on Red, Ramos Polychrome, Babicora Polychrome, Heshatauthla Glaze Polychrome, St. Johns Polychrome, Playas Red Incised, Mimbres Black on White, and a *Broadline* Red on Terracotta (probably San Andres). Each of these types was less than one percent of the site total; intrusives made up approximately five percent of the site total.

LA 4921, THREE RIVERS RECREATION AREA

(Bussey, Kelly and Southward 1976)

Location: Eastern Tularosa Basin, approximately one quarter mile north of Three Rivers Creek, east of Three Rivers, Otero County, New Mexico.

Description: Four occupation/use areas were excavated: a masonry structure; an outside use area; a multi-room semi-subterranean structure; and a group of inter-connected storage pits.

Pottery:

Jornada Brownware	59 %
Chupadero Black on White	23 %
Reserve/Tularosa Corrugated	5 %
El Paso Polychrome	3 %
Plain Three Rivers Red on Terracotta	2 %
El Paso Bichrome	1 %
Playas Red Textured	1 %
Red Slipped <i>Jornada</i>	1 %

Along with Three Rivers Red on Terracotta, San Andres Red on Terracotta, Pinedale Polychrome, St. Johns Polychrome, St. Johns Black on Red, Hesotauthla Polychrome, Wingate Black on Red, Puerco Black on White, Plain White Mountain Redware, Red Mesa Black on White, and Mimbres Black on White. Each of these types made up less than one percent of the site total.

LA 3135, THE HATCH SITE (Schaafsma 1964)

Location: In Dona Any County, on the bank of the Rio Grande, directly across from Hatch, New Mexico.

Description: A three component site, the earliest was a pre-ceramic Archaic site. The other two have associated ceramics and are listed separately.

Dona Ana Phase (El Paso Expression), four pitrooms suspected, three of which were excavated.

Pottery:

El Paso Polychrome	35.4%
Alma Plain	34.4%
San Francisco Red	12.7%
Chupadero Black on White	6.0%
Reserve Smudged, Plain and Corrugated	5.1%
El Paso Brown	2.6%
Jornada Brown	1.5%
Alma Fugitive Red	1.1%
Mimbres Incised	0.6%
Alma Scored	0.2%
Alma Incised	0.2%

The ceramics suggest a cultural affinity with the Western Mogollon cultural area.

LA 2579 (Green 1955; Fenenga 1956)

Location: NW¼ of the NE¼, Section 28, and SW¼ of the SE¼, Section 21, Township 1 North, Range 8 East. In Torrance County, New Mexico, approximately three miles north and three miles east of Gran Quivira National Monument Headquarters.

Description: Eight or nine possible pit houses, two of which were excavated.

Pottery:

Jornada Brownware	66.0%
Alma Plain	6.0%
Lino Gray	2.6%
San Marcial Black on White	1.3%

Traces of Three Rivers Red on Terracotta, Rio Grande Red Glaze and Tabira Black on White were found. These were not associated with the pit rooms.

The ceramics of LA 2579 indicate an affinity with the Jornada culture area. The presence of Lino Gray indicates that there was contact with the Anasazi culture area.

VII – OTHER ARCHAEOLOGICAL SITES

Site No: HSR 702-2
LA 21163

Elevation: 3990 ft.
1216 m

Location: 13SCG646264

CLD: 13.5/m²

Site Size: Approximately 3,000 m²

Ownership: WSNM

Vegetation Type: Mesquite Grasslands

Soil Type: Duneland

Slope and Aspect:

This site lies within Duneland. Overall slope of the formation is approximately 1%. The dune field slopes gradually downward to the lakebeds immediately east.

Physiographic Setting:

Along the lower or downslope edge of the Bajadan Community, fine sand and silt deposits have formed a bench which generally runs the full length of the lower foot slopes of the San Andres. This bench lies slightly above the gypsum terrace formations along the western shore of Lake Lucero. The site is located roughly in the middle of the Duneland formation, about equal distance from the lower Gypland formation and the upper gravel terraces of the bajada. It lies at the upslope (west) edge of a mesquite hummock and grass flat. A similar situation extends slightly further west of the site, but along the north site boundary the grass is in a more turf-like condition. At the west boundary of the site, erosion has lowered the surface generally about 30 centimeters, giving the location of the site a terrace-like appearance.

Present Condition:

Erosion has removed most of the soil in which the original site materials were deposited. It appears that cultural materials have been dropped in position with scattering of major elements of the original site making measurement of site features such as hearths impractical.

Site Description:

The site consists of a scatter of chipped stone detritus, ceramics, ground stone and fire-cracked rock. No evidences of structure other than hearth areas was found. The main area of the site, reflected by greatest density of cultural materials, was about 15 x 15 meters. However, cultural materials were scattered over an area of approximately 3,000 square meters to the edges of the grass flatland to the east and north of the site, and into the mesquite hummocks to the south and west.

Table 6
HSR 702-2 CULTURAL LITTER DENSITY

Sample Point	Fire-cracked Rock	Chipped Stone	Ground Stone	Ceramics	CLD
1	3	1	0	3	7
2	5	1	1	10	17
3	11	0	2	2	15
4	0	4	2	10	16
5	6	1	1	7	15
6	0	2	0	8	10
7	12	3	1	7	23
8	0	2	1	8	11
9	1	3	0	2	6
10	0	3	0	12	15
Total:	38	20	8	69	135
Mean:	4	2	1	7	13
Percent:	28	15	6	51	100

Table 7
HSR 702-2 GROUND STONE

A variety of ground stone tools and fragments were evident. An inventory of all identifiable tools and fragments was conducted.

Metate, Slab type, fragments:	4
Two Hand Mano:	1
” fragments:	3
One Hand Mano:	2
” fragments:	1
Stone Balls:	2
Schist Slab, fragments:	3

Table 8
HSR 702-2 CHIPPED STONE

Sample total inventory of 15 x 15 meter high density area:

Lithic Category	Size (cm)				Total	% Assemb.
	-2	2-4	4-10	10+		
Unutilized Flake	7	36	11		54	
Utilized Flake		2			2	
Angular Fragment						
Unutilized	2	21	4		27	
					83	

One Hammerstone of black chert approximately 10 cm in diameter.

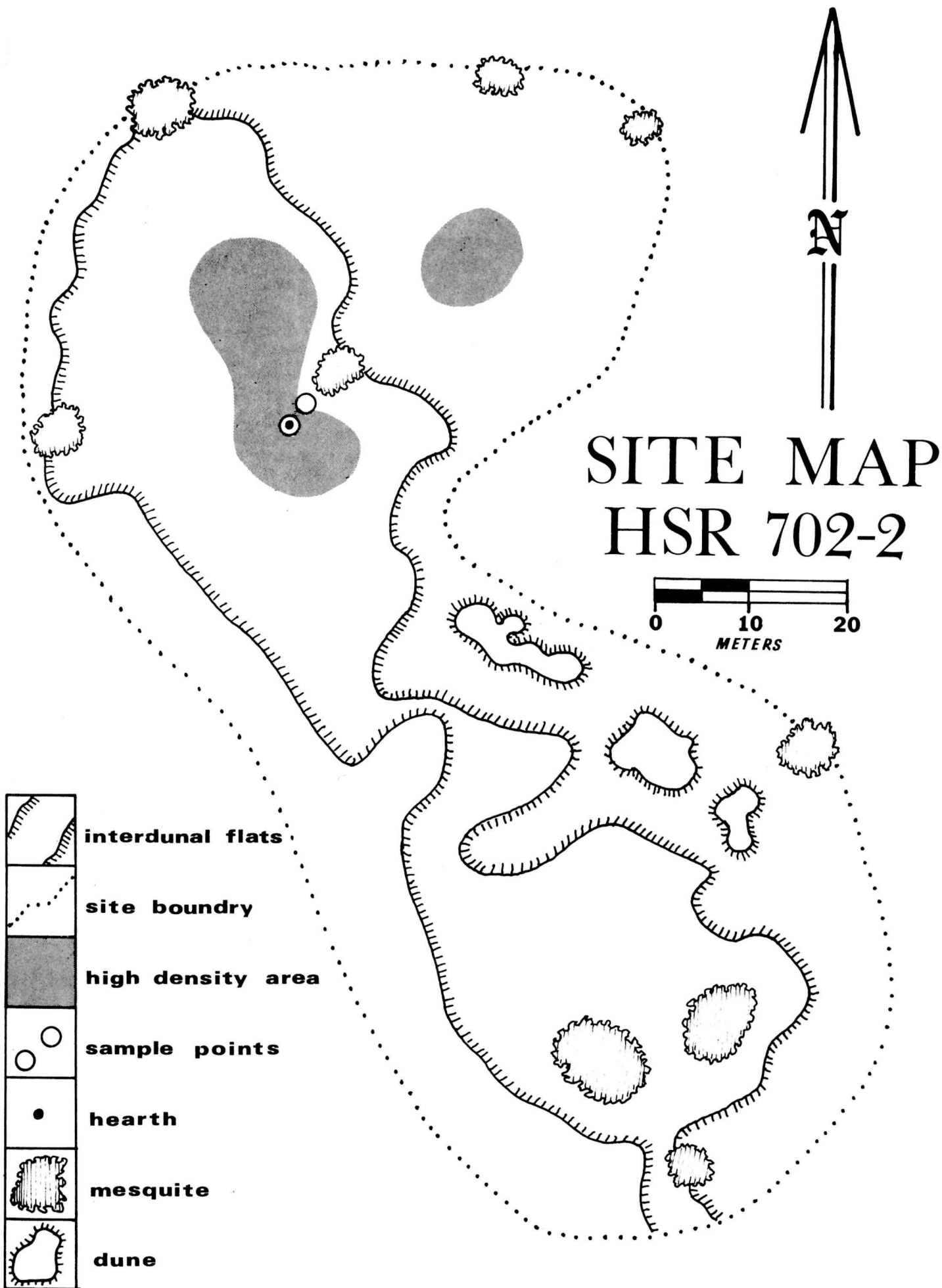
46% of the sample is white to translucent white-gray, fine-grained chert.

43% of the sample is gray, fine-grained limestone or siltstone.

5% of the sample is pink grading to brown, fine-grained, lustrous chert.

5% of the sample is black, glossy, fine-grained chert.

1% of the sample is tan-banded with brown medium to fine-grained chert.



Site No: HSR 702-3
LA 21164

Elevation: 3910 ft.
1192 m

Location: 13SCG657272

CLD: $<1/\text{m}^2$, except
one location: fire-
cracked rock occurs
at $30/\text{m}^2$

Site Size: 190 m E-W
50 m N-S

Formation: Salt flats.

Ownership: WSNM

Soil Type: Camborthids

Slope and Aspect: Toward the east with a 1% slope.

Physiographic Setting:

The site is located on the ridge crest and slightly upslope from the crest of the first major terrace, just above the elevational drop to the floor of Lake Lucero.

Present Condition:

The gyp and alkali hardpan of the ridge structure is exposed in blowouts throughout the site area. Wind erosion appears to have been the primary agent of this erosion, but sheet erosion by water flowing across the terrace toward the edge of Lake Lucero has probably aided this process.

Site Description:

Actual site occupation appears to have been on the leeward side of a small ridge in the last major terrace above Lake Lucero. The site apparently consisted of several hearth locations in the protection of this ridge. Six areas of fire-cracked rock grouped in areas of approximately ten meters or less each. Erosion has thinly scattered the remains of rock-lined hearths. In one case, two concentrations of fire-cracked rock occupied areas of less than 1.5 meters. Small fragments of fire-cracked rock were scattered throughout the measured site area. Only one chipped stone tool was found--the base of a drill. No ground stone and no ceramics were found.



Photo 40: This light scatter (702-3) was exposed in a blow area among the low sand dunes of the first (lowest) alluvial terrace.

Site No: HSR 702-5, THE HUNTINGTON SITE Elevation: 4000 ft.
LA 14820 1219 m

Location: 13SCG612372 CLD: 177/m²

Site Size: Approx. 420,000 m²

Ownership: High density areas in the Huntington Site lie just outside the western boundary of WSNM, in White Sands Missile Range. Portions of lower density areas extend to the east of the main concentration of cultural materials, into the national monument.

Vegetation Type: Grasslands and Bajada Desert shrubs.

Soil Type: Camborthids and Torrifluvents.

Slope and Aspect: <1%, East.

Physiographic Setting:

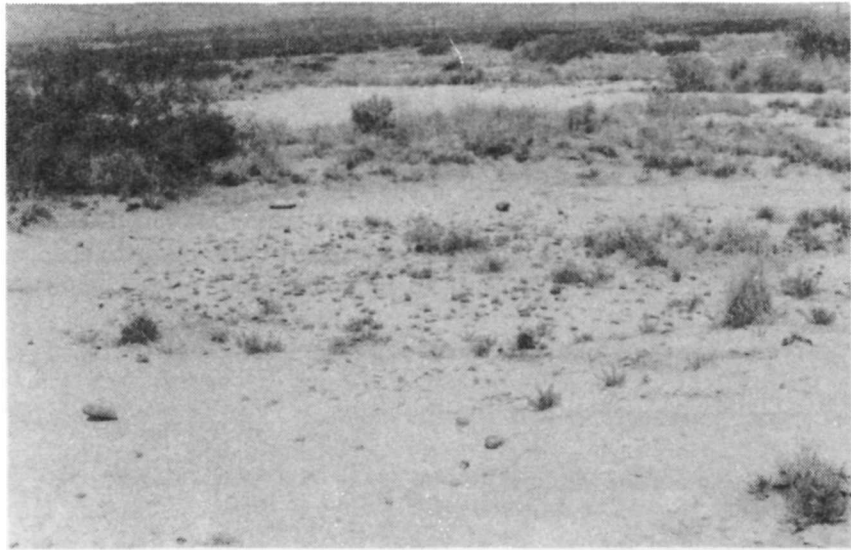
. . . . on the lonely western side of the Otero [Tularosa] Basin, not far from the western shore of one of the saline playas, whence the gypsum of the White Sands is collected by the wind. Here in a distance of 30 miles and perhaps more, the only inhabited place in 1911 was Beard's [Baird's] Ranch, where a sadly diminished stock of cattle is still cared for. Four and a half miles north of the ranch two good-sized canyons, named Dead Man and Lost Man, emerge from the San Andreas Mountains and together form a great fan of gravel and other alluvium. At the lower edge of this, traces of a large village are found. The ancient village covered an area about half a mile in diameter, thickly inhabited in the middle, and with a gradually decreasing number of houses toward the edges. In two distinct central areas pottery is so thickly strewn that one crushes it at every step; in places it is literally so thick that it is almost impossible to put one's foot down without touching it.

—Elsworth Huntington, 1914



Photo 41: This hearth is typical of the exposed features on the Huntington site.

Photo 42: An exposed concentration of firecracked rock may represent the remains of a structure on the Huntington site.



Present Condition:

The Huntington Site has already been subject to both artificial impact, the construction of a WSMR instrumentation site, and natural impact from surface erosion. However, a large portion of the remains continue to be relatively undisturbed.

Site Description:

The Huntington Site is a large pueblo village along the west shore of an unnamed salt playa and alkali flat in the Tularosa Basin, Dona Ana County, New Mexico. This site comprises a large area (approximately 420,000 m²) of densely distributed ceramics, lithics, and other imperishable materials. Although evidence of structures is today blurred by heavy erosion, this site undoubtedly represents a large sedentary village from the ceramic period.

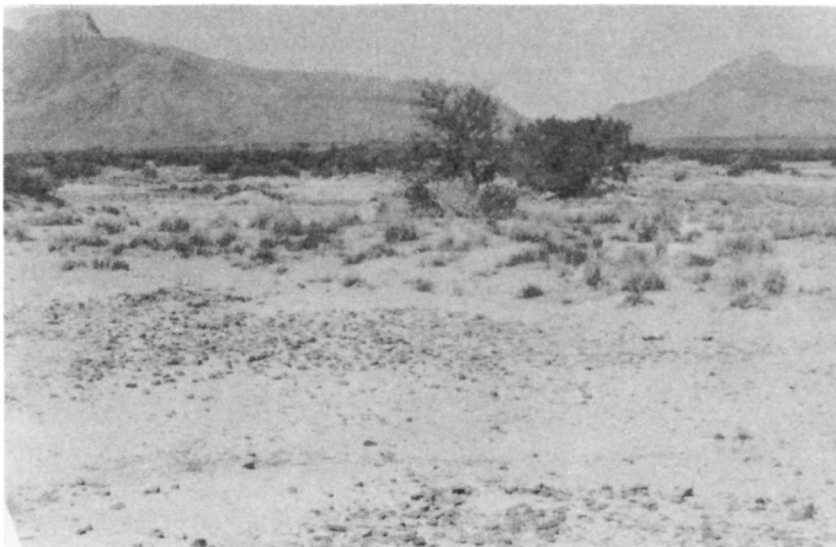


Photo 43: Scatters like this one are all that remain of what Huntington described as *houses* when he visited this site in 1914.

Table 9
HSR 702-5, THE HUNTINGTON SITE
CULTURAL LITTER DENSITY

	Sample Point					Total	(x̄) Mean	Percent
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>			
fire-cracked rock	37	35	8	35	27	142	28	16
chipped stone	16	41	7	38	28	130	26	15
ground stone	2	4	0	2	0	8	2	1
undecorated brownware	72	181	51	278	6	588	118	66
decorated brownware	0	1	0	0	0	1	—	0.1
undecorated white ware	0	0	0	3	0	3	—	0.3
decorated white ware	3	3	3	4	1	14	3	2
hammerstones	0	2	0	0	0	2	—	0.2
Cultural Litter Density:	130	267	69	360	62	888	177	100

DISCUSSION OF CLD AT THE HUNTINGTON SITE

Although the CLD recorded at the Huntington Site is generally comparable to those at the Lucero Lake Site and at other large villages across the Tularosa Basin, two factors are of particular note. First, both the mean (177 items/m²) and the maximum (360 items/m²) CLD are the highest thus far recorded within the Tularosa Basin. Large pueblo village sites seldom average densities greater than 100 items per square meter, usually ranging nearer 50 items per square meter.

Secondly, all but one sherd (identified as Chupadero Black on White) of decorated white ware identified on the main portion of the site were classified as Mimbres. Other sites along the western side of the basin demonstrate a similar high density of Mimbres sherds, and these wares are not uncommon on sites in the Three Rivers Drainage. These high frequencies strongly suggest that Mimbres wares may have been manufactured at Tularosa Basin sites; most authors, however, still consider sites in the basin as the Jornada Branch of the Mogollon distinct from the Mimbres Branch, and restricted to the west of the Rio Grande. Brody (1977) dismisses Breternitz's (1966) contention, that Mimbres Black on White is indigenous at Three Rivers, as impressionistic. Until now, little archaeological research has been conducted on the west side of the Tularosa Basin. Sites previously investigated on the east side were commonly restricted to the El Paso Phase. Recent evidence at Three Rivers (Wimberly and Rogers 1977) and from this survey, however, tend to lend weight to Breternitz's argument for a Mimbres occupation in the Tularosa Basin. However, preliminary evidence from the ceramic study of the Lucero and Huntington Sites suggests a somewhat earlier date for the occupation (probably at least 100 possibly as much as 200 years earlier than the 1340 dates from Three Rivers).

VI – PATTERNS OF HUMAN ACTIVITY IN THE BAJADAN COMMUNITY

Production is low in the arid basin floor and its margins, the bajada. Human populations have repeatedly exploited a variety of resources adapted to this harsh, dry environment. The earliest groups (Folsom) identified in the Tularosa Basin probably continued hunting big game (primarily now-extinct species of bison) after the open plains to the east had become incapable of supporting late Pleistocene woodland conditions. As gradual dessication continued, these woodland communities were displaced upward into the higher and cooler terrain, and the true desert was born. Populations of large mammals, such as bison, elk and deer, became restricted to the surrounding mountains, and the Paleo-Indian hunting traditions were eclipsed by more generalized hunting and gathering traditions collectively known as the Desert Archaic.

Archaeological evidence for the Paleo-Indian period is sparse throughout the Southwest. Temporary camps and kill sites, marked only by occasional stone tools and the debris from stone tool manufacturing, are the only clues left to reconstruct the past. In the Tularosa Basin these locations are commonly found near now-dry playa lakes which dot the basin floor, watering holes that once attracted hunters in search of game.

To date, no evidence of these early hunters has been found within the dunes and dry alkali lakes of the White Sands.

Shortly before the dunes began to form, the flats surrounding the dwindling Pleistocene Lake Otero (Lucero's much larger ancestor) must have supported plant communities essentially similar to those present on the desert flats today. As the dunes grew in size and began to travel before the wind, they overwhelmed and buried all but about eight species out of approximately 128, whose descendents still occupy the nearby flats.

—Sumner 1969:3

White Sands National Monument
Natural Science Study Plan—WSNM

During this period, the features associated with the sands may have been the only desert locations within the basin, while most of the surrounding territory may have been grassland savannah and woodland offering substantially more resources (Van Devender 1976). Undoubtedly, these early hunters passed within the vicinity, but may never have had occasion to penetrate into White Sands for a sufficient period to leave visible evidence.

As the desert biotic communities expanded across the basin floor, seasonality involved in the exploitation of plant food resources increased. With this increased seasonal availability, the importance of low desert species represented on the leading parabolic dunes was magnified. Species such as Indian rice grass and Yucca, common

to the dune areas, mature much earlier than plant species at higher elevations, due to a longer growing season. It is possible that, on a seasonal basis, resources available during late spring and early summer, played a critical role. Food supplies stored for enduring the cold winter months may have reached a deficit by early spring, encouraging Archaic groups to exploit those resources which matured in early summer at low elevations. Single and multiple hearths, in association with stone tools and lithic debris thought to be remains of plant processing activities, are scattered throughout the dunes. The evidence suggests that this pattern continued through the Pueblo period.

Although the domesticates corn and beans were introduced into the area as early as 4,000 years ago, intensive agriculture was not practiced until 2,000 years later. Yet, early agriculture, in its rudimentary form, was the harbinger for the population growth and sedentary living which was to follow. Large villages, attributed to ceramic-bearing peoples referred to in the literature as the *Mogollon*, came into being. Their remains are in the vicinity of major canyon drainages. The Lucero Lake and Huntington sites are typical of such intensive agricultural efforts in the vicinity of White Sands.

For the first time, the human species began to exert a direct impact on the fragile desert ecology of the Tularosa Basin. The invasion of mesquite and creosote in the bajada, commonly attributed to historic ranching practices, was probably encouraged by agricultural practices during this earlier prehistoric period. Mesquite, in particular, is easily collected and stored, and probably constituted a major food resource throughout prehistoric times.

The gathering and transport of mesquite beans to base camps and villages for consumption and storage may account for the wide distribution of this species. Today, mesquite is found throughout the basin floor and extends well into the higher elevations, in part due to the spread of the species by cattle.

Presumably, the combined effects of erosional degradation of the surface and a general drying trend eventually hampered agricultural pursuits. Sometime around A.D. 1400, agricultural village locations were abandoned.

The period that follows constitutes a gap in the archaeological record. No direct evidence of human occupation in the basin between A.D. 1400 and the arrival of the Apaches in the 1500's has been found thus far. Chronicles of Spanish explorers traveling up the Rio Grande record the presence of aboriginal groups in the montane regions north of El Paso and east of the Rio Grande, but no mention is made of the Tularosa Basin farther east.

Aside from the seasonal camps of Apachean groups (Schroeder 1973), little evidence of sedentary occupations occurs in the Tularosa Basin until the establishment of settlements at the mouths of La Luz and Tularosa Canyons in the early 1860's. This reoccupation by sedentary populations differs in one major aspect from previous *Mogollon* agricultural adaptations. This factor was the introduction and rapid expansion in cattle ranching, a feasible alternative to agriculture in areas lacking sufficient moisture. By the turn of the century, it is clear that cattle operations had breached the carrying capacity of available grazing lands in the basin. A series of drought years, common for the area, inflicted severe economic losses as well as furthering degradation of the desert environment through overgrazing.

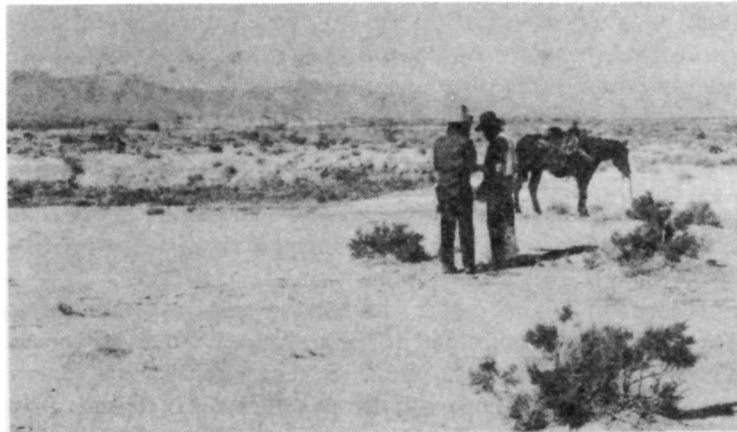
Acquisition of the majority of the basin floor for military purposes effectively put an end to subsistence activity in the White Sands area. The core of the dunes and associated features now serve an expanding tourist market, as do most of the surrounding communities which also house and support military personnel. Although economic and population growth has been substantial, only a minute fraction of the population is involved in subsistence activities. The chief asset of the desert for current space and missile testing efforts lies in its vast and largely uninhabited expanse and will remain so until future population growth forces a reintroduction of subsistence economics into the area.



Photo 44 (left): Deflated and exposed hearths like this one were occasionally encountered among the low sand dunes of the bajada.

Photo 45 (center): Small surface scatters of lithics and ceramics were encountered along the margins of open flats scattered between the dune fields of the lower bajada.

Photo 46 (bottom): This and other broad flat areas suggested the remnants of developed and leveled agricultural fields.



IX – SUMMARY OF THE BAJADAN RECONNAISSANCE

The Lucero Lake and Huntington sites represent large areas of intensive occupation. The presence and nature of any associated structures, whether pithouses or adobe surface structures, however, remains inconclusive. Such structural remains may have already been destroyed by erosional processes which have severely deflated cultural deposits, especially at the Lucero Lake Site. A practical solution to this problem would require either extensive excavation, or detailed analysis of high quality aerial photographs, combined with other forms of remote sensing and ground truth testing (described by Lyons and Scovill 1978). The latter techniques are undoubtedly the least costly and would also be suitable for location and analysis of large features, such as field and irrigation networks, which are often imperceptible at the ground surface.

The frequencies of decorated pottery types at both sites suggest a significant relationship with cultural groups identified as Mimbres across the Rio Grande to the west. The nature of this relationship is uncertain at best, but data from Three Rivers, east, across the basin floor, indicate that such a relationship was by no means unusual or confined to just the west side of the Tularosa Basin. Although cultural materials on the Lucero Lake Site are highly fragmentary, no significant difference in material culture was evident in comparison to so-called *Classic Mimbres* sites.

The time period represented by both sites is equally uncertain. Few sites in the Tularosa Basin have been securely dated. Dates for pottery types represented at these sites are based almost solely on tree-ring samples from Three Rivers and the true context and association of these samples is by no means clear.

Subsistence practices at the national monument locations probably included both agricultural pursuits and the exploitation of native species, including mesquite. However, strong similarities in processing tools utilized in both activities preclude a definitive answer without supplementary evidence derived from pollen and other floral remains contained in the deposits.

In addition to the large sedentary village locations, several other kinds of sites were located in the Bajadan Community: 1) large area, low density scatters of ceramics and fire-cracked rock occur in two locations along major drainages which cross the bajada; 2) small, non-ceramic hearth sites are found at the lower ends of the major drainages as they enter the alkali flat; 3) small localized hearth sites with ceramics and lithic materials are located along the upper edges of sandy soils which occur in a bench formation just above the Lake Lucero bottomland; and 4) sizeable non-ceramic hearth sites occur at several locations along the leading edge of the highest major lake terrace overlooking Lake Lucero and the alkali flats.

A preliminary interpretation of the bajadan evidence would suggest that a late Archaic occupation at a limited number of gathering locations is represented by the non-ceramic terrace sites. Smaller sites and isolated artifacts along the lake-shore are, perhaps, special use locations of this time period or later (or represent

transient camps). Ceramic period sites along the upper edge of this terrace may represent a later use of the same resource area. Very large, but thinly scattered ceramic period sites appear on the major drainage courses, and may be the remains of prehistoric field areas associated with the large ceramic period village locations.

X – SUMMARY OF ARCHAEOLOGICAL RESOURCES LOCATED WITHIN WSNM

In the *White Sands Natural Studies Plan*, six major biotic and physiographic community units have been mapped. On the basis of these field studies, two of these community units are expected to contain the greatest majority of archaeological sites within White Sands National Monument.

1. *The Bajadan Community* occurs along the extreme western edge of the monument, on the broad, sloping plain at the foot of the San Andres Mountains. It is characterized by: a) Creosotebush; b) Mesquite, which grows in large hummocks of wind-blown granitic sand that has been compacted around the roots and basal portions of the plants; and c) Four-wing saltbush. Sites in this community are considered in the bulk of this report.
2. *The Parabolic Dune* area on the eastern and southern margins of the monument is composed of dunes that have been insufficiently replenished with wind-blown sand, or have been slowed up by encroaching plants, or a combination of both. There, the *Pioneering Eight* (see plant list, this report) dominate, *and are accompanied by the greatest variety of plant and animal life in the Monument*. This is the Sumac-yucca zone of Blair and earlier authors (Sumner 1969). A sample of this community was surveyed by HSR during 1973.

ARCHAEOLOGICAL SITES OF THE PARABOLIC DUNES AND DUNE MARGINS

The Parabolic Dunes, especially along the dune margins, support the greatest biotic diversity within the basin floor area. The combination of high water table and long growing season (average frost free season at White Sands Missile Range Headquarters, based on 22 years of climatological data, is 251 days) support approximately one hundred modern floral species. Eleven of the species recorded in this area have been noted previously as food sources for aboriginal peoples in the Southwest (see Table 10). The wealth of edible resources in this region was not ignored by the aboriginal occupants of the Tularosa Basin. The characteristic migrating dunes of this community would preclude agriculture. The exploitation of natural resources (biota previously adapted to the eco-unit) would be the most efficient adaptation by human populations. This type of broad spectrum exploitation of natural resources suggests that the region of the dune margins would be a valuable location only for brief periods during peak production of natural resources. Periods of occupation for such highly specific purposes result in archaeological sites which reflect this limited use.

Eighteen Sections, or approximately 28 percent of the total land area of this community falling within the boundaries of White Sands National Monument, were

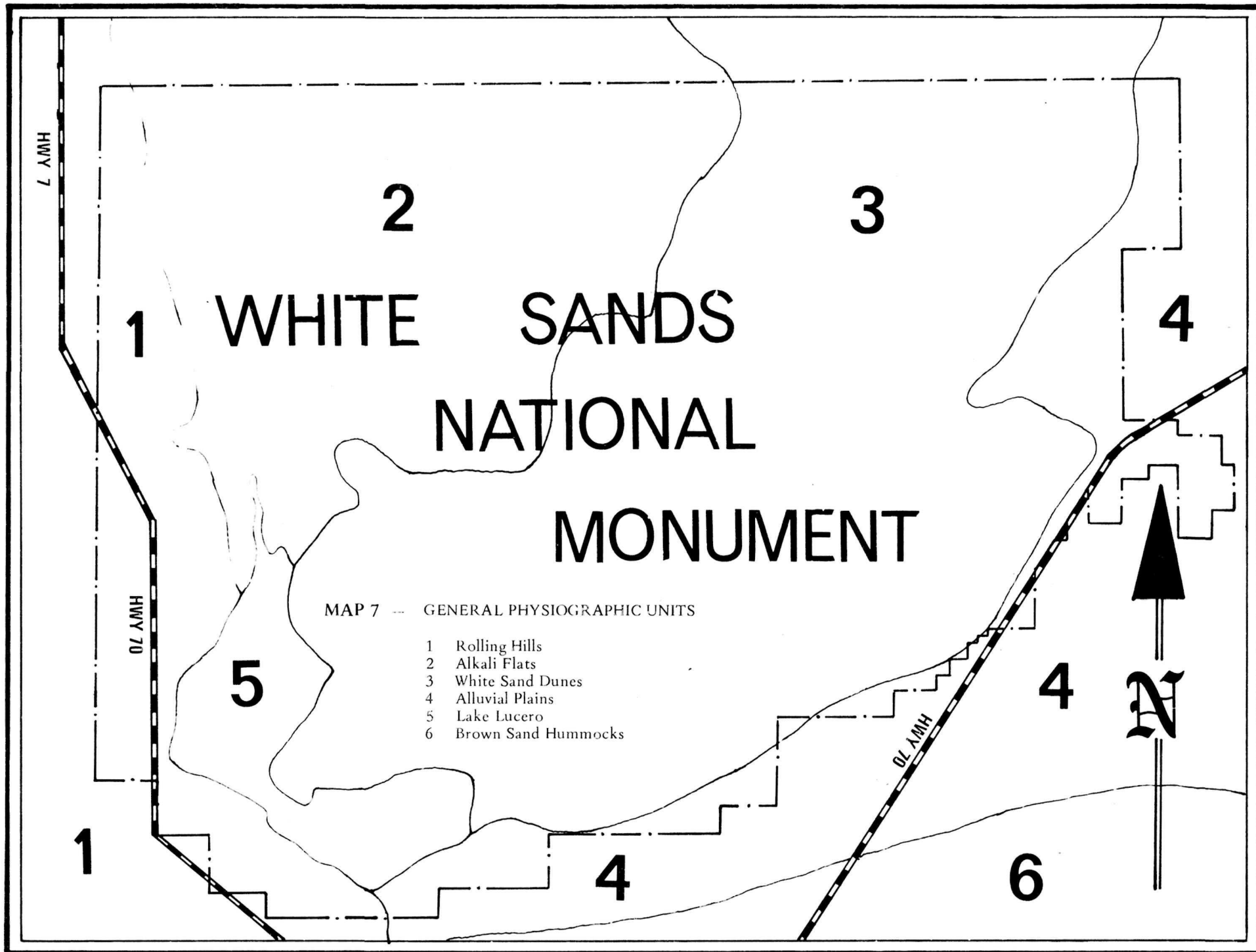
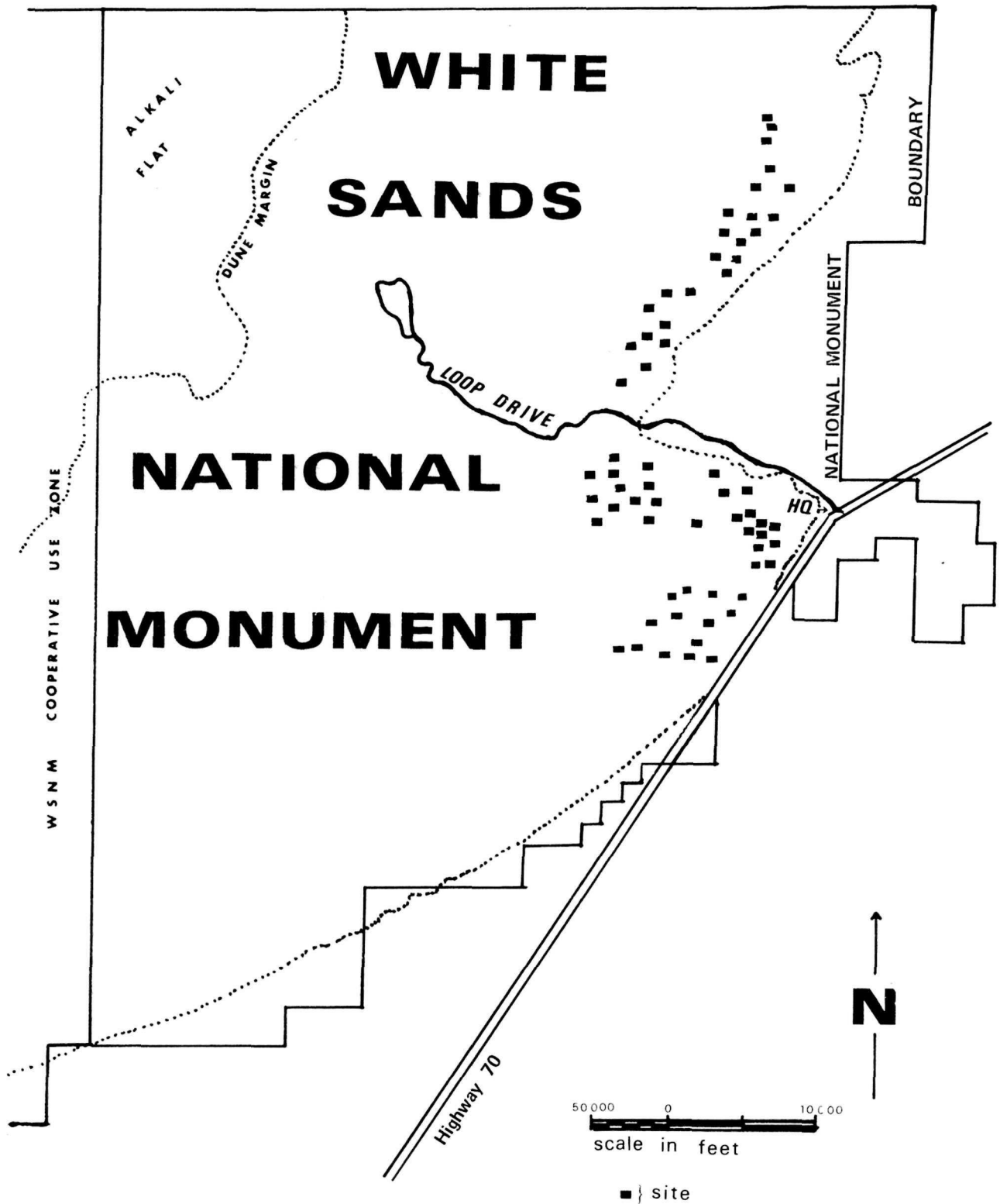


Table 10
**FLORAL SPECIES INDIGENOUS TO WHITE SANDS NATIONAL MONUMENT
 RECOVERED IN THE ARCHAEOLOGICAL DEPOSITS AT FRESNAL SHELTER**
 (Compiled from HSR, 1973)

<u>Species</u>	<u>Portions Recovered</u>	<u>Preparation and Use</u>
*Broadleaf yucca (<i>Yucca bacatta</i>)	leaves, seeds	
*Narrowleaf yucca (<i>Yucca elata</i>)	leaves, seeds	Yucca leaves were used in the manufacture of sandals, thongs and cordage. Seed pods were both roasted and boiled before consumption. Yuccas were used for a greater variety of materials than any other plant species recovered at Fresnal.
*Indian Rice grass (<i>Oryzopsis hymenoides</i>)	seeds	
*Dropseed (<i>Sporobolus sp.</i>)	seeds	
*Alkali sacaton (<i>Sporobolus airoides</i>)	seeds	Edible grass species were generally parched and winnowed to recover the seeds prior to consumption. Other species were utilized in the manufacture of matting. No parts other than the fully processed seeds recovered at Fresnal.
*Squawberry (<i>Rhus trilobata</i>)	pits	Fruit was eaten fresh and may have been brewed into thirst-quenching lemonade-like drink.
*Four-wing saltbush (<i>Atriplex canescens</i>)	seeds, parched fruit	Very hard seeds, probably parched, boiled and ground into meal.
*Mesquite (<i>Prosopis juliflora</i>)	endocarps, pod segments	May have been major dietary staple at Fresnal. Inner bean may have been shelled, parched and stored for later use.
Creosotebush (<i>Larrea tridentata</i>)	fruit, leaves, branches	Major use may have been as a fuel resource and material for manufacture of atlatl foreshafts.
Ocotillo (<i>Fougeria splendens</i>)	stem	Fuel source.
*Gourd (<i>Cucurbita foetidissima</i>)	split seed and rind	Only seeds of wild gourd species are edible. These were removed from the rind, roasted and eaten.
*Sunflower (<i>Helianthus</i>)	seeds	Seeds were roasted and eaten.

* denotes species utilized as food

MAP 8
SITES OF THE PARABOLIC DUNE MARGINS
LOCATED DURING THE 1973 RECONNAISSANCE



preliminarily examined during a 1973 reconnaissance. Prehistoric mounds had been recorded previously by the monument staff in two of the Sections examined. Field examination of these mounds indicates that they do not actually correspond to the normal definition of archaeological sites which, through repeated occupation of the same location, have built up *tells* of cultural material. Rather, most mound sites within the Parabolic Dune area represent single occupations. Only three of the 65 sites recorded in this community offer stratigraphic evidence of multicomponent occupation.

A unique characteristic of the gypsum dunes themselves has resulted in the mound appearance of prehistoric human occupations in this area. When gypsum is subjected to the comparatively intense heat of a cooking hearth, the resulting crude anhydrate forms a rather impure *Plaster of Paris*. If moisture is added to this altered gypsum prior to erosion, the result is a natural *cast* of aboriginal hearth areas. One hundred thirty (130) of these naturally stabilized hearths were recorded in a fifty percent sample of the 65 sites recorded during the 1973 reconnaissance. Individual hearths range from two to eighteen feet in diameter, and from approximately six inches to two feet in depth.

At least three major time periods are represented in the stabilized hearths of this community. The earlier hearth sites yield artifacts comparable to the *Archaic* tools found in the deposits at Fresno Shelter dated ca. 4,000—2,000 years ago (HSR 1973a). Fifteen of the sites sampled along the Parabolic Dune margins yielded pot sherds, suggesting that these sites date from the Pueblo periods of at least 1,200 to 600 years ago. Apache camps of the last 200 years have been historically recorded in the area. It is extremely difficult to distinguish sites reflecting the early *Archaic* adaptations from those of the much later Apache occupations without extensive artifactual material and, preferably, some means of absolute dating. Physical characteristics of 32, or approximately 50 percent, of the 65 sites recorded in the Parabolic Dunes are compared statistically in Table 11. Only the most general site characteristics were considered.

Graphs based on the number of hearths per site and maximum dimension of the stabilized hearth sites given in Table 12 yield bimodal curves. Eighty-eight percent of the 32 sites sampled average approximately 25 feet in greatest dimension, and contain from one to six hearths. Three sites in this sample form the second mode. They average 117 feet in greatest dimension and contain from 12 to 14 hearths. The bimodal distribution of site sizes in this sample of similarly preserved sites occurring in the same biotic community suggests: a) *repetitive use* of only a few sites *through time*; b) *differences in the adaptive strategies* practiced by the occupants of some of the sites; and, perhaps, c) both *time differences* and differences in adaptive strategies.

No significant contrasts in this data separate the hearth sites with pottery from those without pottery. This would imply that a similar adaptive strategy was practiced during several periods of the human occupation of the White Sands.

The largest site in the Parabolic Dunes sample is 150 feet in greatest dimension and contains 14 surficial hearths (WSNM 5 — Table 11). The eroded cross-section of this hearth area exposed two distinct occupation levels. The site contained no pottery. Lithics associated with this site are believed comparable to the tools from the *Archaic* occupations of Fresno Shelter, suggesting an early time reference.

The greatest number of exposed hearths (23) occur on a site 90 feet in maximum dimension (WSNM 15 — Table 11). The eroded cross-section of this site also reveals two distinct levels of occupation. Pottery is associated with at least the exposed hearths at this site.



Photos 47 and 48: Sites of one to twenty-three hearths stabilize the lee side of prehistoric Parabolic Dunes.

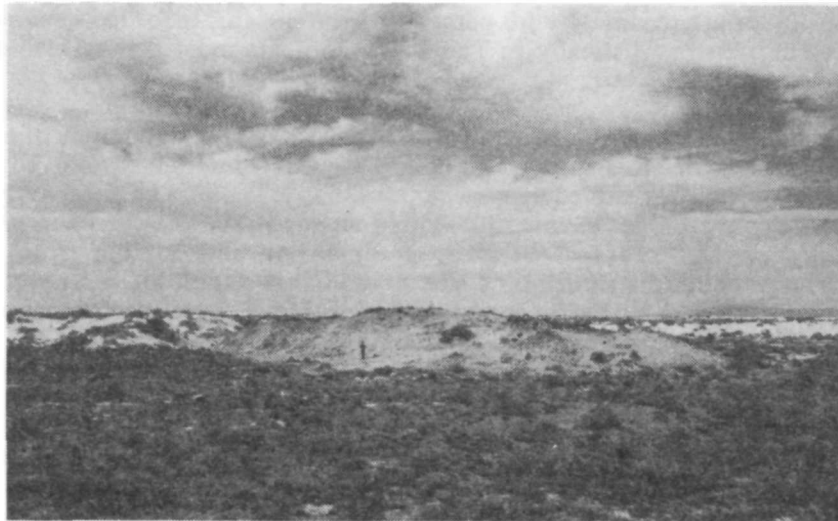


Table 11
LIST OF SITES RECORDED IN THE PARABOLIC DUNE MARGINS

<u>Site No.</u>	<u>No. Hearths</u>	<u>Maximum Dimension</u>	<u>Lithics</u>	<u>Pottery</u>	<u>Stratified</u>
WSNM 1	3	30 ft.	+	+	—
WSNM 2	1	10 ft.	+	+	—
WSNM 3	4	40 ft.	+	+	—
WSNM 4	1	30 ft.	+	+	—
WSNM 5	14	150 ft.	+	—	+
WSNM 6	2	15 ft.	+	—	—
WSNM 7	2	15 ft.	+	—	—
WSNM 8	1	6 ft.	+	—	—
WSNM 9	2	20 ft.	+	—	—
WSNM 10	1	25 ft.	+	—	—
WSNM 11	2	20 ft.	+	—	—
WSNM 12	2	25 ft.	+	—	—
WSNM 13	1	15 ft.	+	—	—
WSNM 14	2	50 ft.	+	—	—
WSNM 15	23	90 ft.	+	+	+
WSNM 16	4	30 ft.	+	+	+
WSNM 17	1	15 ft.	+	+	—
WSNM 18	2	25 ft.	+	+	—
WSNM 19	5	30 ft.	+	—	—
WSNM 20	6	35 ft.	+	—	—
WSNM 21	3	30 ft.	+	—	—
WSNM 22	1	25 ft.	+	—	—
WSNM 23	1	40 ft.	?	?	?
WSNM 24	4	40 ft.	+	—	—
WSNM 25	12	100 ft.	+	—	—
WSNM 26	4	30 ft.	+	+	—
WSNM 27	1	3 ft.	+	+	—
WSNM 28	2	15 ft.	+	+	—
WSNM 29	1	5 ft.	+	+	—
WSNM 30	3	15 ft.	+	+	—
WSNM 31	5	60 ft.	+	+	—
WSNM 32	14	100 ft.	+	+	—



Photo 49: A single component hearth,
example of the *cast* effect of burning gypsum.



Photo 50: Superimposed hearths are apparent
in three of the sixty-five sites recorded in the Parabolic Dunes.

Table 12
SUMMARIZED CHARACTERISTICS OF HEARTH SITES
WITHIN THE PARABOLIC DUNES

	Mean ($\bar{x}$)	Standard Deviation	Number	Range
Number of Hearths:				
All sites	4.06	4.94	32	1-23
Per site without pottery	3.75	3.91	16	1-14
Per site with pottery	4.60	6.05	15	1-23
Maximum Dimension (feet):				
All sites	35.59	32.33	32	3-150
Sites without pottery	37.56	36.91	16	6-150
Sites with pottery	33.20	29.03	15	3-100
Sites with one hearth	17.40	12.21	10	3-40
Sites with one hearth without pottery	17.75	9.14	4	6-25
Sites with one hearth with pottery	12.60	10.78	5	3-30
Mode 1: 1-6 hearths	24.96	13.46	28	3-60
Mode 2: 12-14 hearths	116.67	28.87	3	100-150
Total number of hearths, all sites — 130				
Total number of hearths, sites without pottery — 60				
Total number of hearths, sites with pottery — 69				

Several generalizations concerning this data are possible:

1. Sites in the Parabolic Dune community suggest that human occupation of the area is of considerable antiquity (ca. 4,000 years at least);
2. No significance is found in the comparison of differences in the characteristics of sites with and without pottery, suggesting that subsistence practices changed very little through time;
3. The apparent bimodality of site size suggests a difference in human behavior, but this difference does not appear to relate to time.

The stabilized dune hearth sites found in the east and south marginal dune areas are *natural casts* of temporarily utilized seasonal hearths and do not occur outside the special conditions offered by the gypsum dunes of White Sands National Monument. The excellent *in situ* position of artifactual and other cultural material, together with the preserved, carbonized floral and faunal remains to be found in these stabilized hearths, present an opportunity to examine in detail a phenomena seldom available in other locations, at least 4,000 years of specialized use of a single biotic community.

Artifactual evidence preserved in the stabilized hearth mounds suggests that direct ties may be made with some of the other limited use sites on White Sands National Monument and, in some cases, with contrasting seasonally occupied sites within the local region. Specifically, floral and faunal data from the Archaic occupations of Fresnal Shelter, fifteen miles to the east, suggest that this site was occupied seasonally within the months of June to October. Preserved plant remains in the shelter include numerous examples of *processed* Indian rice grass (*Oryzopsis hymenoides*), a species quite common at White Sands National Monument. This plant does not occur in the biotic communities local to Fresnal Shelter. Material representing the complete processing of species of *Gramineae* local to Fresnal, have also been recorded in the deposits. This evidence would indicate that rice grass was gathered and processed at some other special use, seasonally occupied location. A detailed

examination of the sites along the margins of White Sands would be of great value in an analysis of the seasonal patterning of human adaptive strategies in this arid environment.

OTHER KNOWN AND SUSPECTED SITE LOCATIONS WITHIN WHITE SANDS NATIONAL MONUMENT

Three major areas in White Sands National Monument were not examined during the present reconnaissance. In two of these areas, the national monument staff has reported limited amounts of prehistoric cultural material.

One of these locations, *Section 21, Township 17 South, Range 7 East* (Archaeological artifacts stored by Naturalists Office, WSNM), consists of a concentration of fire-cracked rock (no pottery or artifacts) and is an example of human use of the central dune area. The constantly changing physiography of the central dune area, a region of fast-moving, high dunes, precludes the support of flora and, thus, fauna is rare. It is presently expected that the central dune region was not normally a location for broad scale subsistence exploitation. It is predicted that locations of cultural material in this region of WSNM will fall into categories of extremely specialized use. Examples should indicate: overnight transient camps, temporarily occupied kill site locations, and isolated finds of finished tools lost during hunts or cross-country movements.

A portion of the *Parabolic Dune* unit not examined during the survey of the dune margins occurs along the east and northeast margin of Lake Lucero. The proximity of dune margin communities and aquatic flora and fauna associated with ephemeral lakes and marshes suggests that this area may have been capable of supporting limited occupations in the past. This possibility should be given special attention when considering the possible locations of sites during Pleistocene times.

The major portion of the *Embryonic Dune* unit lies directly adjacent to the desolate Alkali Flat and Lake Lucero and parallels to the west the Brachen and Transverse central dune area. There is very little in this region presently that would attract the occupation of man. However, a small unit of Embryonic Dunes does occur along a portion of the eastern shore of lower Lake Lucero playa and marsh area. This area should be given the same consideration as the portions of the Parabolic Dune unit falling along the same ecotonal boundary.

The *Alkali Flat*, a Pliocene (and perhaps earlier) lake bottom presently almost totally devoid of life, is an area comparable in physiography to the Bonneville Salt Flats in Utah. Only the most unique of events would have brought prehistoric man to this area. Two examples of this occurrence are the discovery of the Spanish carreta parts near the northeastern margin of the Alkali Flat at the northern monument boundary (presently in the Museum at WSNM Headquarters), and the occurrence of large selenite crystals (which most probably originated from the east margin of the Alkali Flat) in late ceramic period village locations along the eastern margins of the Tularosa Basin and as far south as the El Paso area.

Only about eight percent (8%) of the total White Sands National Monument land area is included in what Sumner (1969) has called *Broad Plain or Valley Fill*. This area lies along the eastern and southern margins of the dune field. It was not examined during either reconnaissance. However, a site of the Cody Complex (dated approximately 7 to 8 thousand years ago) has been reported in a similar physiographic and biotic situation, four miles east of the monument headquarters near Holloman Air Force Base (HSR 1973b). The playa areas in the vicinity of Garton Lake (a modern artificial pond in the southeast corner of the monument), as well as the gypsum ridges in the vicinity of Lost Creek at the northeastern monument boundary, could produce similar evidence of the activities of Pleistocene human activities.

XI – SIGNIFICANCE OF CULTURAL RESOURCES, WSNM

This and a previous general assessment have located and described two types of cultural resources which should be regarded as significant and of potential National Register status. The stabilized hearth sites scattered throughout the Parabolic Dunes are as unique as the White Sands themselves. The Lucero Lake and Huntington sites represent the largest Mogollon villages documented on the west side of the central Tularosa Basin and, although other large sites undoubtedly exist, both sites are worthy of preservation and further research.

The numerous hearths and processing sites within the leading dunes appear to represent an extended use of the dune margins spanning the Archaic and Pueblo periods. The gypsum which composes these dunes acts to stabilize and preserve organic and structural remains to a degree seldom seen anywhere in the archaeological record. The long persistence of the subsistence pattern represented by these sites, spanning the period from the introduction of agricultural species to their intensive use by sedentary farming communities, constitutes a feature which has been poorly documented in the Southwest, and has yet to be assessed within general explanations of Southwestern cultural and technological development. The unique degree of preservation in these sites offers an outstanding opportunity for analysis of a variety of problems in the archaeology of the Tularosa Basin and south-central New Mexico.

The appropriate details of such an analysis have been presented in *An Assessment of the Archaeological Potential of WSNM* (HSR 1973b). The close and uncontaminated association of datable charcoal, floral and faunal remains, and atmospheric pollen, together with identifiable artifacts, offer an ideal opportunity for the testing of hypotheses concerning seasonality of exploitation, reconstruction of past vegetation patterns, and exact chronological positions of cultural manifestations. Since some of these sites are located within an easy walk of the Loop Road, they have interpretive potential for present park programs as well. Most, however, are located a distance from visitor activity and should remain well protected by current national monument policies.

The Lucero Lake Site, most of which lies within WSNM boundaries, and the Huntington Site, which is primarily under the jurisdiction of WSMR at this time, have been somewhat erroneously identified as El Paso Phase villages in the past. The recent intensive surface survey of these sites during the current project offers a substantially enhanced perspective on the significance of these two villages. In particular, the low percentage of El Paso Polychrome throughout both sites, and the common occurrence of both Chupadero and Mimbres white wares, contrasts sharply with comparable sites excavated by Lehmer (1948) which have formed the traditional basis for the identification of the Jornada Mogollon as a distinct regional branch.

Although a number of investigators have suggested strong connections between the Mimbres Mogollon groups west of the Rio Grande and those residing in the Tularosa Basin, evidence from the latter area has been too minimal for a thorough assessment of the validity of such contentions. However, in light of the results

of this survey, and Brody's opinion in a recent summary of Mimbres (1977) that Mimbres Classic Black and White wares were traded out of the core area very seldom, if at all, the occurrence of this ware on the west side of the Tularosa Basin now calls for a reappraisal of the relationship between the two groups.

POTENTIAL THREATS TO THE ARCHAEOLOGICAL RESOURCES OF WSNM

Archaeological sites within the actual dune area are considered remarkable in their preservation. However, the actions of natural erosion are an ever-increasing danger to these important resources. As wind removes the unconsolidated portions of the hearth, areas begin to fall away. This natural process is continual and information potentially available from these sites is being lost at an increasing rate.

Potential danger from modern activity threatening sites in both the dune area and the Bajadan Community of the western areas of the monument is continual. Random vehicular traffic in the *Co-operative Use Zone* occurs primarily during recovery operations by WSMR. The program of cooperation between WSMR and WSNM during such operations, using helicopters and the on-the-scene supervision of a Park Ranger, helps to insure protection. Increased knowledge on the part of both parties should insure that great care is taken to avoid damage to sensitive archaeological resources during these operations.

Illegal entrance both on the east and west margins of the national monument, by military or civilian personnel with security badges for entrance to restricted areas, has been and continues to be a problem of great importance in the protection of cultural resources. In spite of the fact that WSMR has posted the monument boundary with *Off Limits* signs, individuals continue to collect materials from the more visible archaeological locations. WSMR is concerned about this problem as much as is the national monument. However, the vastness of land area involved precludes total protection of archaeological resources without considerable investment of funds. It is suggested that Antiquities signs be placed at appropriate locations along the national monument boundary and every effort be made to take punitive actions against individuals disturbing archaeological remains.

In the Parabolic Dune area within the portions of the national monument open to visitors, several of the preserved hearth mounds are within the areas available to unsupervised visitors. In addition, a nature trail in the area of some of the mounds offers some potential danger to archaeological resources. Although it is obvious that the monument staff has taken great precautions to protect these locations (i.e., important artifacts are still found in their *in situ* positions within and around the hearths), even foot traffic across the delicate stabilized dune structures can potentially destroy archaeological resources. It is important that archaeological information take an active role in the interpretive program of the monument, but it is suggested that immediate attention be given to the conservation of these resources. A program of testing and appropriate protection of the stabilized hearth structures should be instituted and given immediate attention.

XII – RECOMMENDATIONS

The human ecology of White Sands National Monument has, in the past, received only low priority as a contributing factor in the study of the ecological organization of the White Sands Bio-unit. Information made available through studies of past human occupation and use of the White Sands area would, however, contribute substantially to the high priority research goals outlined in the *White Sands Natural Studies Plan* (Sumner 1969:Chapter III:15).

The stabilized dune hearth sites of the gypsum dune area may be considered ecological time capsules. Contained in each of these *natural casts* of hearth areas is a wealth of ecological information. Temporal studies of these sites of human occupation will yield not only archaeological data, but will contribute substantially to information on dune movement and structure, contemporary ecological conditions, and the possible effects of man on this environment. Pollen studies of these uniquely preserved sites would provide precise and discrete documentation of general environmental conditions across a time spectrum seldom available to the natural scientist. Results of archaeological explorations recommended here and the environmental research recommended by Sumner would be complimentary in the accomplishment of immediate planning goals put forth in the *White Sands Master Plan*.

Although the major goal of management at White Sands National Monument is the protection and perpetuation of *an outstanding natural area* (Sumner 1969), little has previously been done to take advantage of the immeasurable knowledge of both human and natural history available through archaeological investigations. Humans have articulated directly with the White Sands Eco-unit for thousands of years. Knowledge of this relationship is buried within the sites and activity areas of the Bajadan Community and sealed within the natural plaster of the gypsum dunes. A continuing archaeological research program at White Sands would aid management in evaluation of current environmental effects and in development of future management programs. Thereby, archaeological research can enrich current interpretations of human relationships to an arid environment.

THE PARK SERVICE REMOTE SENSING PROGRAM AS A DIRECT AID TO ENVIRONMENTAL AND ARCHAEOLOGICAL RESEARCH

Human Systems Research has previously estimated that between three and six hundred locations of prehistoric human occupation or use are located within White Sands National Monument. These locations are scattered over more than 200 square miles. The cost of identifying these sites through traditional methods of archaeological survey in the vast, roadless areas of the national monument could run quite high. In addition, the exact mapped location of sites is extremely difficult to derive through traditional means due to the infrequency of distinct landmarks on the basin floor. Many of the archaeological resources within the national monument are quite distinct and easily identified when viewed from the air. Also, many of the features suspected to exist within the monument probably cannot be identified at all without the *birdseye* view afforded by aerial imagery (i.e., possible field areas within the

Bajadan Community). Dr. Thomas Lyons of the Park Service's Remote Sensing Center, Albuquerque, has recently presented a statement on the center's capabilities with respect to both the ecological and archaeological studies on-going and planned for White Sands National Monument. It is suggested here that the monument combine the research goals of on-going ecological and archaeological studies with the capabilities outlined by Lyons, and initiate a program to apply remote sensing capabilities to the location of archaeological resources and mapping of environmental features and ecological communities. In this manner, locations identified through consultation with the remote sensing program can be examined in a systematic manner on the ground eliminating many of the more expensive aspects of on-the-ground explorations.

In brief, information gained in ground-truth confirmation of information gained through remote sensing can be applied to the overall program of environmental study of the Park, and archaeological site locations and information consequently take on new meaning.

PROBLEM AREAS IN THE MANAGEMENT OF CULTURAL RESOURCES

White Sands National Monument is surrounded by lands controlled by the Department of the Army, WSMR. Benefits as well as detriments ensue from this fact. Approximately 75 miles of boundary line are shared by these two organizations. Only along U.S. Highway 54-70 are small portions of the boundary fenced. Along the rest of the boundary, only white and red painted posts at the corners, and varying intervals between, mark the monument boundary. In an area of virtually no roads, it is very difficult to control back country, unauthorized entrance to monument lands. Without an inventory of the cultural resources, and a program by which significance of those resources can be judged, protective action can go little further than the *Keep off the Grass* level.

Cooperative relationships between the staffs of the monument, WSMR, and Holloman Air Force Base are good. Because of the location of the monument within the boundaries of the Federal testing range, and a cooperative agreement between National Park Service and the Army, occasions arise in which Missile Range recovery crews and military installation crews must enter the national monument. It is during these activities that the greatest program threat to cultural resources exists. Documented knowledge of the location and significance of cultural resources within the monument is a necessity if such activity is to continue within the monument.

In addition to the potential hazards to cultural resources resulting from on-going military programs, other military related factors have resulted in damage to cultural resources within the monument. For example, altered drainage patterns resulting from the construction of Range Road 7, along the west boundary of the monument, have significantly affected the erosional pattern across downslope lands within the monument. (It must be realized that Road 7 predates the environmental and cultural properties legislation; nevertheless, the effect is ongoing. The Lucero Lake Site, for one, is greatly affected by this factor.)

By far the greatest threat to cultural properties within the monument results from illegal entrance into supervised areas of the *back country*. For example, along the eastern boundary of the monument, motorcyclists enter the Parabolic Dune, gaining entrance from Holloman Air Force Base. Security clearance is needed to

enter either the Air Force Base or the Missile Range. However, once on these bases, nothing prevents off-road traffic from entering the national monument. In the dune areas, the exposed nature of the stabilized hearth sites leaves them open to both intentional and accidental damage. Along Range Road 7, on the west side of the monument, several of the major sites are within easy walking distance. Vandalism, through surface collection of artifacts and excavation, is common. WSMR has placed *Off-Limits* signs along the monument boundary and has instructed MP's on patrol to prevent illegal entrance. WSNM Rangers regularly patrol, but the area of exposure is large. It is essential that resources within the areas of highest potential program impact and vandal destruction be inventoried at the earliest possible date.

OUTLINE FOR FUTURE RESEARCH

1. Inventory cultural resources;
2. Based on limited sampling of the sites recorded by inventory procedures, determine the following:
 - a. chronology of human occupation and use,
 - b. environmental variability during the periods of human occupation,
 - c. purpose and significance of the various sites or groups of sites recorded;
3. Based on all of the above, develop interpretive and management goals for cultural resources within White Sands National Monument.

INVENTORY OF CULTURAL RESOURCES

White Sands National Monument contains approximately 210 square miles. Human Systems Research, has to date, under contract to National Park Service, conducted preliminary reconnaissance of approximately 30 square miles. In a preliminary study of this nature, approximately 90 acres per square mile are directly examined by field archaeologists. This would indicate that something between two and three percent of the land area within the national monument has been examined for the presence of cultural resources. Sixty-five sites were recorded in the Parabolic Dune sample and eleven sites were recorded in the sample of the Bajadan Community. It is calculated that a maximum of seven to eight sites per square mile can be expected within the monument. However, as already discussed, large portions of land area within the monument can be expected to yield little or nothing in the way of cultural resources. Thus, it is presently estimated that the monument contains from 300 to 600 separate locations of cultural resources. Human Systems Research has expended 122 man-days in the locations and preliminary descriptions of the 76 sites discussed in this report.

If a total inventory survey under standard archaeological field procedures were initiated, it would require almost three man-years to complete. Even under the most ideal of conditions, such a standard ground survey would be likely to fail to recognize significant locations of human activity (i.e., prehistoric field areas, ditches, roads, or trails). Through a coordinated program using remote sensing, and ground-truth field checks and evaluations, a great deal of the expensive *leg work* in the inventory process can be forestalled. In addition, accurate locations may be easily derived and groupings of sites and site features, unrecognizable in any other manner, may be determined.

CHRONOLOGY, ENVIRONMENT, AND SIGNIFICANCE

As archaeological research continues on WSNM and in the Tularosa Basin, the pressing need for an accurate correlation between environmental conditions and the chronology of human occupation becomes more critical. Although a variety of methods allow such reconstruction (including dendrochronology and packrat midden analysis), the unique preservation characteristics of the Parabolic Dune sites allow a more direct approach. The potential chronological significance of the large number of hearth mounds along the eastern and southern dune margins cannot be underestimated. Current chronologies are not reliable. These sites offer a unique research opportunity requiring minimal field expenditure. The majority of these hearth mounds are well exposed, undisturbed, and well-preserved. Undoubtedly, these sites represent the remains of limited seasonal activities of short duration. Recognized examples represent a temporal span of as much as 4,000 years, during both the Archaic and Pueblo periods of occupation. Later examples, as yet unrecognized, representing the activities of Apachean groups, seem likely. Both stratified mounds are quite discrete and the nature of the preservation makes later contamination of pollen and carbon deposits highly unlikely.

A series of Carbon-14 samples from a sample of hearth mounds would constitute a major contribution to an understanding of the prehistoric chronology of White Sands National Monument and the occupation of the Tularosa Basin.

Seldom are stratified sites of this type sufficiently stabilized and discrete to guarantee a minimum of more recent disturbance or mixing of deposits. Prevailing winds and the nature and extent of downwind floral communities suggest fairly stable and discrete pollen frequencies during differing seasons. A pollen series and study of carbonized plant remains, in conjunction with a comparable Carbon-14 sample, would allow the assessment of the nature and direction of human adaptation through time.

With the development of a chronology and an understanding of past environmental conditions, the various groupings and individual cases of cultural resources may be more adequately assessed. Judgements of significance can then be based on the full range of cultural resources within the monument and management policy will therefore be more firmly based.

INTERPRETATIVE AND MANAGEMENT GOALS

The ultimate purpose of this research should be to derive goals for the management of cultural resources within White Sands National Monument. In addition to preservation and conservation of this resource, the Park Service is obligated to interpret the knowledge gained from this research to the public. Therefore, at the same time that management policy is being formulated, an interpretation program should be developed and instituted.

REFERENCES CITED

Basehart, Harry W.

- 1960 *Mescalero-Apache subsistence patterns and sociopolitical organization*. Mescalero-Chiricahua Land Claims Project, Contract Research No. 290-154. University of New Mexico mimeograph, Albuquerque.

Bohrer, Vorsila L.

- 1970 Ethnobotanical aspects of Snaketown, a Hohokam village in southern Arizona. *American Antiquity* 35(4):413-430, Salt Lake City.

Brand, D.D.

- 1935 The distribution of pottery types in northwest Mexico. *American Anthropologist* 37(2), Part 1, Menasha.

Breternitz, D.A.

- 1966 An appraisal of tree-ring dated pottery in the Southwest. *Anthropological Papers of the University of Arizona* 10, Tucson.

Brody, J.J.

- 1977 *Mimbres painted pottery*. School of American Research Indian Art Series. UNM Press, Albuquerque.

Bussey, S., R. Kelly and J. Southward

- 1976 *LA 4921 Three Rivers, Otero County, New Mexico, a project of excavation, stabilization and interpretation of a prehistoric village*. Cultural Resources Management Division, New Mexico State University Report No. 69 (Preliminary), Las Cruces.

Castetter, E.F. and M.E. Opler

- 1936 The ethnobiology of the Chiricahua and Mescalero Apache: A) The use of plants for foods, beverages and narcotics. *Ethnobiological Studies in the American Southwest* 3, The University of New Mexico Bulletin 297, Biological Series 4(5).

Colton, H.S.

- 1953 Potsherds: An introduction to the study of prehistoric Southwestern ceramics and their use in historical reconstruction. *Museum of Northern Arizona Bulletin* 25, Flagstaff.

Colton, H.S. and L.L. Hargrave

- 1938 Handbook of northern Arizona pottery wares. *Museum of Northern Arizona Bulletin* 11, Flagstaff.

Eidenbach, Peter L.

- n.d. Functional analysis of ground stone from Unkar Delta, Grand Canyon. Unpublished manuscript, School of American Research.

Fenenga, F.

- 1956 Excavations at site LA 2579, a Mogollon village near Gran Quivira, New Mexico. In *Pipeline archaeology*, Laboratory of Anthropology and Museum of Northern Arizona, pp. 226-233.

Greene, E.

- 1955 Excavations near Gran Quivira, New Mexico. *Texas Archaeological Society Bulletin* 26, Austin.

Harrington, H.D.

- 1967 *Edible native plants of the Rocky Mountains*. University of New Mexico Press, Albuquerque.

Hawley, Florence M.

- 1950 Field manual of prehistoric Southwestern pottery types (Revised Edition). University of New Mexico Bulletin, *Anthropological Series* 1(4), Albuquerque.

Holdridge, L.R.

- 1947 Determination of world plant formations from simple climatic data. *Science* 105: 367-368.

Human Systems Research, Inc.

- 1973a *Technical Manual: 1973 survey of the Tularosa Basin, the research design*. Albuquerque.
- 1973b Evaluation of the archaeological potential of White Sands National Monument. Unpublished manuscript: Contract No. CS700030220, National Park Service, Santa Fe.

Huntington, Elsworth

- 1914 The climate factor as illustrated in arid America. *Carnegie Institution of Washington Publication* 192:37-43.

Jennings, J.D. and G. Neumann

- 1940 A variation of Southwestern Pueblo culture. *Laboratory of Anthropology Technical Series Bulletin* 10, Santa Fe.

Lehmer, Donald J.

- 1948 The Jornada branch of the Mogollon. *University of Arizona Social Science Bulletin* 17, XIX(2), Tucson.

Lyons, Thomas R. and Douglas H. Scovill

- 1978 Non-destructive archeology and remote sensing: A conceptual and methodological stance. IN Remote sensing and non-destructive archeology. National Park Service, Cultural Resources Management Division, *Publication No. 38*, Washington, D.C.

MacArthur, Robert and Joseph Connell

- 1966 *The biology of populations*. J. Wiley & Sons, New York.

Maker, J.H., P.S. Derr and J.U. Anderson

- 1972 Soil associations and land classification for irrigation, Otero County. *Agricultural Experiment Station Research Report* 238, NMSU, Las Cruces.

Marshall, Michael

- 1973 The Jornada culture area. IN *Technical Manual: 1973 survey of the Tularosa Basin, the research design*. Human Systems Research, Albuquerque.

McCluney, Eugene B.

- 1962 A new name and revised description for a Mogollon pottery type from southern New Mexico. *Southwestern Lore* XXVII(4):49-55. Boulder, Colorado.

Meinzer, O.E. and R.F. Hare

- 1915 Geology and water resources of Tularosa Basin, New Mexico. *USGS Water Supply Paper* 343. Washington Government Printing Office, Washington, D.C.

Mera, H.P.

- 1935 Ceramic clues to the prehistory of north central New Mexico. *Laboratory of Anthropology Technical Series Bulletin* 9, Santa Fe.
- 1943 An outline of ceramic developments in southern and southeastern New Mexico. *Laboratory of Anthropology Technical Series Bulletin* 11, Santa Fe.

Mera, H.P. and W.S. Stallings

- 1931 Lincoln black on red. *Laboratory of Anthropology Technical Series Bulletin* 2, Santa Fe.

Metz, Leon C.

- 1974 *Pat Garrett, the Story of a Western Lawman*. University of Oklahoma Press, Norman.

Mullin, Robert N.

- 1969 The strange story of Wayne Brazel. IN *Panhandle-Plains Historical Review* XLII, Panhandle-Plains Historical Society, Canyon, Texas.

Munsell Soil Color Chart

- 1954 *Munsell Soil Color Chart*. Munsell Color Company, Inc., Baltimore.

Neher, Raymond E. and Oran F. Bailey

- 1976 *Soil and vegetation of White Sands Missile Range, New Mexico*. U.S. Department of Agriculture, Soil Conservation Service.

Rinaldo, J.B.

- 1974 *Casas Grandes, a fallen trading center of the Gran Chichimeca*. The Amerind Foundation 6. Dragoon, Arizona.

Rinaldo, J.B. and E.A. Bluhm

- 1956 Late Mogollon pottery types of the Reserve area. *Fieldiana:Anthropology* 36(7). Chicago Natural History Museum, Chicago.

Schaafsma, Curt

- 1964 Archaeological salvage excavation of the Hatch site LA 3135. Unpublished manuscript on file at the Museum of New Mexico, Santa Fe.

Schroeder, Albert H.

- 1973 The Mescalero Apaches. IN *Technical Manual: 1973 survey of the Tularosa Basin, the research design*. Human Systems Research, Albuquerque.

Smiley, T.A., S. Stubbs and B. Bannister

- 1953 A foundation for the dating of some late archeological sites in the Rio Grande area, New Mexico. *University of Arizona Bulletin* 24(3):58, Tucson.

Sonnichsen, C.L.

- 1973 *The Mescalero Apache*. University of Oklahoma Press, Norman.

Sumner, Lowell

- 1969 *White Sands National Monument Natural Science Studies Plan*. U.S. Department of the Interior, National Park Service, Washington.

Van Devender, Thomas R.

- 1976 *The biota of the hot deserts of North America during the last glaciation: the pack-rat midden record*. Paper presented to October meeting of American Quaternary Association.

Westphall, Victor

- 1965 *The Public Domain in New Mexico, 1854-1891*. University of New Mexico Press, Albuquerque.

Whalen, Michael E.

- 1977 Settlement patterns of the eastern Hueco Bolson. *Anthropological Paper* 4. Centennial Museum, University of Texas at El Paso.

White Sands National Monument

- 1969 *White Sands National Monument Natural Science Studies Plan*. National Park Service, Washington, D.C.
- n.d. *A Master Plan*. Preliminary Draft. U.S. Department of the Interior, National Park Service, Washington, D.C.

Wimberly, Mark L. and Alan Rogers

- 1977 Cultural succession: A case study, archaeological survey of the Three Rivers drainage, New Mexico. *The Artifact* 15. El Paso Archaeological Society.

York, John C. and W.A. Dick-Peddie

- 1969 Vegetation changes in southern New Mexico during the past hundred years. IN *Arid lands in perspective*, W.G. McGinnies and B.J. Goldman, eds. American Association for the Advancement of Science and University of Arizona Press, Tucson.



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