Archeological Investigations
of
Arches National Park, Utah

by
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ABSTRACT

This report presents the descriptive and analytical results of an archeological survey of Arches National Park in southeast Utah (Utah Project No. U87-NA-054N). A total of 26 sites and 69 isolated artifact finds was recorded in the 1,160 acres surveyed during August 1987. This report is produced in cooperation with the National Park Service, Midwest Archeological Center, in accordance with Supplemental Agreement No. CA-6115-7-8008 and in furtherance of Master Cooperative Agreement No. CA-6000-4-8020 between the National Park Service, Midwest Region, and the University of Nebraska, Lincoln.

Arches National Park encompasses a broad range of geological formations and microenvironments. The Park is bounded to the north by Salt Valley and Salt Wash and to the south by Courthouse Wash. Elevations range from 4,100 ft (1,250 m) to 5,500 ft (1,676 m). Vegetation is generally sparse within the Park. The archeological resources recorded during this survey included lithic scatters, several rock shelters, a pictograph/petroglyph panel, and an historic site. The survey data is outlined descriptively, and evaluated using descriptive and analytic statistics.

The purpose of the project was to conduct an intensive pedestrian survey in order to locate archeological resources in areas which might be adversely affected by future maintenance and development in the Park. Also, this report is intended to serve Park personnel as a cultural resource management tool. Effective management and interpretation of these archeological resources can be based, in part, on some of the study results presented in this document.

ACKNOWLEDGMENTS

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Arches National Park personnel helped to provide a pleasant and fruitful field experience. Barbie Flanigan was helpful in preparing forms and in insuring that mail and messages were delivered. Chas Cartwright is especially thanked for his field assistance and his obvious concern for the archeological resources and their protection.

Field work was carried out with crew members Sherrian Edwards and Rusty Greaves. The latter is thanked for his considerable assistance. Steve Baumann and Jenny McNeil are thanked for their preparation of the data base files. A special appreciation is extended to Jesslyn Brown for her diligence and reliability during the editing process and for preparing the maps for this publication. Alan Osborn, Carol Raish, and Judy Pace are thanked for their extensive efforts in editing and technical preparation of this report. Midwest Center personnel contributed their clerical support. Other University and Center personnel are thanked for helping this project to run smoothly.

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INTRODUCTION

A systematic survey at Arches National Park, several miles north of Moab in southeast Utah (Figure 1), was initiated to document archeological resources in areas where Park facility improvements are anticipated. Delimitation of cultural resources is intended to assist in Park development planning and resource management.

Approximately 1,160 acres were systematically surveyed during August of 1987. Included were corridors on either side of roads and trails which will be subjected to maintenance or construction impact in the future.

Surveys have been conducted in the Park since the 1930s (Appendix A). Since the 1950s, a number of sites have been recorded by Lloyd Pierson and others. Large portions of the Park, however, have not been systematically documented. This project was designed to locate both documented and undocumented archeological sites. Archeological work conducted in the Park to date does not constitute a systematically derived sample. Specifically, cultural resource surveys have not been carried out within all environmental zones within Arches National Park.

This project included two goals. The first was to provide National Park Service personnel with an inventory and assessment of cultural resources that would be affected by future developments within the Park. The second goal involved the collection of archeological data that would enable the investigators to examine questions regarding prehistoric resource procurement in this area of southeastern Utah. Specifically, this study focused on the procurement and use of lithic raw materials within the Park and its immediate environs.

This report includes the following: 1) a description of environmental variables and their implications for prehistoric behavior; 2) a summary of previous archeological work in the area; 3) an account of Euro-American exploration and use of the area; 4) archeological survey and recording methods; 5) a description of archeological remains observed; and, 6) a summary of survey results and management recommendations. [This report was completed in 1988 and we have chosen not to incorporate additional references or literature citations.]

In addition, a collection of archeological materials that is curated at Arches National Park was examined prior to this survey. Artifact data previously recorded in existing catalog records was copied and later transferred to a computer data base (Appendix B). The artifact and observation code is also included in Appendix B.

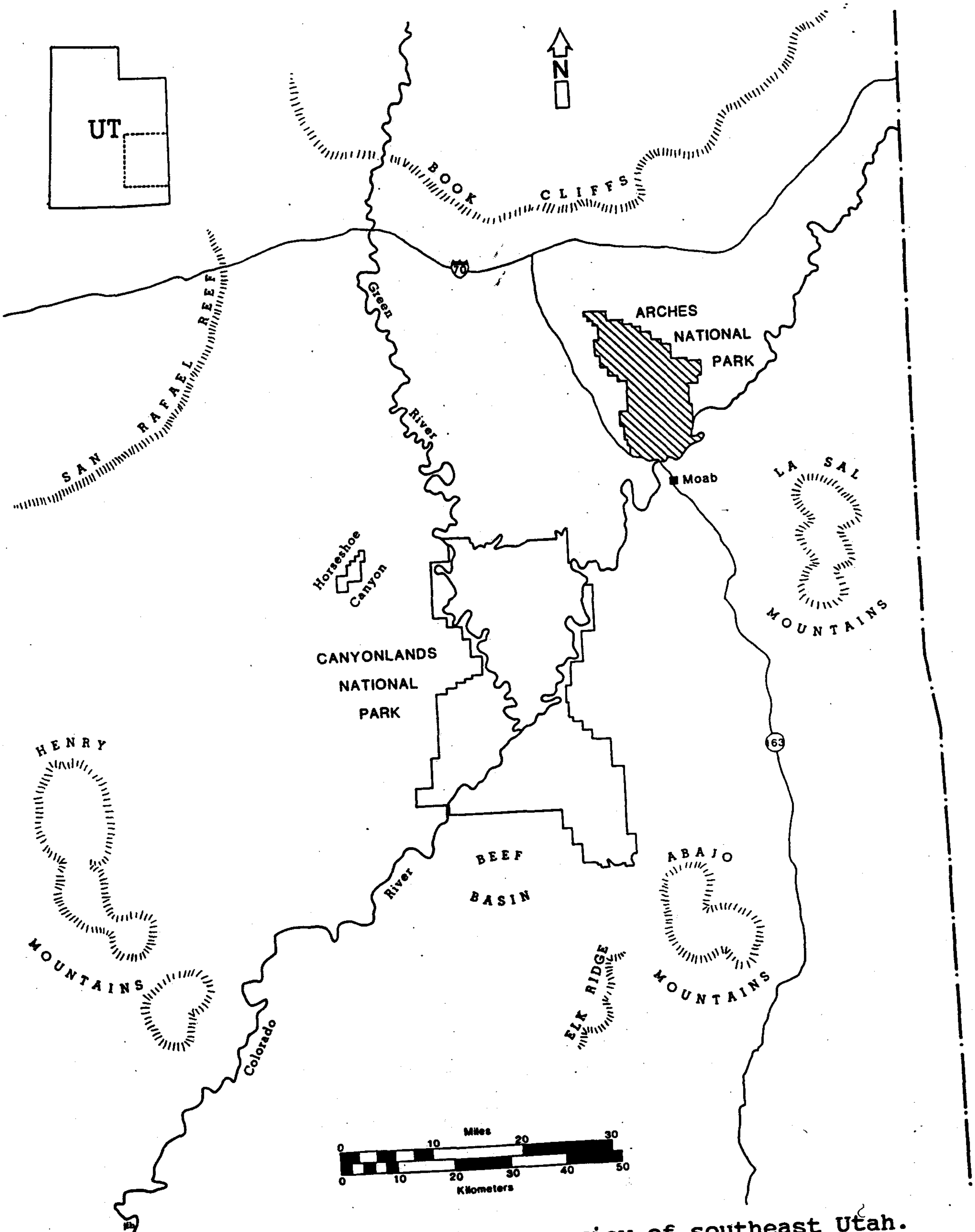

Figure 1. Arches National Park; overview of southeast Utah.

THE PROJECT AREA

Physiographical Setting

Arches National Park is 6.5 km (4 miles) north of Moab in an area generally characterized by highlands rising above the Colorado River. This plateau, the Colorado Plateau, is marked by various changes in topography, drainage systems, and exposed formations. Elevations range from 1,250 m (4,100 ft) to 1,585 m (5,200 ft). The Park entrance is at 1,250 m (4,100 ft).

The boundary of the Park's northern portion is Salt Valley, a southeast-trending drainage system (Figures 2 and 3). The breadth of the valley is about 4 km at its widest. Numerous runoff channels flow into the Salt Valley drainage from the escarpments to the northeast and southwest. Alluvial downcutting has incised the valley floor in arroyos up to 10 m deep.

Ridgelines that rise to 110 m (350 ft) above the drainage floor delimit the valley's perimeter (Figure 4). Rolling badlands and steep sandstone escarpments define these margins. The central valley floor is about 1,372 m (4,500 ft) above mean sea level. Wingate sandstone escarpments on the southwest rise to about 1,493 m (4,900 ft). To the northeast the terrain rises abruptly to 1,585 m (5,200 ft). The ridge is level along the crest and slopes northeast in an extensive series of Entrada sandstone fin formations which drain into Salt Wash.

The topographic relief between Salt Valley and these escarpments diminishes north of Klondike Bluffs. The valley's eastern margin constricts and runs east to the confluence with Salt Wash. South of Salt Valley, Salt Wash is an aggregate of the Salt Valley, Winter Camp, and Cache Valley drainages. The area of confluence is a low, flat basin, heavily dissected by meandering intermittent drainages (Figures 5 and 6). Salt Wash drains the area north of Salt Valley. Trending to the south, it flows into the Colorado River south of the confluence. The Salt Wash Syncline defines the drainage course.

In the 13 km (8 miles) between Salt Valley and Courthouse Wash the terrain slopes gently southward decreasing in elevation from approximately 1,463 m (4,800 ft) to 1,341 m (4,400 ft). The primary drainage is Courthouse Wash which flows south through Navajo sandstone and descends through a narrow canyon into the Colorado River. The southeast margin of the Park is edged by the Colorado River. At the southern end of the Park, the Navajo sandstone slickrock drops off precipitously. This escarpment overlooks the Moab Fault, Moab Canyon, and the Colorado River basin.

The project area is located in the east central portion of the Colorado Plateau. This precinct encompasses a series of environmental and landform domains, including several major drainage systems and unusual topographic features formed by a

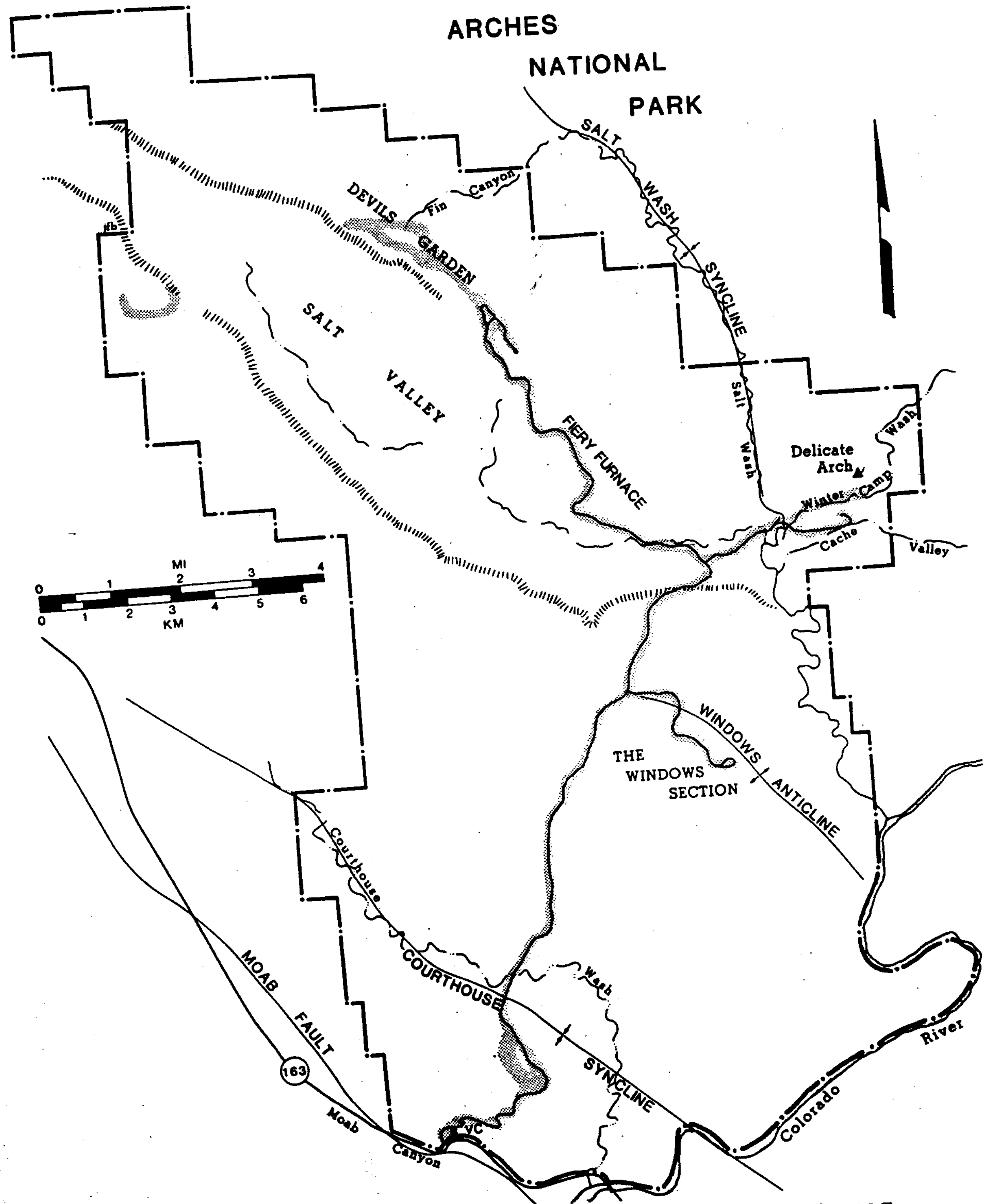

Figure 2. Arches National Park; geographic features.

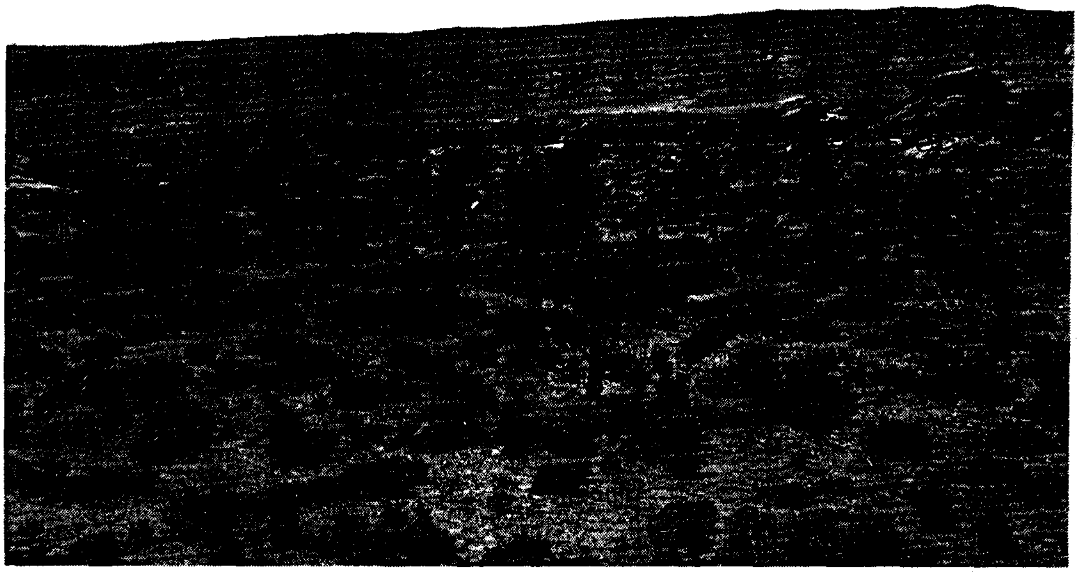

Figure 3. Overview of Salt Valley.

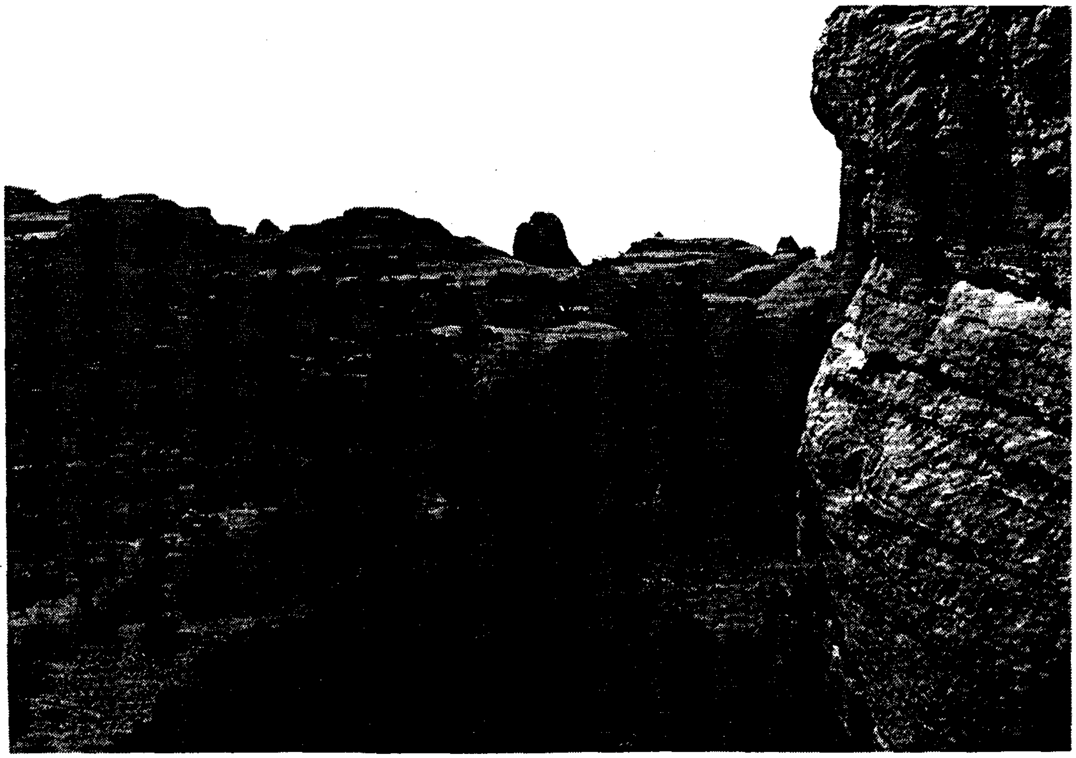

Figure 4. Overview of the ridge on the northeast margin of Salt Valley.

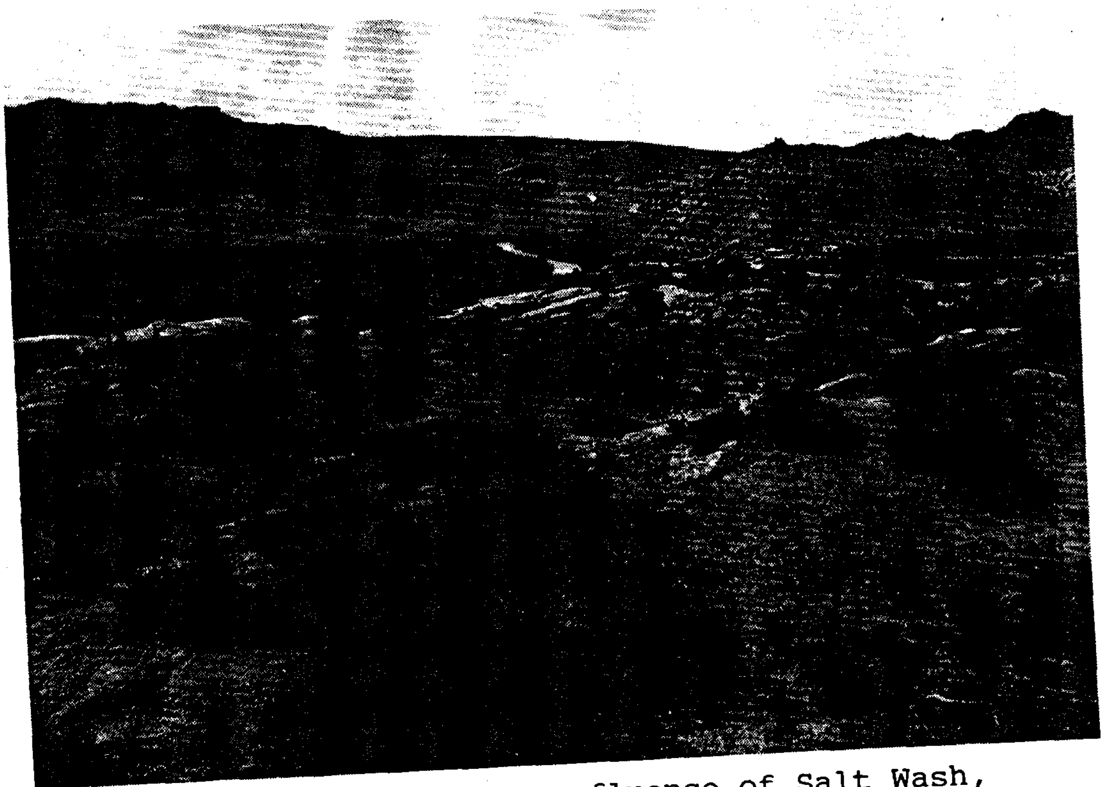

Figure 5. Salt Wash; the confluence of Salt Wash, Cache Valley, Winter Camp, and Salt Valley drainages.

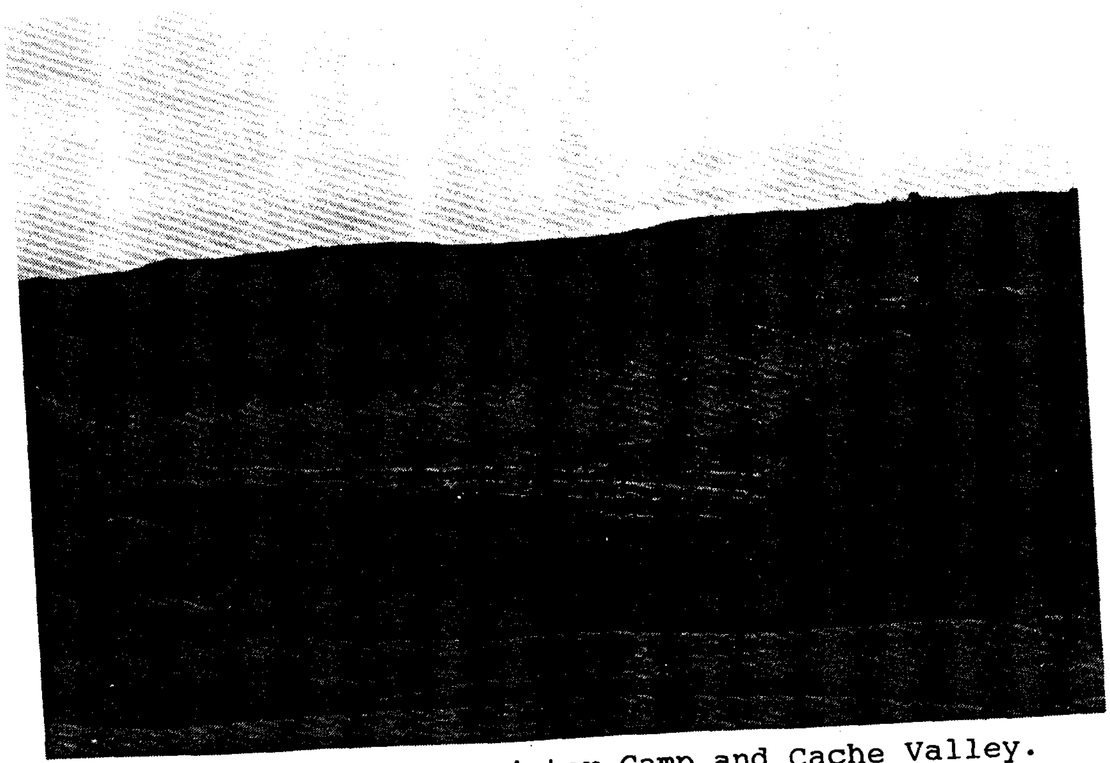

Figure 6. Overview of Winter Camp and Cache Valley.

relatively long and active geologic sequence. The survey sampled only a small cross section of this diversity.

Geology

Structural Geology

Arches National Park is situated in the Paradox Basin of the central Colorado Plateau in a physiographic province that has been defined as the Salt Anticline Section (Stokes 1977). The area is of geologic interest because of the complexity of its formations and developmental sequence. Causal factors which produced the present landscape are salt dome tectonics and the uplifting of the Colorado Plateau.

Salt and Cache Valleys, flanked by escarpments, are representative of the Hermosa member, a subsurface geologic structure of the Paradox Formation (see Appendix C). The Hermosa Member consists of evaporates deposited in the Paradox Basin some 300 million years ago when the area was covered by an inland sea. This salt base is more plastic and soluble than rock. Differential dissolution of the salt renders an unstable surface. This substructure tended to warp under the overburden of ensuing sand, shale and limestone deposits, resulting in an area that is characterized by anticlines and synclines (Doelling 1985; Lohman 1975; Stokes 1977).

The Basin itself subsequently was faulted, producing the presently convoluted surface. This warping process, exemplified in Salt Valley, exposed extensive stratigraphic sequences that otherwise would have remained below the surface. Warping also leads to discontinuities in those sequences seen from one side of the valley to the other. The fin and arch formations reflect the result of subterranean salt plasticity and dissolution (Doelling 1985).

In the Colorado Plateau, upwarping during the Late Cretaceous and Early Tertiary shaped the surface further. The Moab Vault, a Tertiary development that borders the southern portion of the Park, punctuates the long span of visible strata on the east margin of the Park. The erosion and downcutting which occurred subsequent to the uplift further exposed the geologic sequences. Exposed stratigraphy consists of numerous formations ranging in age from the Quaternary to the Pennsylvanian. A descriptive summary of these strata is provided in Gregory (1938), Jobin (1962), and Doelling (1985).

Much of the southeastern portion of the Park consists of Navajo sandstone with intermittent accumulations of Quaternary aeolian deposits. This surface is undulating and slopes to the southeast. Various Jurassic members of the Entrada Formation, with more sharply defined topographic features, are exposed in the southwest portion of the Park (Figure 7). It is in the Entrada Formation that the arches and fins, the Park's

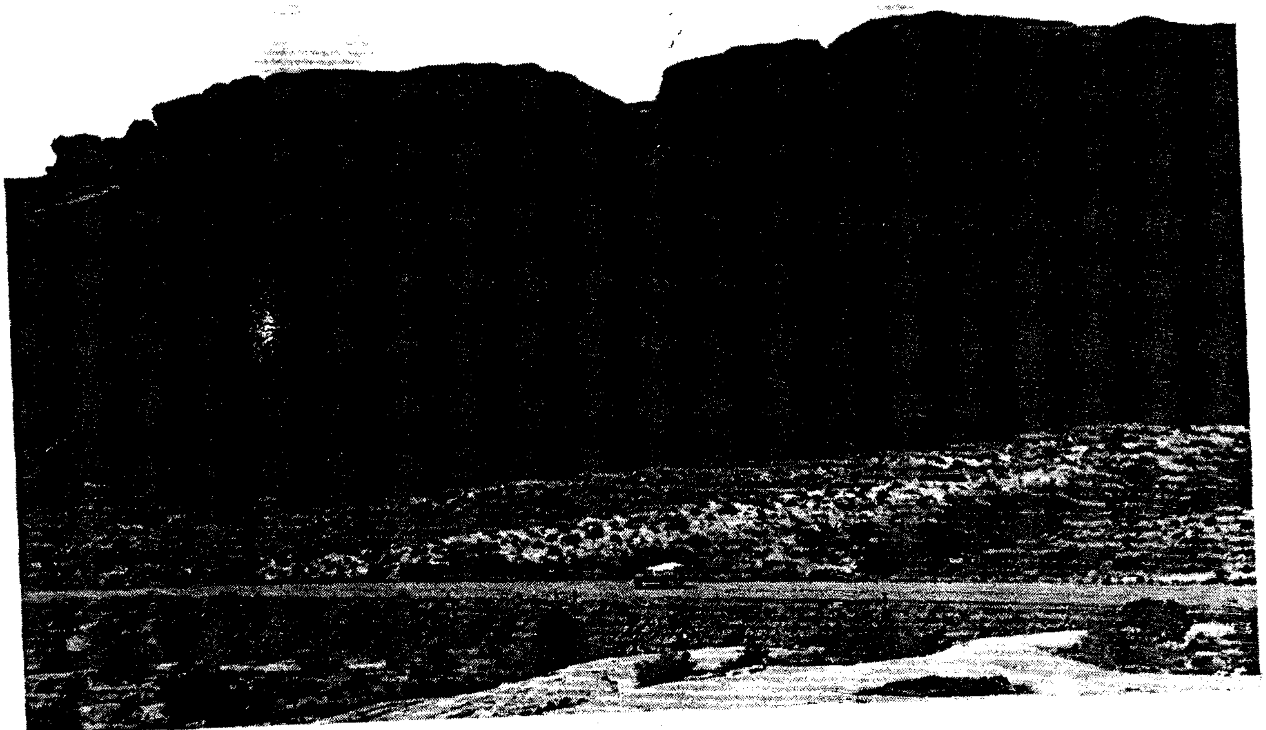

Figure 7. Entrada sandstone cliffs.

characteristic features, have formed. In the northern portion of the Park, older Triassic formations, i.e., the Kayenta, Wingate, Chinle, and Moenkopi, are exposed. Members of the Morrison Formation are intermittently dispersed in narrow exposures throughout the Park. The surface of Salt Valley ranges from recent alluvium deposits to exposures of Paleozoic deposits. These strata include the Pennsylvanian and Paradox Formations. More recent Cretaceous units, Dakota sandstone, Mancos shale, and Cedar Mountain sandstone, are visible along the margins of Salt Valley.

Lithic Raw Materials

The local geology of specific archeological interest is the surface presence of high quality cryptocrystalline and siliceous deposits. Knappable raw materials have a wide distribution throughout the Park. All artifactual material recorded was produced from locally available sources. Several clearly distinguishable types of cryptocrystallines and quartzites were found in the archeological assemblages. All of these raw materials were located within the Park and vary in distribution, accessibility, quality, and packaging. Raw-material-bearing strata are depicted in Figure 8.

Tidwell Chalcedony. Most common in lithic assemblages is a white chalcedony. This chalcedony occurs in the Tidwell Member of the Morrison Formation. Tidwell is the lowest member of the Morrison and is at its interface with the older Entrada Formation. The Morrison is a Jurassic reddish shale with interbeds of fine-grained yellow sandstone and gray limestone. The "eastern exposures exhibit large white siliceous concretionary bodies" (Doelling 1985).

This white chalcedony occurs in island outcrops which are more durable than the surrounding shale and sandstone and have a high visibility on the landscape. The material is friable and the outcrops themselves consist largely of mounds of exfoliating natural shatter. The shatter occurs in pieces sizable enough that actual quarrying would not have been mandated. Although a patina forms on the natural broken surfaces, little actual cortex is present. The material's "packaging" would not generate extensive amounts of decortication debris, although primary reduction may have occurred.

The Tidwell Member occurs along the northeast and southwest margins of the escarpments defining Salt Valley, north of Salt Wash and near the confluence of Salt Valley and Salt Wash. The chalcedony outcrops are dotted along these exposures. Most outcrops that were ground checked had associated cultural material. However, due to the large quantity of natural shatter, any evaluations of the density of cultural material would require extensive sampling.

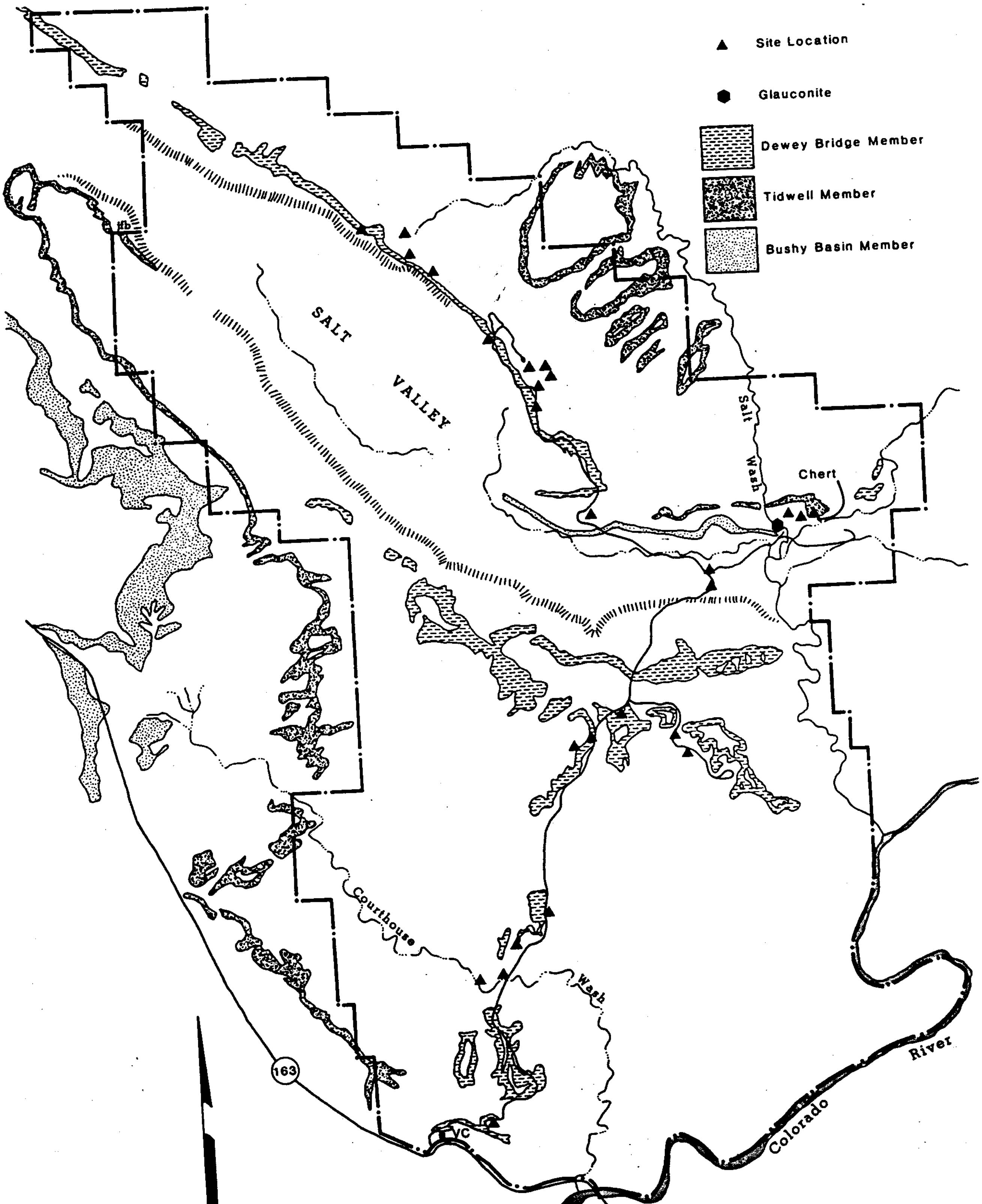

Figure 8. Arches National Park; distribution of raw material bearing strata and site locations.

Brushy Basin Chalcedony. This chalcedony is a pastel-colored chalcedony occuring in cobbles eroding out of the Brushy Basin Member of the Morrison Formation. The Brushy Basin Member is defined as

> mostly variegated slope-forming mudstone with thin ledges of conglomerate sandstone, conglomerate, nodular weathering limestone, and gritstone, containing varicolored chert. Purplish and lavender hues dominate to the north, but bright greens dominate in Cache Valley and the southern part of Salt Valley anticline [Doelling 1985: from description on map].

The Brushy Basin is distributed the length of the base of the southwest slope of the escarpment defining Salt Valley, approximately along the 1,463 m (4,800 ft) contour. West of Klondike Bluffs, the Brushy Basin exposure is up to a kilometer wide in places. The sources ground checked here appear to be cobbles eroding from limestone boulders. The lenses in which these occur are intermittently exposed. Cultural material was associated in some areas. Due to the material's occurrence as cobbles, one might expect a greater investment in decortication to procure usable material.

The availability of this material varies from the Tidwell because of its dispersed and intermittent distribution. The purple, lavender, and amber chalcedonies were present in low densities in many assemblages. The greens were not noted. Sources in Cache Valley were not ground checked. They are less available at surface level than other Brushy Basin surface strata.

Morrison Quartzite. This quartzite occurs as large boulders eroding out of what was identified as the Salt Wash Member of the Morrison Formation. The cobbles are fairly fine-grained and gray to black with patinated surfaces. Some cultural material was noted in association.

Dewey Bridge Chert. A pink "salami" chert is eroding out of the Dewey Bridge Member of the Entrada sandstone. The Dewey Bridge is described as a "dark reddish fine-grained silty sandstone, with occasional white bands" (Doelling 1985). The formation tends to weather in steep, shear cliff faces.

The Dewey Bridge Member is exposed in the escarpments on both sides of Salt Valley. Outcrops are intermittent and trend north-south from Salt Valley to the Moab Fault (along the main Park road corridor north of Courthouse Wash) and south of Cache Valley.

Unlike the chalcedonies, the quality of the Dewey Bridge cherts varies considerably. In the southern portion of the Park, secondary alluvial deposits of small, Dewey Bridge chert gravels are eroding out of the outcrops. The chert also occurs in these areas in larger nodules which are inferior in quality, due to crazed interiors, checks, and inclusions. These cobbles do not fracture conchoidally. No sources of good material were located in the Entrada Cliff Formations that flank the west side of the road north of Courthouse Wash.

The only good quality sources of knappable materials were located in the Dewey Bridge cliffs in Klondike Bluffs. The discontinuous cobbles occurred in a narrow lens above an indistinguishable narrow white unit in the Dewey Bridge Member. This high quality raw material is inaccessible in the cliff face but is eroding onto the slickrock below. Archeological material was found in association with this source area. Undoubtedly, there are additional sources within the extensive Entrada Formation; however, they were not located. Again, the occurrence of the chert as cobbles would entail a more extensive decortication reduction.

Altered Volcanic Ash. A green mineral, altered volcanic ash, occurs in narrow beds in the Brushy Basin Member of the Morrison Formation. This material has been referred to as glauconite, a silicious crystalline mineral. More recently it has been redefined as a volcanic ash which, when deposited in lacustrine contexts, was minerally altered (Dr. David Loope, Department of Geology, University of Nebraska, personal communication, 1987). It is distinguishable due to its bright green hue. The material is variable in its surface character. The higher quality stone produces conchoidal fractures when submitted to force.

The only outcrop exposed in the Park is west of the junction of Delicate Arch road and Salt Wash. No cultural material was immediately associated, but a few artifacts manufactured from the material were recorded. Small flakes produced from the material could easily be mistaken as a chert.

Amber Chert. A single source of high quality banded amber chert was located east of Salt Wash on a terrace overlooking Winter Camp Wash. The chert is interbedded immediately below the Tidwell chalcedony outcrops, which are directly east and upslope. This chert is undergoing natural exfoliation.

Human procurement activities are evident. A scatter of interior debitage (Site 42GR2159) is located downslope from the small outcrop. No cultural material was associated with the immediately adjacent Tidwell chalcedony outcrops.

In summary, raw materials of varied quality and accessibility are available. Raw material procurement and its technological implications will be discussed later.

Soil

Surface character varies throughout the Park. Much of the survey area consists of highly dissected erosional surfaces with little soil formation evident. Sediments are very fine grained and defined as sandy silts. Lag gravels and other pediments visible on the surface vary considerably. Gravels are common in the ephemeral run-off channels in the areas adjacent to the road. These areas often include chert cobbles from the Dewey Bridge and Tidwell formations. Extensive slickrock exposures are common in portions of the Park.

Climatology

Arches National Park occupies a relatively low elevation area within southeast Utah. Elevations within the Park range from about 1,250 m (4,100 ft) at the entrance along Moab Canyon up to 1,676 m (5,500 ft) on the ridge northeast of Salt Valley. Montane regions lie to the north, south, and southeast.

Air masses from the Pacific Ocean and the Gulf of Mexico are principal sources of moisture and affect local climatic variables such as temperature, precipitation, and wind. The climate in southeast Utah is characterized by little consistency or annual predictability. Temperature changes are fostered by the juxtaposition of these large, transient air masses and local diurnal and seasonal oscillations (Davis n.d.; Gregory 1938).

Local temperatures, weather, and moisture are predominantly influenced by elevation and cyclonic storms. In addition, climate in southeast Utah is conditioned by changes in topography. Insolation is fundamentally affected by elevation. Climate varies diurnally, seasonally, annually, and microgeographically (Gregory 1938; Davis n.d.).

The general pattern of vegetation distribution reflects these climatic variables. While climatic variables may not have changed since prehistoric occupations, annual precipitation can be highly variable, thus causing variation in local, annual plant productivity. Fluctuations in annual precipitation affects large floral species more than annual and perennial grasses and fruit-bearing bushes. Thus, one might expect that plant availability varied from year to year throughout prehistoric occupations, although this variability may not be reflected in climatic data (West 1978).

Precipitation

Southeast Utah has rainfall patterns similar to much of the Southwest. The quality of summer and winter moisture varies. Summer moisture occurs in short, torrential downpours. Fall and winter moisture comes from steadier and lengthier rains and snows.

From 1931 to 1960, annual precipitation rates for Moab averaged eight inches per year (Jeppson et al. 1968). From data collected between 1958 and 1973 average precipitation rates remained the same (Davis n.d.). July through February are the wet months. The heaviest precipitation occurs in April, August, September, and October. Only the month of October tends to have a mean monthly precipitation over one inch. The least amount of precipitation occurs in January and June (Davis n.d.).

As evident in the last several years in the Southwest, mean precipitation values are variable and apparently occur in cycles which were not documented until recently.

The early portion of the growing season, from May to mid-June, has very little rainfall and plants rely on effective ground moisture from the snow melt. Thirty to forty percent of the rainfall occurs during the latter half of the growing season. This, however, is also the period of extreme evaporation (Gregory 1938).

During the winter months storms originate primarily as fronts traveling east from the Pacific. Precipitation from these storms is generated by movement of relatively warm air over stationary or more localized air masses. A continual rainy season occurs during the winter months because of the dynamic interaction of these air masses (Davis n.d.).

Summer storms are initiated by local conditions. Large-scale interaction between air masses occurs infrequently during summer months. Local unstable air conditions are promoted by diurnal fluctuation in temperature. Solar radiation is at its greatest during summer days, yet nighttime cooling is significant. The interaction between warmer and cooler thermal layers induces local thunderstorms. Topographic variation and related fluctuations in temperature further augment the production of localized thunderstorms. Spring and fall tend to be periods of low precipitation because extralocal air masses and diurnal temperature ranges are not as active (Davis n.d.).

Precipitation tends to be less around Moab than in the high plateau areas immediately to the west. As fronts move into Utah they essentially are lifted by the plateaus of the southern Wasatch Range. This effects a marked increase in precipitation with increases in elevation. On the eastern slopes descending air is less moist and precipitation potential decreases (Davis n.d.).

Wind

Winds around Moab are generally strongest during April and May. The velocity decreases through the summer and slightly increases during September. Generally, the area is characterized by light breezes. Winds result primarily from frontal and thunderstorm activity. Wind direction is difficult to determine due to convolutions in the topography --mountains and basins--that effect them. Chaotic surface wind-patterns are normal; however, the wind is predominately out of the southwest at higher elevations (several hundred to 1,000 ft above ground surface [Davis n.d.]). During the night cool air flows from the higher elevations into lower ones. Daytime surface winds result from rising cool air interacting with the prevailing upper air flows.

Temperature

In this area, temperature ranges depend significantly on other climatic variables, i.e., elevation and insolation. Mean annual temperature is not an accurate measure of climatic variability in southeast Utah, because areas with similar temperature ranges can support different climates (Davis n.d.). More relevant indices of climate are diurnal temperature ranges and average temperatures between daytime maximum and nighttime minimum temperature. Temperatures in southeast Utah tend to exhibit broad diurnal ranges due to high insolation during the day and rapid nocturnal cooling.

Temperature records from 1931 to 1973 for Moab and Arches indicate consistent mean monthly warming from February to August and a cooling cycle from September to January. Both maximum and minimum monthly temperatures reflect this pattern. July is the hottest month and January the coldest. The mean annual diurnal range is 28 degrees (F). These daily fluctuations have a significant impact on biological communities and trophic levels.

Much of the temperature variance can be explained by elevation. In Utah, temperature decreases at an average of 3 degrees (F) per every 305 m (1,000 ft) increase in elevation (Davis n.d.).

November through February have an average each month of 20 days with below freezing temperatures. March has an average of 17 days with below freezing temperatures. April and October may have a few days, and from May through September temperatures occasionally fall below 32 degrees (F).

Evaporation rates have a positive lineal correlation with temperature. Soil moisture is pertinent to vegetative productivity in arid climates. Soil insolation, amount of ground surface water, wind, and whether vegetation is dormant or growing effect evapotranspiration, or water loss. The hottest months induce the greatest water evaporation. In Moab, the evaporation rate exceeds the average precipitation from May to August. Because higher elevations have cooler temperatures and greater precipitation, they have lower evaporation rates. In southeast Utah, only the montane regions (La Sals, Henry, and Abajo Mountains) have evapotranspiration rates less than that of precipitation. Humidity and temperature are lineally correlated as well. Humidity varies daily, seasonally, and annually. As temperatures increase, humidity decreases (Davis n.d.).

Vegetation

The area surrounding Moab encompasses a range of geographic precincts. These include upper montane areas such as the La sals, river basin zones such as the Colorado River, major and minor drainage systems tributary to the Colorado, semiarid plateaus, and extensive slickrock exposures and sandstone formations.

Vegetation varies in these environments in conjunction with other environmental factors; topography, elevation, insolation, soil quality, and moisture retention. Biologic communities generally reflect microclimatic variability. Scrub oak communities are found in cool, moist canyon bottoms; Douglas firs and maples are at high elevations with cool temperatures; cottonwoods and tamarisks are along more significant drainages and perennial streams; sagebrush and blackbrush parks occur in the flat, low-moisture areas. Much of the area specifically within the Park is predominately sparse grass and sagebrush (Figure 9).

Although vegetation appears scant throughout much of the Park due to differential water availability and other climatic factors, plant diversity is high. Plant communities in the washes include overstories of cottonwoods, tamarisk, willow, Russian Olive, and dense understories. In the pinyon/juniper and desert scrub zones, common vegetation is pinyon, juniper, sagebrush, blackbrush, yucca, mormon tea, prickly pear, saltbush, Indian rice grass, and various gramas. More complete plant species lists for the Moab area can be found in Gregory (1938), Hunt (1953), Harrison et al. (1964) and Berry (1975).

Fauna

Five habitats based on faunal composition have been recognized in Arches National Park. First, there is the low flood plain and open valley habitat bordering the shallow washes. This zone has clayey soils and supports vegetative communities of tamarisk and greasewood. Animal numbers and diversity are relatively low in these areas. Mammals found in this habitat include black-tailed jack rabbits and kangaroo rats. However, in these drainages bird population and diversity are high. These include blue heron, killdeer, warblers, townee, bushtit, towhee, finches, sparrows, and blackbirds.

Second, the open sandy flats and slopes above the drainages and areas between rock formations support a number of burrowing species. The small-rodent population is high in these areas.

Third, the pinyon/juniper uplands support limited mammal populations. The cottontail rabbit is the most abundant mammal in these areas today. The bird species in the pinyon/juniper highlands are distinctive. These include gnatcatchers, titmice, warblers, flycatcher jays, and sparrows.

Fourth, the rock formations themselves obviously support little floral life. However, several species of rats, mice, and chipmunks use these habitats. Raptors also nest and roost in

Figure 9. Overview of local vegetation.

these areas. These include the red-tailed hawk along with several other species of hawk, prairie falcon, and raven. Swifts, wrens, and finches also utilize these rocky areas.

The fifth habitat is the open sandy desert and shrub flats along wash margins which have limited mammal populations. Reptiles which can be found in this habitat include several species of lizards and utas (Hayward et al. 1958).

Previous Archaeological Research

Interpretation of Lithic Artifact Scatters

A considerable portion of the archeological research conducted in the American Southwest has dealt with artifact assemblages dominated by lithic tools and debitage. Most archeological investigations were primarily concerned with chronology and cultural historical affiliation. Since artifact scatters frequently lacked stratified deposits, architectural features, diagnostic stone tools, ceramic remains, faunal remains, or ecofactual materials suitable for radiometric dating, this site class was deemed nonsignificant. Frequently, archeologists assumed that lithic artifact scatters represented prehistoric groups that inhabited the region prior to the adoption of ceramics and agriculture. Such "aceramic" sites were then assigned to the Archaic occupation(s) throughout the American Southwest.

Cultural resource management studies initiated during the late 1960s and early 1970s, however, made it very apparent that such "low visibility" archeological remains represented a significant portion of the prehistoric/historic record in North America, particularly in the western states. Numerous cultural resource surveys and mitigation projects, frequently of large blocks of land, revealed thousands of artifact scatters that had generally been overlooked by previous investigators.

Archeologists have made use of artifact scatters in the American Southwest and the Great Basin to develop and to test ideas regarding past hunter-gatherer adaptations. For example, lithic scatters have been central to studies of intersite variability and settlement patterns for Paleo-Indian and Archaic occupations (e.g., Allan et al. 1975; Chapman 1980; Gumerman, ed. 1971; Judge 1973; Reher 1977). Residential and limited activity site locations were thought to reflect past reliance on mini-max strategies for resource procurement.

Chapman (1980:53) states, for example, "It is frequently assumed that Archaic populations situated their residential campsites in areas which would maximize access to and minimize energetic expenditure in procuring food resources." Furthermore, the most suitable site locations are those with access to high resource diversity. Environmental strata have been hypothesized to be a determinant in locational variability in Archaic habitational site density (Reher 1977). High site densities co-varied with the greatest vegetative diversity.

Chapman initiated a series of tests to evaluate this model. His study area was chosen because of its documented ecological diversity. Chapman's analysis illustrates that "vegetative diversity can not be demonstrated in any way as a significant determinant of the intensity of Archaic period occupation . . ." (Chapman 1980:97). The results of his work suggest that resource distributions and occupational patterns do not co-vary in a simple linear relationship.

Chapman (1980) has taken issue with two models of Archaic adaptation in the Southwest. These two explanatory models include: 1) a "food resource diversity" model; and 2) the "base camp-limited activity site distinction" model. He posits that these interpretations have not been adequately tested by archeologists and should not be accepted as adequate reflections of Archaic-period lifeways.

The "food resource diversity" model ". . . attempts to explain Archaic settlement behavior as a logistical feeding response which maximizes spatial access to the greatest variety of available foodstuffs" (Chapman 1980:2). This model is derived from mini-max economic models that were employed during the 1970s to account for site locational strategies and food procurement patterns (Gumerman 1971; Jochim 1976).

Using the "base camp - limited activity site distinction," Chapman summarizes the convention used to explain intersite variance. The underlying assumption in this model is that sites have specific functions. Sites exhibit a limited range of types that can be classified as either "residential" or "special purpose" locations. Chapman (1980:120-121) argues against such a notion about the Archaic because it

> employs descriptive statistics derived from a population as if they were behavioral variables underlying the nature of that population. The analytic procedure thus becomes an exercise in circularity through which the researcher posits an assumption that a population of sites should exhibit modal variation along some dimension . . . arrays his sites against that dimension and then interprets <u>any</u> modality observed as a verification of the assumption.

The concept of residential and special purpose sites does serve to organize site variability. However, such a distinction may not be directly discernible given a static archeological record. Variances in occupational histories which may render a site as "residential" or "special purpose" have been re-evaluated recently (Camilli 1983). Recent re-evaluation of Archaic adaptations and artifact scatters in the context of "distributional archeology" (e.g., Isaac 1981; Binford 1980; Camilli 1983; Ebert 1986) are relevant to the present study. The implications of distributional archeology for the present study will be discussed later.

Local Archeological Investigations

Archeological reconnaissance has occurred in limited sections of the Park for over 50 years (Appendix A). Prior to this survey, approximately 100 sites had been recorded within Arches National Park. The current survey inventoried an additional 20 sites. The relatively recent interest is due in part to the overriding attention given to Anasazi and Fremont components in the adjacent canyon country. The earliest work in the area was by Frank Beckwith in 1934 and involved recording a pictograph panel near the mouth of Courthouse Wash. Over a decade later, between 1949 and 1952, Alice Hunt conducted a survey in the La Sal Mountains and vicinity. She recorded 350 sites; eight of these were located within the southern portion of Arches National Park.

Not until the 1950s was the extensive distribution of lithic scatters formally recognized. Lloyd Pierson, from 1956 to 1972, standardized the recording procedures for 51 sites in the Park. Lindsay and Madsen (1973) surveyed limited areas in the Park prior to improvements. This survey produced no archeological evidence. However, one area, the Delicate Arch Road, may have had no resources in the immediate road corridor, but surrounding it is perhaps one of the richest archeological areas in the Park. Sites in the vicinity include several rock shelters (42GR516, 42GR517, 42GR518, 42GR294, 42GR295), petroglyph sites (42GR519, 42GR542), a quarry site (42GR572), and several lithic scatters (42GR541, 42GR558, 42GR559). Berry (1975) surveyed the northeastern portion of the Park and located 30 new sites and re-recorded six sites previously recorded by Pierson (Anderson 1978; Berry 1975). Many of these were lithic scatters. Berry also identified the Tidwell outcrops, a commonly utilized lithic source in the Park. Pierson (1978a, 1978b) provides an extensive overview of site types, previous work in the area, and a summary of the culture history of the area.

Since 1982 the Midwest Archeological Center has conducted several projects in response to improvement and maintenance projects. Six new sites, all lithic scatters, were identified in the Devil's Garden Loop and seven new sites were found along the east and west fence boundaries of the Park. In the Park, only one site (42GR1533) has been tested for subsurface components.

Apparently, a greater diversity of sites was identified during previous surveys. The 1987 survey documented 24 temporally and culturally nonspecific lithic scatters. One artifact assemblage contained several vessel fragments. A rock art panel and a historic site were also recorded. The Anasazi component appears to be scant in this area. Few structural and artifactual remains have been located, although Anasazi/Fremont rock art has been more extensively identified. While the area at large supports evidence from all Pueblo development stages, no Basketmaker or Pueblo III components have been identified within the boundaries of the Park. Paleo-Indian remains have been recorded in the vicinity of the La Sal Mountains, as well, but no evidence has come from within Park boundaries.

The surveys completed by Hunt and Tanner are responsible for a large portion of local investigations. They proposed a series of Paleo-Indian sequences, e.g., the "Moab," the "La Sal," and "Uncompahgre" complexes (Hunt and Tanner 1960). These culture historical units were based on the presence of diagnostic projectile point types in artifact assemblages. The depositional surfaces on which these assemblages were found were assigned relative dates through geomorphological comparisons of remnant dunes.

The Moab complex is associated with Folsom and certain Pinto point types. These sites are located on the divide between the Colorado and Green Rivers at elevations of about 1,524 m (5,000 ft) (Hunt and Tanner 1960).

The La Sal complex is defined by association of assemblages with Gypsum Cave and Pinto points. These sites extend from the base of the La Sals to about 3,049 m (10,000 ft). Generally, water, floral, and faunal resources are more plentiful at the higher elevations. From a seriation evaluation from Ventana Cave, the La Sal complex is thought to be older than that of the Moab. These complexes are seen to be separate both temporally and spatially (Hunt and Tanner 1960).

The local manifestation of the Uncompahgre complex is characterized by flat, or slightly basin-shaped metates, one-hand manos, and large to medium sized corner-notched points. Dates of 1000 B.C. to A.D. 500 were extrapolated from radiocarbon dates and alluvial depositional contexts (Hunt and Tanner 1960).

Six sites within the Park are thought to have Numic components; these are identified by petroglyph motifs and ceramic types. However, "stylistic" variation in artifacts and features as a means of identifying Fremont and Numic cultures is still debated widely. Hunt (1953) does state that masonry sites are not located above 1,829 m (6,000 ft) in the La Sal Mountains.

Historic Euro-American Occupation

The earliest reported European contact in the Moab area in the 1540s represents the initial effort of the Spanish to claim southern Utah. A group of Spanish scouts, led by Garcia Lopez de Cardenas, were adjunct to Coronado's exploration of the Southwest in search of the seven cities of Cibola. However, the inability to locate Cibola discouraged further exploration for another century. (For a more complete historical overview of southeast

Utah see Crampton 1964, Mehls 1986, Miller 1968, and Pierson 1978a; much of the following is derived from Mehls' compilation).

Although the Spanish were established along the northern Rio Grande by the mid-1600s, interest in southeastern Utah was not revitalized until the mid-1700s. This expedition was inspired by a search for silver mines. Rivera, sent by the governor of New Mexico, is thought to have reached the southern bank of the Colorado River near present-day Moab.

Escalante traveled portions of central and western Utah in 1776 in search of a trade route from northern New Mexico to California. His expedition traversed north to the Green River and west from there to western Utah. However, somewhere near Cedar City they turned back, deciding that there was no propitious route to the Pacific through Utah (Miller 1968). Due to the failure to locate a route, further exploration or settlement of Utah was again not encouraged. However, the maps made during this exploration are among the earliest of Utah.

The Old Spanish Trail, which passed through modern Moab, was the eventual outcome of the effort to establish a trade route to California from the northern New Mexico settlements. The more direct route to the Pacific coast via Arizona was avoided due to inhospitable relations with Native Americans.

Rivera's expedition is thought to have broken the trail in 1765. However, it was not extensively used for another 50 years. Arze and Garcia recorded the first trip along the Old Spanish Trail in 1813. Although no longer in use when the Mormons arrived, the ruts are still visible.

The trail is thought to pass through the very southwest corner of Arches National Park. An attempt was made to relocate the section in the Park during this survey. While a cut through the cliff edge was noted, it could not be verified if this were the Spanish Trail or not. Inscriptions reported to be engraved on the boulders there were not relocated. However, the inscription "Montrose Waugh 1753" is located about 15 miles north of Moab on what may have been the same route.

Southeast Utah was formally apportioned to Spain in 1819 when the United States signed the Adams-Onis Treaty. By the 1820s, there was an annual trade caravan of several hundred people who traveled west with woolen goods and returned east with livestock. The Spanish and Utes also traded along the route. In the early 1820s, Mexico sought independence from Spain. After the Mexican Revolution, trade was permitted between Hispanic New Mexico and the Anglo United States. The increased market for beaver and the lenient trade restrictions brought the first flux of northern Europeans into southeast Utah. By the 1850s, Hispanic interaction in southeast Utah was curtailed when the Mormons ended the slave trade in which the Hispanics participated.

W.H. Ashley, a co-owner of the Rocky Mountain Fur Company, negotiated the southern portion of the Green River in 1825 during a reconnaissance venture. He did not reach the confluence of the Colorado River. According to chronicles, Jedediah Smith is considered to have trapped in the area in 1825. While the trapping industry revitalized use of the Old Spanish Trail and increased the knowledge of this portion of Utah, no Anglo settlements were established. The trappers' occupation of the area is documented by few archeological remains, however, a number of inscriptions are present. The engraving "Julien 1844" was recorded in Arches. The decline of the fur market in the 1840s ended use of the trail and travel slowed through this portion of southeast Utah.

In 1848, at the end of the Mexican War, the United States gained possession of Utah. Southeastern Utah, one of the last areas in the country to be geographically charted, was finally documented during military reconnaissance. The U. S. Army Corps of Topographical Engineers, under the direction of John Fremont, had explored the area between 1843 and 1845. Again, the object of the exploration was an alternative route to the west coast. Fremont's cartographer provided the first detailed maps of the area.

During exploration for a transcontinental railroad route by the Corps, the area north of Moab was explored by Capt. John Gunnison in the 1850s. The Denver & Rio Grande Western was built in the early 1880s. It was routed from Grand Junction, Colorado, northwest to Salt Lake City, skirting Moab. The nearest station stop was Thompson's Spring, 35 miles north. This route approximated that which Gunnison had recommended in 1853. The railroad, which provided improved transportation and communication potentials, impacted market networks, economic redistribution, and settlement accessibility.

In the early 1870s, John Powell explored the Green River drainage. The sketches made during these trips were the first maps of the Colorado and Green River systems. Between 1875 and 1876 the La Sal and Abajo Mountains were charted.

The first cadastral survey in southeast Utah occurred in the 1880s. Projects to plat the area were sporadic and contingent on resource exploitation interests. The effort was not complete until the uranium boom of the 1950s. Currently, most of the area's maps are only available in a 15-minute scale.

Early Mormon settlement began in 1846 with the migration to Salt Lake Valley west of the Wasatch Range. Mormon interest centered on establishing Salt Lake City. Colonization south of Salt Lake did not occur until almost ten years later with the establishment of the Elk Mountain Mission near modern Moab. However, relations with local Native Americans prohibited the formation of a permanent settlement. Intentions to further settle southeast Utah were abandoned until the 1870s.

Only after the Utes were relegated to reservations were advancements made in permanently settling the area. During the 1870s, migration to the Moab area was sporadic. In the early 1880s, Moab was a town of about 20. A successful migration of Mormon farmers occurred in the 1880s. San Juan, Emery, and Grand counties were established between 1880 and 1890.

The cattle industry promoted the first extensive European settlement of the area by ranchers expanding out of the Texas plains. By the 1870s lands to the east and west of Moab were overgrazed. By 1893, the environmental constraints of the area were being felt by the cattle industry. A ten-year dry spell seriously threatened the local carrying capacity of an area dominated by short grasses and relative patchy water distribution. Ranchers expanded into pristine lands in southeast Utah where the first ranches were small, family-based outfits.

The ranching industry oscillated between boom and bust cycles. By providing a distribution system, the railroad had an enormous impact on the success of the western cattle industry. The first boom occurred after the Civil War with the opening of the west by the railroad. Although the Denver & Rio Grande railroad was 20 miles north, it did facilitate access to the area. The mining industry in Colorado supported much of the early demand for beef and encouraged substantial growth of the industry.

The 1880s was an era of large cattle holding companies throughout the west. Small family holdings did not re-emerge until the turn of the century. The organization of the stock industry continued to fluctuate in response to larger economic factors.

Liberalization of the Homesteading Acts encouraged the last wave of homesteading between the 1910s and mid-1920s. Inflated produce costs during World War I encouraged family farming in the west. This temporary population boom was short-lived, however. Many homesteads were abandoned after the war due to the reduction in food prices and water limitations. The Dust Bowl and the Great Depression also adversely affected the local farming and ranching economies.

Problems surrounding overgrazing and federal intervention were characteristic of twentieth-century ranching developments. Range control tactics had varied success. Disputes between sheep and cattle ranchers were prevalent, but did not escalate to the violence common elsewhere.

By the late 1890s, the popularity of sheepherding further reduced the continued success of cattle ranching. After 1900, cattle were being replaced by sheep to a significant degree. This condition was fueled by wool market prices. The last large cattle company sold out in 1965. Generally, during the 1960s economic emphasis changed to mining exploitation and wage labor.

Although livestock and agriculture comprised the economic mainstay, mining and lumbering did augment the local economy in the later nineteenth and early twentieth centuries. While there were several precious-metal boom cycles, these population influxes were based mostly upon spurious information and were short-lived.

Placer mining had some marginal success along the Colorado River. Hard-rock mining, due to heavy technological and financial investments, was limited because no substantial subsurface ore deposits were located. Uranium and potash mining did become a vital aspect of the post-World War II economy (Pierson 1978a).

The forested slopes of the La Sals provided the nearest building material and fuel source for the town of Moab. These forests were timbered prior to their coming under conservation jurisdiction by the federal government.

Southeast Utah did not begin to interest scientists until the 1900s. Dr. Byron Cummings of Harvard University directed the first archeological field work during the early 1900s. In the 1930s, the geologic resources came to scholarly attention. A systematic survey of Arches was conducted in 1933. The post-World War II energy demands for uranium, oil, and natural gas contributed to significant interest and study of the area.

Southeast Utah's early history is developmentally dissimilar from many of the other areas involved in the general western expansion. Its early history was characterized by isolation, environmental constraints, a late Indian occupation, and economic instability. Permanent settlement occurred considerably later than in other areas of the Southwest.

Several geographic and environmental factors precluded early development and conditioned settlement when it did occur. Unreliable and uneven distribution of water and arable land restricted ranching and farming-based economies. The Colorado River, which is a major drainage through southern Utah, was obviously of considerable value as a water resource, but it also hindered travel routes. Fording locations significantly conditioned transportation patterns.

Native Americans were not subservient to early Euro-American explorers and settlers and the area was avoided for a long time. Because transportation routes skirted the Moab area, it remained uncharted until the late 1880s. Southeast Utah was bypassed by major thoroughfares from the transcontinental trails, through the railroad, and up to the present-day Interstate 70. This general lack of access limited settlement until the late nineteenth century.

METHODOLOGY

Distributional Archeology

The recent development of anthropological theory of hunter-gatherer behavior, as well as middle-range studies, has required that archeologists develop data recovery and analytical methods appropriate for regional-level distributions of artifactual remains (Ebert 1986). Large-scale areal surveys have begun to reveal variable, yet continuous, distribution of artifactual remains across the present-day landscape. A number of studies have also demonstrated that surface remains could be used in order to evaluate an array of archeological and anthropological problems.

Archeologists have been required to reconsider the utility of the "site concept" itself (Ebert 1986). The development of theory regarding hunter-gatherer behavior discussed above, as well as ethnoarcheological observations, has required reassessment of the site-specific, activity-centered view of past human behavior. Ebert (1986) points out that such an archeological assumption had been adopted from an ethnologist's perspective. A long-term view of the spatial aspects of human behavior and a better appreciation of the mobility of hunter-gatherers create a much more complex view of the archeological record. This view does not readily support the classification of archeological remains into discrete sites.

Ebert (1986:85) provides a description of the archeological record that differs considerably from our traditional "site" approach:

> . . . this sort of archaeological record is, instead, best seen as a "web of pathways over a piece of terrain" [Isaac 1981:131], as the product of mobility rather than the focus of specific activity . . . . Over even short time periods, human mobility forms a dense web consisting of lines with "nodes" at which discard is repeated. Over longer periods of time the nodes tend to blend together in different ways; the result is that ". . . the archaeological record as it comes down to us is in no sense a simple 'map' of where humans discarded things, much less a map of where they used things or where they went" [Isaac 1981:134].

Ultimately, any interpretation of artifact scatters in Arches National Park must incorporate these recent developments in distributional archeology. The archeological survey in the Park did delineate boundaries for lithic artifact scatters; however, "site" definition in this case was designed to fulfill Park management needs. These boundaries were defined on the basis of "in-the-field" judgements regarding artifact densities and/or clustering. In some cases, "site" boundaries coincided with discontinuities in artifact distribution created by arroyos, bedrock surfaces, and/or trails and roads.

Recording Procedures

Areas surveyed were prioritized by Park personnel. Evaluation was based on the extensiveness and imminence of anticipated development and maintenance in the Park. All areas suggested for clearance were surveyed. These included a probable impact swath of 50 meters and 15 meters wide on either side of roads and trails, respectively.

Specific areas inventoried, by order of priority, were the following: (1) the Delicate Arch Road including the area surrounding the Delicate Arch Viewpoint parking lot that is anticipated for improvement; (2) the interior portion of the parking lot loop of the Windows Section Road, and the trail to Double Arch; (3) the Devils Garden Campground improvement areas (surveyed 1982; Griffin 1985) (4) the heavily trafficked trails in the Devils Garden Landscape Arch complex, including the Landscape, Partition, Navajo, Double O, Dark Angel, Pine Tree Tunnel, and Wall Arch trails and the Fin Canyon primitive trail, as well as the Windows Section trail complex including North Window, South Window, and Turret Arch trails; (5) the paved road including the Windows Section access road, and the Fiery Furnace Viewpoint, Salt Valley Overlook, Panorama Point, and La Sal Mountains Viewpoint access roads; (6) the less-trafficked trails including Park Avenue, the Delicate Arch, Sand Dune, Broken, Skyline, and Tower Arch trails.

Twenty-six sites and 79 isolated occurrences were located within a total survey area of 1,160 acres. Six sites had been recorded previously including three rock shelters situated outside the clearance areas. These sites were visited to redocument prior work and to evaluate any evident vandalism. Based on previous inventories of the area, the density of the archeological resources was considerably higher than anticipated. The areas surveyed included 24 miles of paved roads, three miles of unpaved roads, 14 miles of trails, and about 40 acres in block areas that had been slated for development or maintenance.

Field procedures varied somewhat with the parcel type--road, trail, or block area--being surveyed. A swath 50 meters wide on either side of paved and unpaved roads was covered. On the Delicate Arch dirt road a three-person crew walked at 15 meters intervals on each side of the road. The coverage intensity was due to anticipated paving of the road which would result in major ground disturbance. Additional areas around Salt Wash were also covered as this is where the road is to be rerouted. Areas investigated were marked by survey stakes.

The main paved road, the Windows Section road, and the paved access roads to turnouts and view points were surveyed in a 50 meter swath on either side of the road. Intervals between th surveyors varied. A two-person and a one-person crew alternated every other mile on either side of the road. Thus, transect intervals varied from 15 to 25 meters. As much of the area consists of small lithic scatters, part of the reason for this procedure was to evaluate to what extent site density indices are a result of coverage intensity. In other words, would more sites be recorded on sides of the road with smaller transect intervals?

Observed site frequencies do not vary strongly with survey crew size or intensity. Five sites were recorded by a single crew member surveying a 50-meter swath. Four sites were documented by a survey crew of two persons. Isolated occurrences, however, tended to be noticed almost twice as frequently (28) when two crew members were covering the same area as one (18). These findings suggest that reconnaissance ability appears to be related to crew size and to the spatial extent of the archeological distribution.

A clearance swath of 15 meters was maintained while surveying trails. On trails, surveyors walked at seven-meter intervals, one on each side of the trail and one on the trail itself.

Isolated Occurrences

Isolated occurrences were defined as spatially discrete, limited-sample manifestations. In most instances they included one or two artifacts. When more artifacts were present, a "field call" was made. Small samples of similar artifact types, all debitage for example, were considered isolates. When a greater diversity was represented, these artifact clusters tended to be recorded as sites.

Isolated occurrences were recorded on a standardized form. Their cadastral and topographic location, vegetation zone, and an artifact variable description were recorded. They were plotted on topographic and aerial photo maps. All tools were drawn. Site recording was a much lengthier procedure.

Sites

When assemblages were encountered, the extent of the scatter was determined by reconnaissance of the immediate area. The noodling, or wandering, fashion of reconnaissance was avoided when possible and a more systematic method was employed. Features, artifact concentrations, and tools were flagged. This accommodated mapping and site recording.

Site perimeters included the furthest span of continuous artifact distribution. Frequently, this incorporated highly dispersed artifacts, which extended away from the more aggregated assemblage and followed run-off patterns. These peripheral distributions are likely secondary alluvial deposits, not cultural ones. Nonetheless, to delimit perimeters using criteria other than surface visibility would have been a subjective .mb8 exercise. Therefore, site area alone is not a useful index of occupational intensity or site complexity.

Once the general perimeter was identified, tasks were divided. A map was drawn, an IMACS form completed, photographs taken, features described, and a sample transect inventoried.

Detailed site sketch maps included topographic and erosional attributes, features, artifact concentrations, and specific artifact locations. These site maps were based on a central datum. Larger sites required a series of interrelated datum points. Scale and orientation varied to accommodate the 8 1/2-in- x-11-in page format.

An aluminum site tag with a temporary number (UNL 1 to 26) was tied to a tree or bush as close to the datum as possible. The original Smithsonian trinomial number was reused on sites which had been previously recorded. A list of sites located during this survey that correlates temporary UNL site numbers with permanent trinomial numbers is included in Appendix D.

Six of the 26 sites had been previously recorded. L.M. Pierson had identified five of these locations from 1957 to 1959. No formal documentation or analysis was derived from his work.

Berry (1975) had previously documented one site. However, site dimensions varied between the two recording efforts. A few of the localities Berry inventoried were relocated, but no cultural material was found. These specifically surround the Tidwell chalcedony outcrops. Problems with determining natural and cultural assemblages at these raw material loci are discussed in the overview of the project area. Several sites recorded on the archeological basemap were not relocated. However, the scale and lack of detail on a 15-minute map make pinpointing ground locations very difficult. Site descriptions, locational information, and site maps were inadequate to verify locations of these artifact scatters.

Features were described on the basis of dimension, content, shape, structural components, and associated artifacts. Written documentation was accompanied by a detailed map. Features were documented at only two sites, one of which was an historic locale.

An IMACS form was completed according to the requirements outlined in the current IMACS manual. Both black-and-white and color photographs were taken of the overall site area, features, and specific artifacts. All site and isolated occurrence locations were plotted on the 15-minute Arches National Park USGS quadrangle map and on black-and-white aerial photographs. Since 7.5-minute maps have been issued for only the central portion of the Park, aerial photographs were more useful and consistent in plotting ground locations. Their scale (1:5,208 or 295 m to the inch) was sufficient to maintain accurate surface identifications.

At the beginning of the project, it was decided that data recorded on an IMACS form could not adequately quantify variability across the project area and, therefore, little analytical use could be made. Consequently, in an attempt to systematically collect data that would reflect assemblage variability as well as satisfy managerial and budgetary concerns, a simple sampling strategy was implemented at each site.

A meter-wide transect was randomly placed across the scatter. On very low-density distributions, transects were situated to collect an adequate sample. Transect sample density is not necessarily proportional to the overall site density. This transect data facilitated initial assessment of artifact assemblage variability. Quantification of assemblage diversity based on the Shannon-Weaver statistic circumvents the sample size dilemma. (This sample size issue will be dissussed in the section on assemblage observations).

The meter-wide swath was divided into two, meter-long units. Artifacts in each 1 m x 2 m unit were recorded separately. Within transect samples, frequencies of material types for each artifact type were observed. Artifact types and terms are defined in Appendix E. Material types are discussed in the chapter on Project Area. Other artifacts not within sample units were recorded as per allowances on the IMACS form.

Artifact classes are intended to be descriptive. Functional interpretations are not presumed at a macroscopic level of observation. Notable may be the paucity of utilization and retouch recorded for artifacts. Recent microwear studies show that assessing edge damage is a complex issue. The information derived from macroscopic analysis does not reliably reflect use and functional patterns. Numerous factors, from spontaneous retouch to postdepositional wear, can contribute to what macroscopically may appear as retouch or utilization (Keeley 1974; Keeley and Newcomer 1977; Odell 1977; Odell and Odell-Vereecken 1980; Tringham et al. 1974).

Determining use versus retouch in the field is in most cases virtually impossible. When edge damage was uniform and displayed several polythetic characteristics of use or retouch, the attribute was recorded (one piece of debitage was recorded as used). No artifacts were collected.

THE ARCHEOLOGICAL RECORD

Introduction

Twenty-six sites and 69 isolated occurrences were recorded during the 1987 field season (Figure 10). Eighty percent (23) of these sites were lithic scatters. A petroglyph (42GR297), an historic site (42GR544), and a lithic scatter with associated ceramics (42GR290) were also identified. Six sites had been previously recorded. All but one of the 69 isolated occurrences (an historic horseshoe) were lithics.

In general, assemblages are described by (1) a high frequency of interior debitage; (2) few primary or decortication flakes; (3) a relatively low proportion of angular debris to flakes; (4) few cores, projectile points, and unifacial tools; and (5) the use of local white chalcedony in flake and tool manufacture.

Most surface assemblages are lithic scatters of unknown age. The lack of chronological specificity does not preclude observing variability in assemblage and locational data. Across sites, assemblages varied in density, size, artifact diversity, and material type represented. Formalized tools occurred in 50 percent of the assemblages. For the most part, tools consisted of bifaces and extensively retouched flakes. Little ground stone was recorded. Appendix E contains a glossary of lithic terms used in this report.

A large proportion of the material utilized for all artifact classes was a local Tidwell white chalcedony. This source is distributed intermittently throughout the Park as small, clustered outcrops. Lithics also were manufactured from Brushy Basin chalcedony, Dewey Bridge chert, quartzites, and a minerally altered volcanic ash, all locally available. It is notable that very few unidentifiable or extralocal materials were documented. However, a few cherts, for which the sources are unknown, were recorded.

This survey covered a limited portion of the local geographic variability. Areas inventoried were confined to corridors on either side of roads and trails, which on many stretches are impacted both from construction and visitor access. The overall density, content, and distribution of the following assemblages is likely representative of a small segment of the range of site variability within the area. Fundamental to any comprehensive archeological analysis would be a consideration of the range of local environmental strata not included here.

A descriptive summary of the archeology follows. Site descriptions include provenience data, site dimensions, depositional context, assemblage content and distribution, factors leading to site disturbance, and previous documentation. General landform refers to the greater geographic situation;

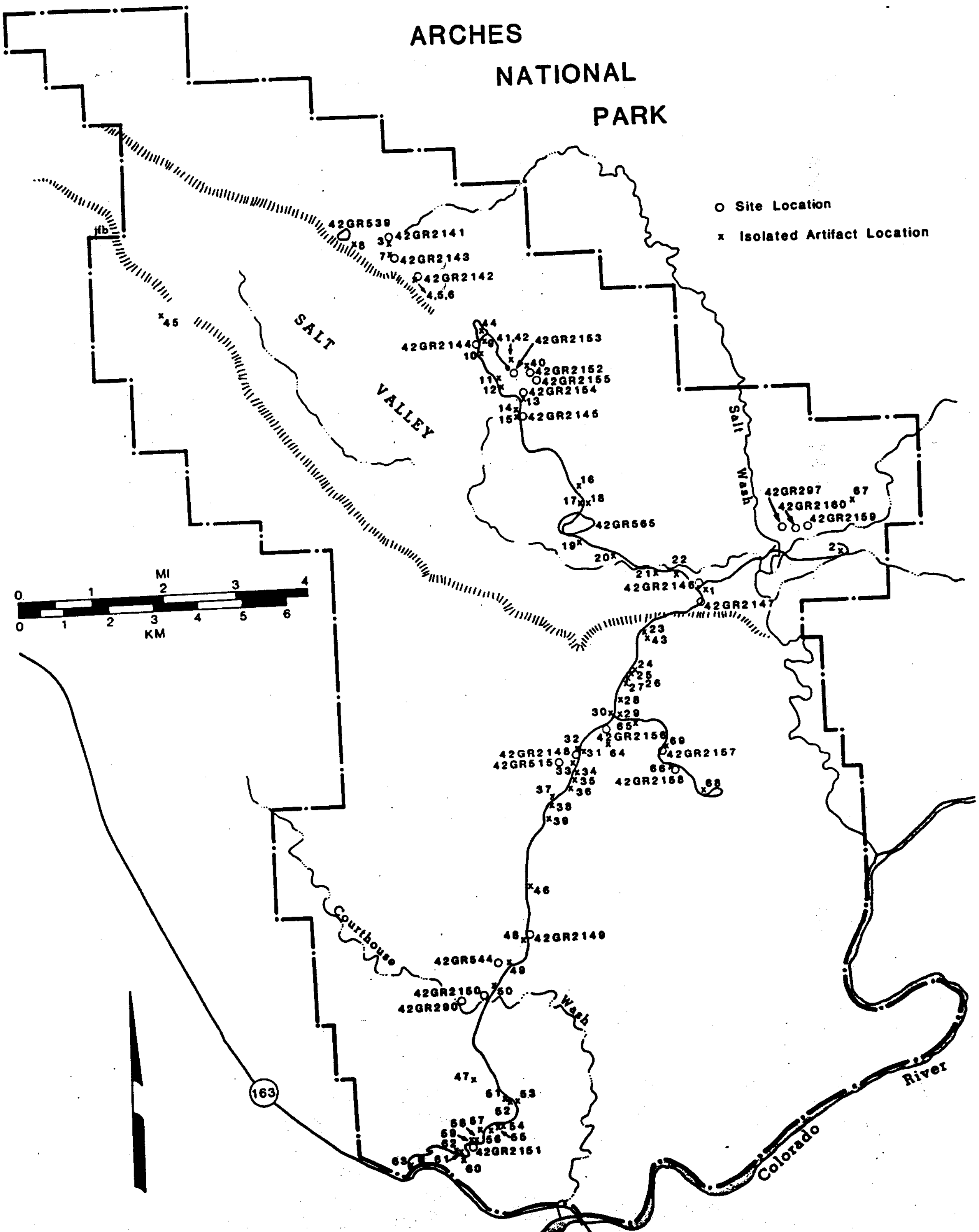

Figure 10. Arches National Park; distribution of archeological sites and isolated occurrences.

specific landform refers to the immediate ground surface on which the site is located.

Site Descriptions

Site: 42GR297
Field designation: UNL1
Location: T24S, R22E, Section 8; SW1/4 of NW1/4 of NW1/4
Elevation: 4,320 ft 1,317 m
Area: 24 sq m
General landform: Valley
Specific landform: Cliff face

This rock art site is at the base of a low, east-west trending ridge 150 m west of Salt Wash (Figure 11). The confluence of three major tributaries to Salt Wash is about 600 m south. The petroglyph panels are pecked in a heavily patinated, south facing rock outcrop. The Entrada sandstone face is about 15 m high.

Three panels were documented. The central panel is the largest and depicts a series of Big Horn sheep (7), figures on horses (5), coyotes (3), and undifferentiated curvilinear forms. The panel to the north is a single curvilinear form, 60 cm high and 25 cm wide. It resembles a Fremont anthropomorph. The southern panel is a depiction of a figure on a horse and a stick figure. The central panel has received some vandalism. Several bullet holes were noted, and the surface has been abraded. Since the site is about 130 m north of the trail to Delicate Arch, it is easily accessible. Heavy visitation to the area may promote casual collecting. No artifacts were associated.

Pierson recorded the site in 1957. He reported no vandalism at that time. No artifacts were collected, and no mention is made of surface remains.

Site: 42GR2141
Field designation: UNL2
Location: T23S, R21E, Section 21; SW1/4 of NW1/4 of NW1/4
Elevation: 5,120 ft 1,560 m
Area: 444 sq m
General landform: Entrada fins
Specific landform: Ridge saddle

This dense lithic scatter is on a level area between two east-west trending sandstone fins. Due to the longitudinal position of the fins, the area is somewhat protected to the north and south. The area overlooks the extensive, northeast sloping Entrada fin formation. The site is on the northwest periphery of Fin Canyon, a mayor drainage in this area.

The assemblage distribution is discrete, confined, and dense. Density is upward of 100 artifacts per meter square. Debitage is the only artifact class noted.

This dense lithic scatter is composed predominately of small interior flakes and angular debris less than two centimeters in length. The lack of decortication flakes and cores, combined with the preponderance of small, interior flakes, suggests that partially reduced lithics were transported to the locality for further reduction. Evidence of heat treatment is common and appears to have been initiated on materials that already had been partially reduced.

A homogeneity in material type characterizes the assemblage. A local, white/clear chalcedony constitutes more than 99 percent of the lithic sample. Very sparse amounts of gray silicified wood, white chert, quartzite, and an amber/red silicified wood were noted.

The Devils Garden primitive trail is several meters east of the site and may have disturbed the original distribution. A recent campfire, a tent stake, and metal cans were located in the densest portion of the site. Modern disturbance continues to impact the site. Diagnostic artifacts may have been collected from the site.

Site: 42GR2142
Field designation: UNL3
Location: T23S, R21E, Section 21; NE1/4 of SE1/4 of SW1/4
Elevation: 5,440 ft 1,658 m
Area: 3,200 sq m
General landform: Entrada fins; Ridge
Specific landform: Dune

This lithic scatter is in a dunal area between two southeast-northwest trending sandstone fins. The area is situated on the high, northeast sloping plateau east of Salt Valley. The immediate area consists of remnant dunes and internally drained blowouts. Little of the area is intact.

The primary assemblage is distributed in a blowout. The assemblage is highly dispersed. No artifact concentrations were noted. The scatter probably represents an aeolian and alluvial redeposition of material eroding out of the deflated dunes.

The assemblage consists of debitage. No tools were located. Material types and reduction stages were consistent across the site. The debitage sample consists of small interior flakes and finishing flakes. A large proportion of the sample are pressure flakes suggesting that final tool manufacture, or retooling, was an activity focus.

All debitage, except one quartzite fragment, was of white chalcedony. Maximum density is 10 artifacts per meter square.

Site: 42GR2143
Field designation: UNL4
Location: T23S, R21E, Section 21; NW1/4 of NW1/4 of SW1/4
Elevation: 5,440 ft 1,658 m
Area: 1,880 sq m
General landform: Entrada fins; Ridge
Specific landform: Dune

A highly dispersed lithic scatter is situated on a wide level area among several southeast-northwest trending fins. The scatter is distributed on a remnant deflated dune surface. Several ephemeral drainages bisect the site. The Devils Garden trail is on the site's southern perimeter.

This dispersed and sparse lithic scatter is a fairly redundant assemblage. Small interior and pressure flakes are common. Debitage is predominately of white chalcedony and Brushy Basin pastel chalcedony.

The area is highly deflated. The artifact spatial distribution likely retains little integrity. The lack of tools and larger flakes could be biased by visitor collection.

Site: 42GR539
Field designation: UNL5
Location: T23S, R21E, Section 20; SE1/4 of NE1/4 of NW1/4
Elevation: 5,360 ft 1,634 m
Area: 33,000 sq m
General landform: Ridge edge
Specific landform: Dune

This large dispersed lithic scatter is in a broad valley that slopes to the northwest. The valley drains this portion of the ridge east of Salt Valley. At this point the plateau rises abruptly about 200 m above Salt Valley. This valley trends northeast and is one drainage north of Fin Canyon. The site area overlooks Salt Valley to the west and the extensive Entrada fin formations to the east.

The assemblage is widely distributed across a deflated dunal slope. The site extends from the bedrock on the ridge edge downslope to the northeast (Figure 12). The distribution appears to continue onto the first bench below the plateau rim, but it is not accessible. This is probably the Dark Angel site.

The pattern of artifact distribution is relatively undifferentiated across the site. Discrete artifact loci were not identified. The northeast portion, which is downslope, has a somewhat greater artifact density, which ranged up to 15 artifacts per meter square. Slopewash may affect this distribution.

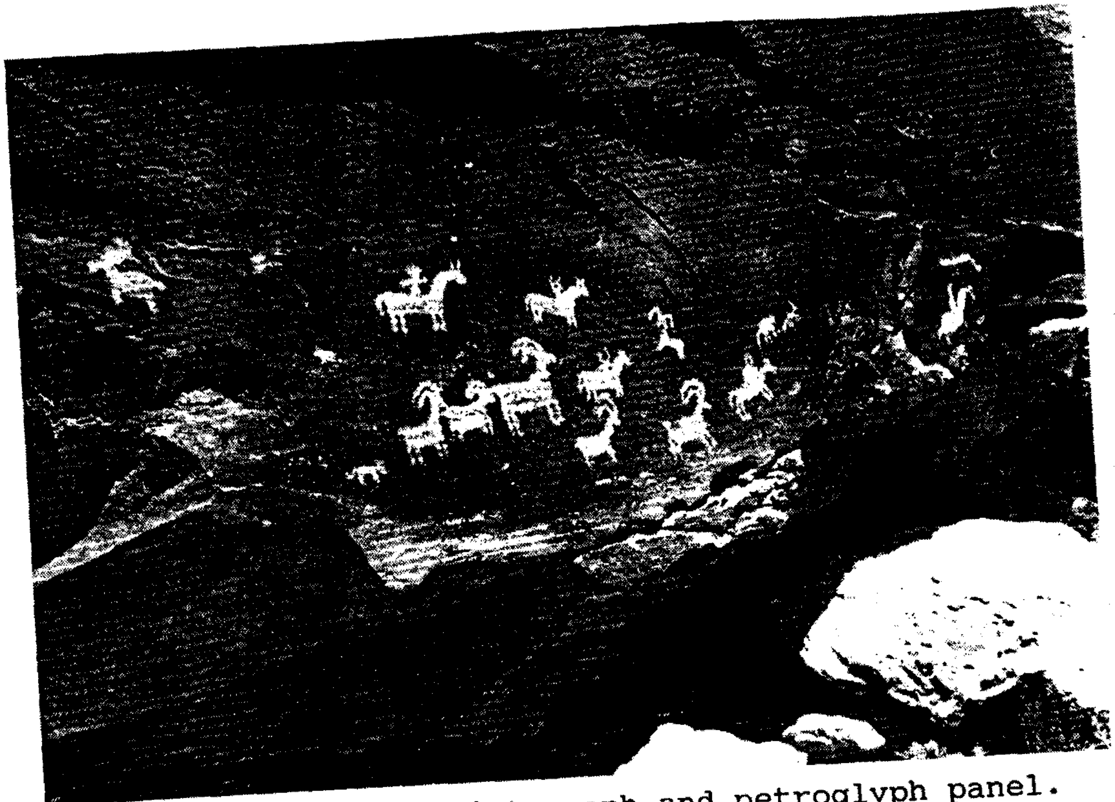

Figure 11. 42GR297; pictograph and petroglyph panel.

Figure 12. 42GR539; overview.

Assemblage content does not appear to vary across the site. All reduction stages were noted, although decortication evidence was nominal. Interior and pressure flakes were common. A large chert and a white chalcedony flake were unidirectionally retouched along one margin. One tested chert cobble was recorded. Cores are not common in assemblages documented during this project.

Two projectile points were located in the northwest portion of the scatter (Appendix F). One, a small, complete, triangular point has a convex base. It was manufactured from a white chert, or chalcedony, and has a heavily patinated surface. The other is a similar small triangular point with a straight base and is complete. It was manufactured from purple Brushy Basin chalcedony. Also, a large, thick, chunky white chert biface is broken and retains cortex on one surface. Owing to erosion and deflation, the scatter probably has little spatial integrity. Subsurface remains are probable. The Dark Angel trail bisects the site. Visitor access probably has had an impact on certain classes of artifacts which may have been selectively collected.

Pierson recorded the site in 1959. No artifacts were collected. He indicates the presence of "points and chipped material." The site is described as a "series of almost continuous campsites along south exposure of north wall of the valley. Also a series of pecked pictographs on north side and one panel of painted on south side" (Site form on file at the Midwest Archeological Center, Lincoln, Nebraska). The rock art panels were not relocated. The site that was rerecorded during this survey may be the southeast extension of the area Pierson documented.

Site: 42GR2144
Field designation: UNL6
Location: T23S, R21E, Section 27; SE1/4 of NW1/4 of SW1/4
Elevation: 5,120 ft 1,560 m
Area: 1,200 sq m
General landform: Valley
Specific landform: Slope

This sparse and dispersed lithic scatter is situated on the east flank that defines the perimeter of Salt Valley. The locale affords an overview of Salt Valley to the north and south. The scatter is distributed across a west trending slope. The area is dissected by ephemeral alluvial channels.

Debitage consists of various reduction stages. Large interior flakes dominate the sample. The frequency of smaller biface flakes is limited. Most debitage is of white chalcedony, although some pastel chalcedonies and red cherts were recorded. A multiplatform core produced from white chalcedony has a battered edge.

Three bifaces and a mano were inventoried. A large, complete, ovoid chert biface is reduced on only one surface (Appendix F). The margins on both surfaces, however, are extensively retouched. A thick, chert biface is broken at the tapered end. The edges are polished and step fracturing is extensive on both the proximal and distal ends. A white chert biface fragment is thin and has a regular cross section and shallow edge angle.

A complete sandstone mano is bifacially ground. It is ovoid in plan view and wedge shaped in cross section. One end is battered.

A high proportion of tools to debitage and tool diversity characterize this assemblage. A few rare, or extralocal, brown and red cherts were noted. Debitage consists of local material while the uncommon materials are present as tools.

Site: 42GR2145
Field designation: UNL7
Location: T23S, R21E, Section 34; SW1/4 of NE1/4 of SE1/4
Elevation: 5,200 ft 1,585 m
Area: 560 sq m
General landform: Ridge
Specific landform: Dune

This sparse and spatially confined lithic scatter is located at the base of the east flank of Salt Valley (Figure 13). Entrada sandstone outcrops are located to the east about 300 m. The scatter is distributed across a west trending dunal slope.

Artifact density is low and the assemblage is fairly evenly distributed across the site. Several reduction stages are present. Interior flakes predominate. A range of flake sizes is represented. Several large flakes (both cortical and interior) were noted. Smaller biface flakes were not common.

Material type was consistent throughout the assemblage. Debitage was of white and pastel chalcedonies. Flake type, size diversity, and the absence of tools are characteristic of the assemblage.

Site: 42GR565
Field designation: UNL8
Location: T24S, R21E, Section 2; S1/2 of section
Elevation: 4,720 ft 1,439 m
Area: 426,800 sq m
General landform: Valley edge
Specific landform: Slope

This large lithic scatter is distributed over a series of ridges and drainages on the eastern flank of Salt Valley (Figure 14). The Salt Valley Wash itself is about 600 m southwest. The road bisects the site.

Figure 13. 42GR2145; overview.

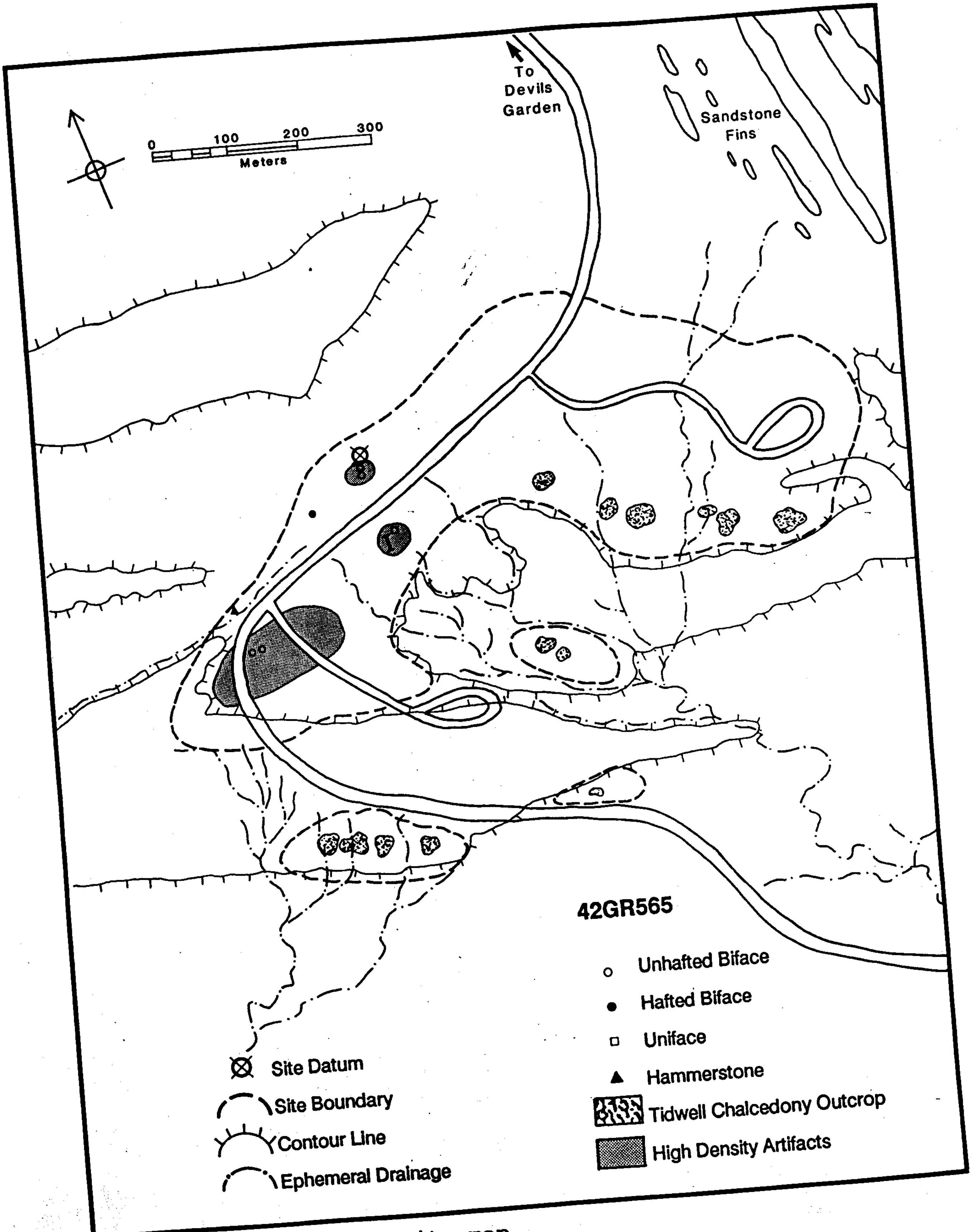

Figure 14. 42GR2565; site map.

Entrada sandstone outcrops border the site's eastern margin. The western margin slopes into Salt Valley. The site area is dissected by run-off channels, which essentially flow south. The valley floor is about 100 m below the site's west margin.

Tidwell chalcedony is exposed in small island outcrops throughout this area. During previous recording efforts, these were considered the primary reason for the site's location and led to its interpretation as a "quarry" (Berry 1975). However, the assemblage distribution is highly variable across the site and does not necessarily center around these outcrops.

The proposed "quarry" locations and the artifact concentrations are at some distance from each other. The location of the artifact concentrations varies from scatters immediately associated with the outcrops to those at some distance. Much of the material around these eroding outcrops is natural shatter. Very little discernible cultural material immediately associated with them was observed. This pattern suggests that quarrying was not a dominant focus or that quarried materials were subsequently removed.

The assemblage consists of debitage, bifacial and unifacial tools, and ground stone. The distribution was diffuse with a few relatively concentrated areas. Between the more concentrated loci, the distribution was sparse but consistent. Tools tended to be more clustered.

Debitage is almost exclusively from the immediately available Tidwell chalcedony. All reduction stages are present. Large interior flakes are prominent. Cores and decortication flakes are few, both at the outcrop locations and in scatters some distance from them. Larger interior flakes predominate in both situations, suggesting that some primary reduction occurred at the locus of procurement and larger flakes were transported to surrounding areas. Maximum density was 10 artifacts per meter square. Some pastel, or Brushy Basin, chalcedonies were also present.

Two unifacial and five bifacial tools were recorded (Appendix F). A hafted biface was manufactured from a white chalcedony flake. It is corner notched, has rounded shoulders, a concave base, and a convex cross section. Four large chalcedony bifaces were recorded. All were formalized, with extensive facial and marginal retouch, regular and thin cross sections, straight edges, and shallow edge angles. They were manufactured from a variety of materials including white Tidwell chalcedony and Brushy Basin chalcedony. All were broken. One was recognized as a use break. Two were reworked.

A small, thin, white chalcedony scraper is circular in plan view, has a shallow edge angle, and is marginally retouched along one edge. A white chalcedony interior flake is extensively retouched along one margin. One ground stone was located. It is an unidentified fragment which is three centimeters thick and is unifacially ground and pecked.

This locale was recorded as a large "quarry" site in 1974. The site perimeters overlap somewhat with the current ones. However, site dimensions and descriptions vary. Berry (1975: Appendix IV) describes the site as "an eroding chalcedony ridge used as a quarry site. Detritus found all along ridge and out onto Entrada sandstone."

The outcrops are littered with natural shatter with little manmade debitage present. Determination of the relationship between the natural and cultural material would require extensive sampling. Although material was procured from the Tidwell outcrops, the assemblage content and distribution indicate that primary reduction was not the only activity focus. A range of manufacture, maintenance, and discard patterns are present suggesting that the locale's use was variable either due to reuse or to differential activity patterns.

Site: 42GR2146
Field Designation: UNL9
Location: T24S, R21E, Section 7; SW1/4 of NW1/4 of SW1/4
Elevation: 4,480 ft 1,365 m
Area: 2,000 sq m
General landform: Valley
Specific landform: Terrace

This sparse lithic scatter is situated on a remnant river terrace at the base of a sloping ridge. This low, northwest trending ridge is at the east end of Salt Valley between two major escarpments to the north and south. These escarpments form the margin of the area where Salt Valley Wash drains into Salt Wash. Salt Valley Wash is about 250 m north and the confluence is about 1,300 m to the east. The terrace itself is composed of a dunal surface. Much of the surface assemblage is confined to the blowouts.

The distribution is highly dispersed. It consists of debitage and a few tools. Artifacts are more clustered in the eastern portion of the site. They are sparse in the western portion.

Debitage for the most part consists of interior flakes and some angular debris. No decortication evidence or cores were noted. Some smaller biface flakes were recorded. Interior flakes produced from white chalcedony predominate in the assemblage. Other material types, a gray chert and a green altered volcanic ash, were present but uncommon.

A white chalcedony projectile point was lanceolate shaped and had an expanding stem (Appendix F). Only the very tip is missing. An informal scraper was manufactured from a white chalcedony cobble. It is thick, has a steep edge angle, and is retouched along two margins. Some larger flakes have been removed. The cobble may have been reduced for usable flakes.

The site is less accessible than some owing to its location on a ridge above the road. It has probably been disturbed less by visitor collection than other scatters along the road. However, assemblage visibility is biased by the distribution of dunes and blowouts.

Site: 42GR2147
Field designation: UNL10
Location: T24S, R21E, Section 7; SW1/4 of SW1/4 of SW1/4
Elevation: 4,480 ft 1,365 m
Area: 6,300 sq m
General landform: Valley
Specific landform: Ridge

This sparse lithic scatter is at the southeastern margin of Salt Valley. The locale is about 500 m south of the Salt Valley Wash. The confluence of the Salt Valley Wash and Salt Wash is about 1,300 m east.

The site is on a broad, remnant river terrace. The terrace is at the base of a major, east-west trending ridge which rises about 76 m above the valley floor.

The terrace slopes slightly northeast. The road bisects the distribution. The area east of the road has a steeper slope and is dissected by ephemeral drainages.

The assemblage consists of debitage, a core, and a number of tools. Two lithic concentrations, about five meters in diameter, were identified. The distribution in other portions of the site is highly dispersed. Maximum density in these clusters is up to 30 artifacts per meter square.

White chalcedony interior flakes represented the greatest portion of the debitage sample. No decortication evidence was noted. Biface reduction was uncommon.

A chert flake was extensively retouched unidirectionally along one margin. One multiplatform core was produced from white chalcedony. Other material types present were pastel chalcedonies, siltstone, and green volcanic ash. These were not common.

One unifacial and three bifacial tools were recorded. A small, white chalcedony, corner notched point has a concave base (Appendix F). The lateral margins are parallel. The tip is broken along a fracture line. This may be a manufacture break. A white chalcedony, biface margin fragment has a thin and regular cross section, and shallow edge angles. A white chalcedony, rounded biface tip is less formalized. A white chalcedony, informal scraper is unidirectionally retouched along one margin.

The tools and the core are manufactured from the same materials as the debitage. The incidence of both informal and formal tools is relatively high.

Site: 42GR2148
Field designation: UNL11
Location: T24S, R21E, Section 23; SW1/4 of SE1/4 of SW1/4
Elevation: 4,960 ft 1,512 m
Area: 2,250 sq m
General landform: Ridge
Specific landform: Ridge

This site is a sparse lithic scatter on a low ridge on the west side of a drainage. The location affords an overview to the south and east towards Elephant Butte. A low, intermittent ridge of Entrada sandstone outcrops is exposed to the west and southwest.

The distribution has a low density and is not clustered. The debitage sample consists predominately of white chalcedony interior flakes and angular debris. No biface reduction was noted, and only a few decortication flakes were present. The material type consistently is white chalcedony.

One limestone cortical flake was noted. One flake was extensively retouched along one margin. The edge angle is high, and the piece morphologically resembles an informal scraper. An exhausted, white chalcedony, multiplatform core was also found.

The proportion of tools to debitage is high. Two bifacial tools and a unifacial tool were recorded. A rudimentary, white chalcedony biface has a thick and irregular cross section. The surface quality indicates that it was ineffectually heat altered. A rhyolitic cobble was bifacially reduced along one margin, forming a steep edge angle and a sinuous edge. A white chalcedony uniface was unifacially reduced and unidirectionally retouched on the opposite face.

Site: 42GR2149
Field designation: UNL12
Location: T25S, R21E, Section 3; NW1/4 of SW1/4 of NE1/4
Elevation: 4,320 ft 1,317 m
Area: 3,200 sq m
General landform: Valley
Specific landform: Dune

This dispersed and sparse lithic scatter is on a south trending dunal slope (Figure 15). The ground surface is variable and consists of active dunes, red cryptogamic soils, desert pavement, and Dewey Bridge chert gravels. Bedrock is exposed on the eastern margin of the site. An Entrada ridge outcrop is about 900 m west.

The distribution is concentrated in the blowouts and on the desert pavement. It is otherwise very intermittent. The debitage sample consists of all reduction stages. White chalcedony flakes from the earlier reduction stages are most common. Some decortication is evident. Angular debris and biface flakes are present.

Debitage is predominately white chalcedony. Although there are some cultural samples, most of the Dewey Bridge chert on the site area is natural shatter. The one tool, however, is produced from an uncommon material. A large, thin biface fragment is a possible knife tip. It is of a mottled gray chert and is transversely broken. A small (10 cm x 8 cm x 5 cm), quartzite cobble is battered on one end. It was the only cobble noted in the area.

Site: 42GR2150
Field designation: UNL13
Location: T25S, R21E, Section 9; NE1/4 of SW1/4 of NE1/4
Elevation: 4,240 ft 1,292 m
Area: 3,000 sq m
General landform: Valley
Specific landform: Dune

This dispersed lithic scatter is on a rise overlooking the Courthouse Syncline to the south-southeast. The assemblage is distributed across a slight, south trending slope on a bank above an intermittent drainage. The site is about 200 m north of Courthouse Wash. Entrada sandstone cliff outcrops are approximately 700 m to the northwest.

The immediate area is a slight, south trending dunal slope, on which there are equal areas of active dunes and stabilized cryptogamic soils. The site is bisected by a water control ditch.

Two artifact concentrations were recognized. Surface material is evident only on current erosional surfaces. Debitage is predominantly small, thick interior flakes of white chalcedony. No decortication evidence or cores were noted. Biface production appears to have been a primary activity at this site. Most debitage was produced from white chalcedony, but some mottled cherts were present. No tools were noted.

The site has been impacted by the water control ditch that bisects the distribution. Much artifactual material is evident in the backdirt from the trench. Ongoing erosion is caused by the ditch.

Site: 42GR2151
Field designation: UNL14
Location: T25S, R21E, Section 21; SE1/4 of NW1/4 of NE1/4
Elevation: 4,560 ft 1,390 m
Area: 9,000 sq m
General landform: Ridge
Specific landform: Swale

This large lithic scatter is located in a shallow swale between two bedrock ridges. The Entrada cliffs are 150 m west. The area is dissected by southeast-northwest trending drainages.

The site is within 600 m of the slickrock, where the mesa steeply descends into the Colorado River basin. The site is bisected by the road.

Most of the currently visible assemblage is confined to the south side of the road. However, a number of isolated occurrences were located north of the road. Their presence may indicate that the assemblage originally extended north to the cliffs. This area has been buried by talus slope, alluvial fans, and recent rock fall. Numerous ephemeral drainages dissect the area as well.

Three discrete artifact concentrations were recognized. The distribution was otherwise intermittent. The lithic assemblage consisted of debitage. No tools were located. The debitage sample represented all reduction stages. A relatively strong emphasis on early stage reduction characterizes the debitage.

Interior and decortication flakes were most common. Decortication is not prominent in most of these assemblages. Decortication flakes tend to have less than 50 percent dorsal surface cortex. Much of the angular debris is cortical as well. Early stage reduction appears to have been the primary goal of lithic reduction episodes on this site. Except for one piece of gray silicified wood, all debitage is of white chalcedony. A few cores of similar material were noted.

There is an intermittent distribution of unmodified, small chalcedony cobbles. The parent material from which these cobbles derive is not located in proximity to the site. The local topography and drainage patterns do not suggest that they are necessarily secondary alluvial deposits. Whether they represent natural deposits or manuports is unclear.

Site: 42GR2152
Field designation: UNL15
Location: T23S, R21E, Section 34; SE1/4 of NE1/4 of NE1/4
Elevation: 5,200 ft 1,585 m
Area: 9,900 sq m
General landform: Ridge
Specific landform: Dune

This site is a dense lithic scatter situated at the western margin of an extensive Entrada sandstone fin formation (Figure 16). The assemblage is distributed across a gentle dunal slope. In the southern portion of the site, a fin provides an overhang with a southwest exposure. Alluvial channels bisect the site.

A difference in assemblage density and content is apparent across the site. The distribution is densest adjacent to the fin. The debitage in this provenience consists of very small interior flakes and angular debris. Small pressure flakes are common, while larger finishing flakes are not.

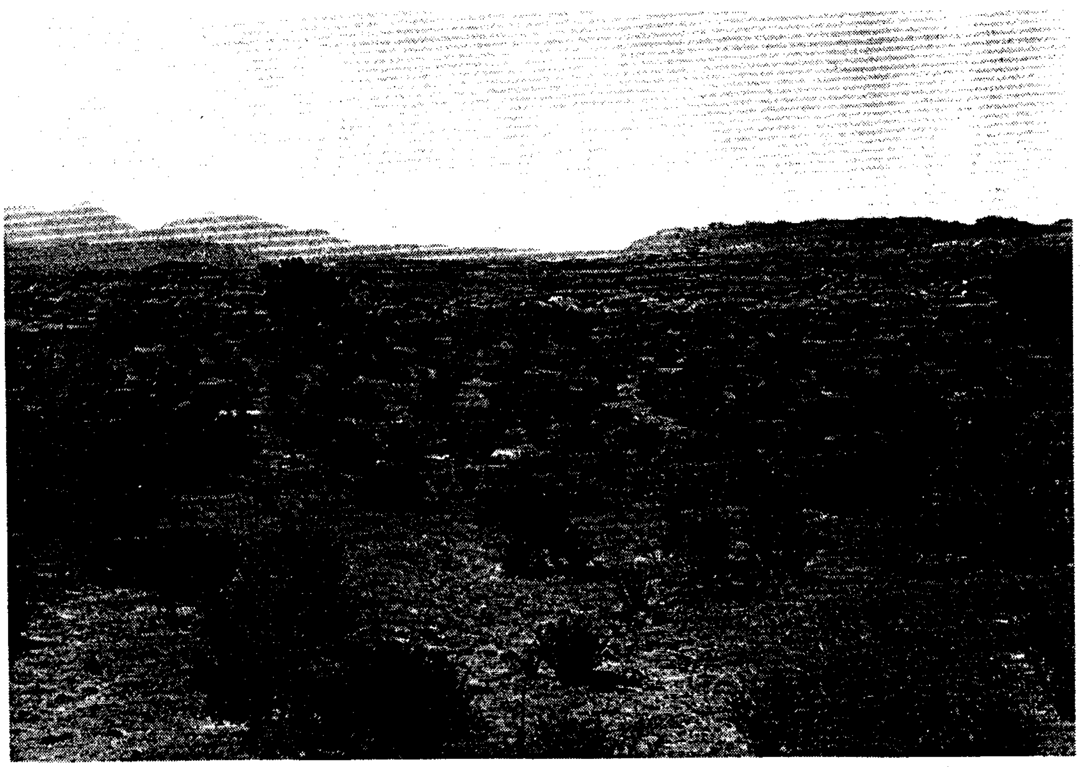

Figure 15. 42GR2149; overview.

Figure 16. 42GR2152; overview.

In other areas of the site the distribution is sparse and intermittent. There is also a greater diversity in flake size and type. One small, nucleated reduction locus was identified.

Debitage was mainly of white chalcedony. Some samples of quartzite, amber chert, and silicified wood are present. Material type and flake type did not appear to co-vary. No tools were recorded.

The scatter is confined to the north side of the trail. Visitor access and casual collection may have contributed to the absence of tools and larger flakes.

Site: 42GR2153
Field designation: UNL16
Location: T23S, R21E, Section 34; SE1/4 of NW1/4 of NE1/4
Elevation: 5,200 ft 1,585 m
Area: 5,250 sq m
General landform: Entrada fins
Specific landform: Dune

This site is a sparse lithic scatter located at the western periphery of an extensive Entrada sandstone fin formation (Figure 17). The scatter is distributed across dunes and blowouts in an open area defined by sandstone fin formations on three sides. The area slopes slightly to the west. The trail bisects the site.

The low density scatter is concentrated in the deflated blowout areas. The assemblage consists exclusively of white chalcedony interior debitage. Predominant are the smaller interior flakes and pressure flakes. Absent are the larger flakes and decortication flakes. A size bias may be effected by the depositional context. No tools were recorded.

Postdepositional factors likely have influenced the content of the visible assemblage. Visitor access, casual collecting, and dunal processes may in part account for the lack of tools and larger flakes.

Site: 42GR2154
Field designation: UNL17
Location: T23S, R21E, Section 34; SW1/4 of SE1/4 of NE1/4
Elevation: 5,120 ft 1,560 m
Area: 7,800 sq m
General landform: Valley
Specific landform: Dune

This dispersed and low density lithic scatter is on the southeast margin of an open area that slopes north. This valley drains into an extensive Entrada fin formation.

The scatter is distributed across the north side of a low east-west trending rise. This dunal ridge runs parallel to the

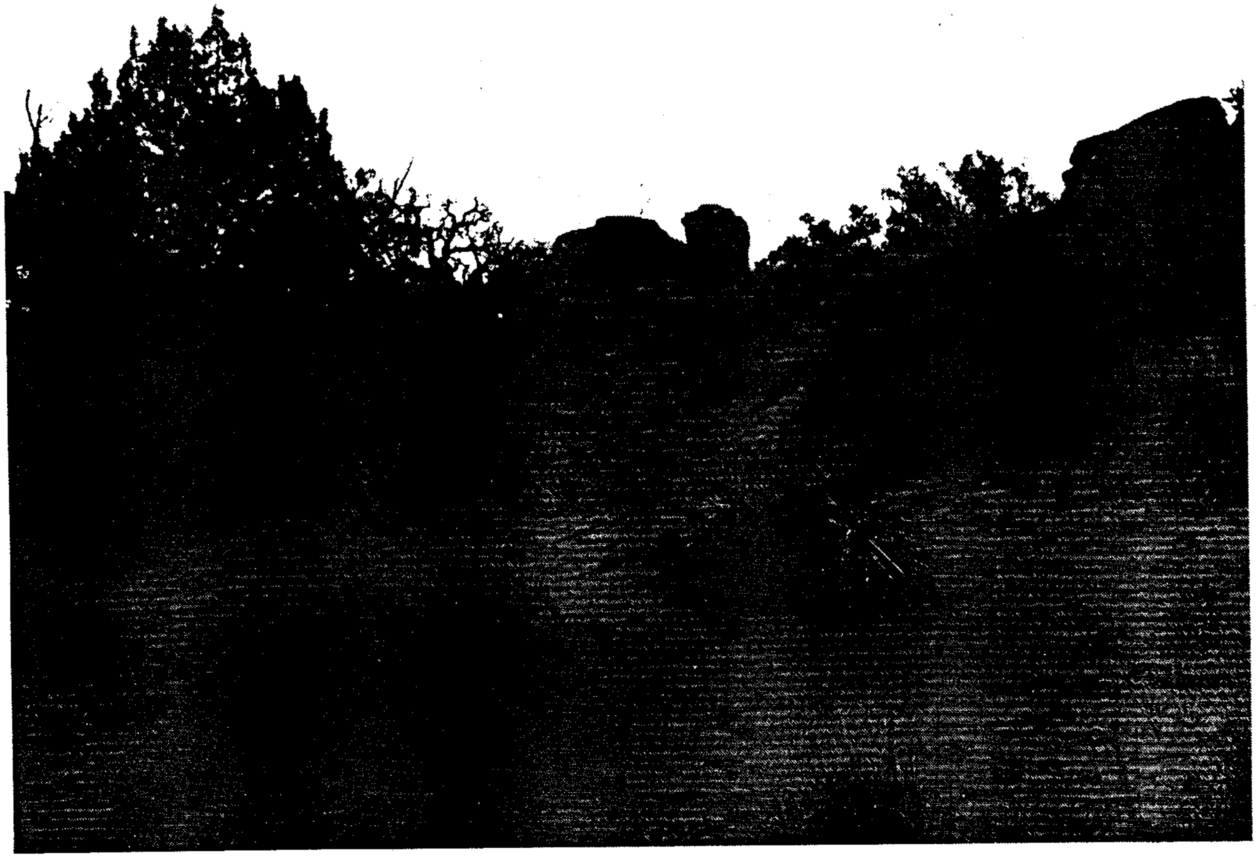

Figure 17. 42GR2153; overview.

fins to the north. Small sandstone gravels cover the ground surface. The trail bisects the distribution.

An artifact concentration, about 10 m in diameter, was identified on the site's eastern margin. Artifacts elsewhere were highly dispersed. The assemblage consisted of small, white chalcedony interior flakes. The only other material was a red chert biface flake. No decortication evidence or cores were recorded. One large, interior flake was unidirectionally utilized along one margin. No tools were located. This site is bisected by a hiking trail and is near a campground. One might expect that Park visitors may have collected artifacts from this site and, thusly, would have altered artifact assemblage composition.

Site: 42GR2155
Field designation: UNL18
Location: T23S, R21E, Section 35; NW1/4 of SW1/4 of NW1/4
Elevation: 5,120 ft 1,560 m
Area: 800 sq m
General landform: Valley
Specific landform: Dune

This low density lithic scatter is on the north margin of an open area that slopes northeast with the valley draining into an extensive Entrada sandstone fin formation. The site is distributed over a northeast trending dunal ridge overlooking this valley.

Much of the site surface is either deflated to bedrock or is covered with small sandstone gravels. The artifact distribution is very sparse and occurs mainly in deflated contexts.

The assemblage is very homogeneous. It consists almost entirely of small, white chalcedony interior flakes. No angular debris or primary or biface reduction debitage was noted. No tools were recorded. One sample of green volcanic ash was located.

Assemblage content and distribution are undoubtedly biased by slope wash, deflation, and visitor access. Spatial integrity has not been maintained. The absence of tools and flake size diversity may be conditioned by casual collection.

Site: 42GR2156
Field designation: UNL19
Location: T24S, R21E, Section 23; NW1/4 of NE1/4 of SE1/4
Elevation: 5,040 ft 1,536 m
Area: 2,625 sq m
General landform: Ridge
Specific landform: Dune

This lithic scatter is on a level, remnant dunal area adjacent to eroded sandstone outcrops. Much of the surface is exposed to bedrock or is almost completely deflated. Only a few shallow dunes are present.

The Balanced Rock trail bisects the site in several places. The area has been highly impacted by roads, trails, and visitor traffic. It is probable that little of the site remains.

The lithic sample consists of small interior flakes and pressure flakes. There is a high incidence of broken flakes. No decortication evidence or angular debris were noted. The material type is predominantly white chalcedony. A few samples of green volcanic ash also are present. Maximum density is three pieces of debitage per meter square. No tools were recorded.

The lack of tools and larger flakes along with the presence of broken flakes are the likely result of collection by visitors. A large portion of the site is probably already impacted. It was apparently not recorded when the initial road and trail construction took place. Further investigation should be made before the site is completely destroyed.

Site: 42GR2157
Field designation: UNL20
Location: T24S, R21E, Section 24; SW1/4 of SW1/4 of SE1/4
Elevation: 5,120 ft 1,560 m
Area: 2,800 sq m
General landform: Ridge
Specific landform: Dune

This low density lithic scatter is between a break in outcrops of the Slickrock Member of the Entrada sandstone. The site is distributed across a south trending ridge/slope that overlooks a deeply incised drainage to the east. The slope is heavily dissected.

Distribution may be obscured by roads in the area. Much of the assemblage is found in erosional contexts, suggesting that it is a secondary deposit. Present surface spatial integrity is negligible. Because the only remnant level area is paved over, the intact portion of the site has probably been destroyed.

The lithic sample consists predominately of small, white chalcedony interior flakes. A few larger interior flakes and primary flakes were also present. A green volcanic ash biface flake and a piece of angular debris of brown chert were recorded.

Two bifaces were inventoried. A white chalcedony biface tip was relatively formalized. It was thin and had a regular cross section with a shallow edge angle. The other white chalcedony biface tip, although thin, had less retouch investment. The cross section is irregular, and the piece retained some cortical surface.

The relative diversity of material and flake types is notable. The proportion of tools to debitage is high, although the area has been extensively impacted by road construction and tourist access. Evidently the site was not recorded before the initial road construction, and little of it remains intact. It should be further investigated before additional destruction occurs.

Site: 42GR2158
Field designation: UNL21
Location: T24S, R21E, Section 25; SE1/4 of NW1/4 of NE1/4
Elevation: 5,080 ft 1,548 m
Area: 28,600 sq m
General landform: Ridge
Specific landform: Dune

This large, but sparse, lithic scatter is west of the Entrada outcrops and east of a large, flat area of exposed Navajo bedrock (Figure 18). The site is distributed over a north facing slope of an east-west trending ridge. The slope consists of a series of dunes and blowouts. These are most developed towards the top of the slope. The northern portion of the site overlooks a deeply incised drainage. An old two-track road borders the southern perimeter of the site. The Windows Section road bisects the northern portion of the site. The north margin is delimited by a drainage.

Artifact distribution varies across the site. Four lithic concentrations were identified. These were not high density but were discrete scatters in an otherwise very intermittent artifact distribution. These concentrations tended to be on north facing dunes. The artifacts tended to be more clustered in locations near the ridge top where dunes are less deflated.

The debitage sample was only white chalcedony interior flakes. Size varied and smaller biface flakes were present. No decortication evidence or other material types were noted. A white chalcedony biface edge fragment was recorded. It was thin and had a shallow edge angle.

The site appears to be actively eroding, especially at the slope crest. Site boundaries are delimited by contour breaks, roads, and a drainage. This is one of the few sites recorded which may offer substantial subsurface deposits.

Site: 42GR2159
Field designation: UNL22
Location: T24S, R22E, Section 5; SE1/4 of SE1/4 of SW1/4
Elevation: 4,320 ft 1,317 m
Area: 105 sq m
General landform: Ridge
Specific landform: Outcrop

This lithic scatter is on a west facing ridge/slope. The ridge overlooks Winter Camp Wash to the south and one of its

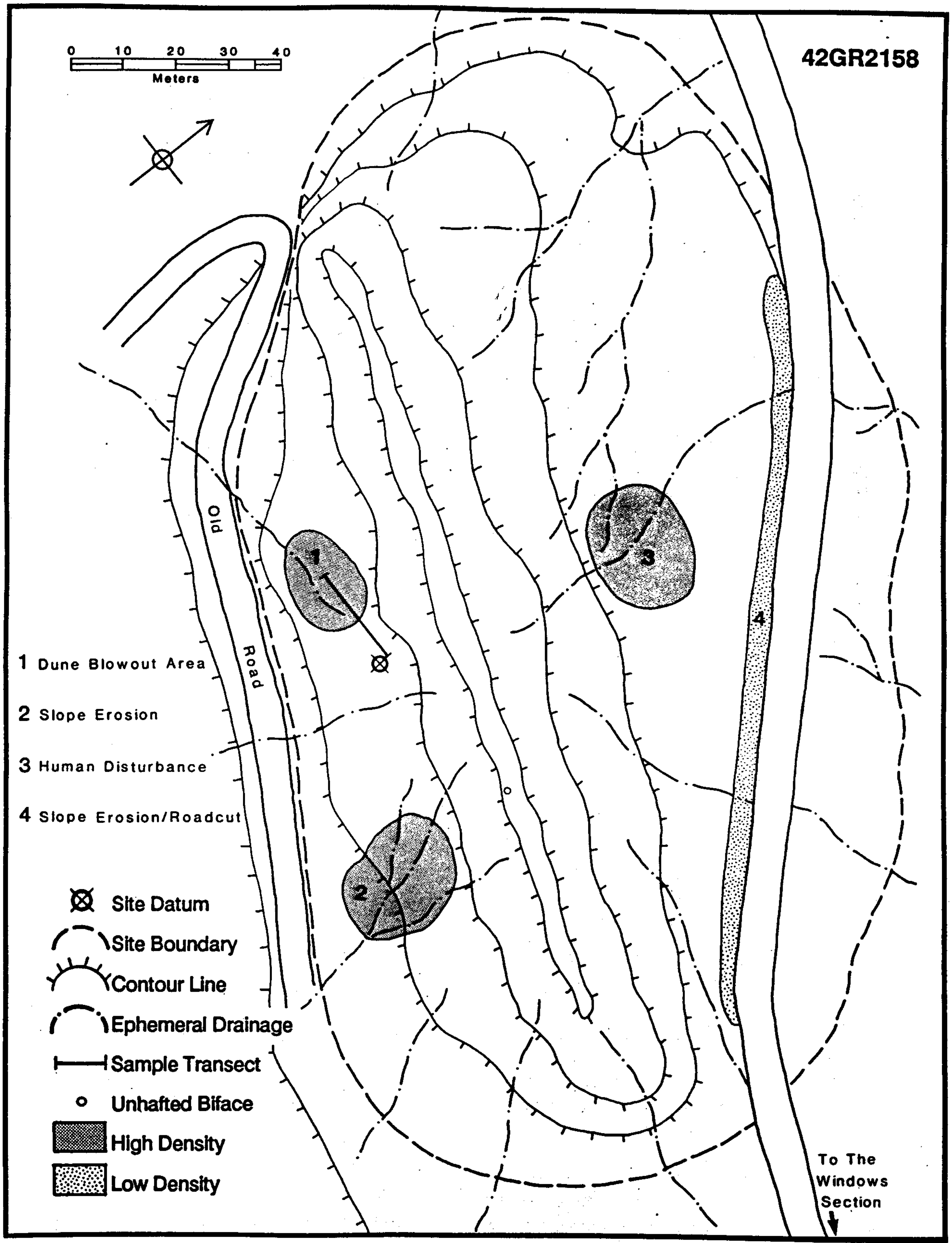

Figure 18. 42GR2158; site map.

south flowing tributaries (Figure 19). The site is about 80 m above Winter Camp Wash.

A series of small island outcrops of Tidwell white chalcedony are located on this ridge. Below one of these is a small, exposed bed of greenish amber chert. From surface observation, this chert appears to be interbedded immediately below the Tidwell chalcedony. This is the only outcrop of this material seen during the survey. The siltstone has been extensively quarried. It appears to have been specifically selected for. The white chalcedony outcrop above it has no associated cultural debris.

This site consists of a very discrete and nucleated scatter of material surrounding the chert outcrop. Debitage density ranges up to 40 artifacts per meter square. The lithic sample consists predominately of large interior flakes and angular debris. Flake type is highly redundant. Decortication flakes are present but not common. The outcrop material, however, has very little cortical surface. Smaller interior and biface flakes are absent. No cores, tools, or other material types are present.

Assemblage content suggests that the material was quarried and that partially reduced nodules were transported elsewhere. The apparent selection of this material is of interest. A large amount of natural shatter surrounds the outcrop and obscures the density of cultural material.

Site: 42GR2160
Field designation: UNL23
Location: T24S, R22E, Section 8; NE1/4 of NW1/4 of NW1/4
Elevation: 4,320 ft 1,317 m
Area: 4,350 sq m
General landform: Valley
Specific landform: Terrace

This site is a dense lithic scatter on a bench overlooking Winter Camp Wash. The site's location is equidistant from Salt Wash and Winter Camp Wash, about 250 m west and east respectively. The drainage floor is about 80 m below. The bench is an exposed outcrop of the Salt Wash Member of the Morrison Formation. Bedrock is exposed over portions of the site. In other areas, there is some cryptogamic soil formation. The bench, or outcrop, slopes slightly south. The location affords an overview of the confluence of Salt Wash and Winter Camp Wash to the south.

Tidwell chalcedony is exposed in a small island less than 300 m east along the same bench above Winter Camp Wash. The islands are primarily exposed along the north trending drainage cuts which flow into Winter Camp.

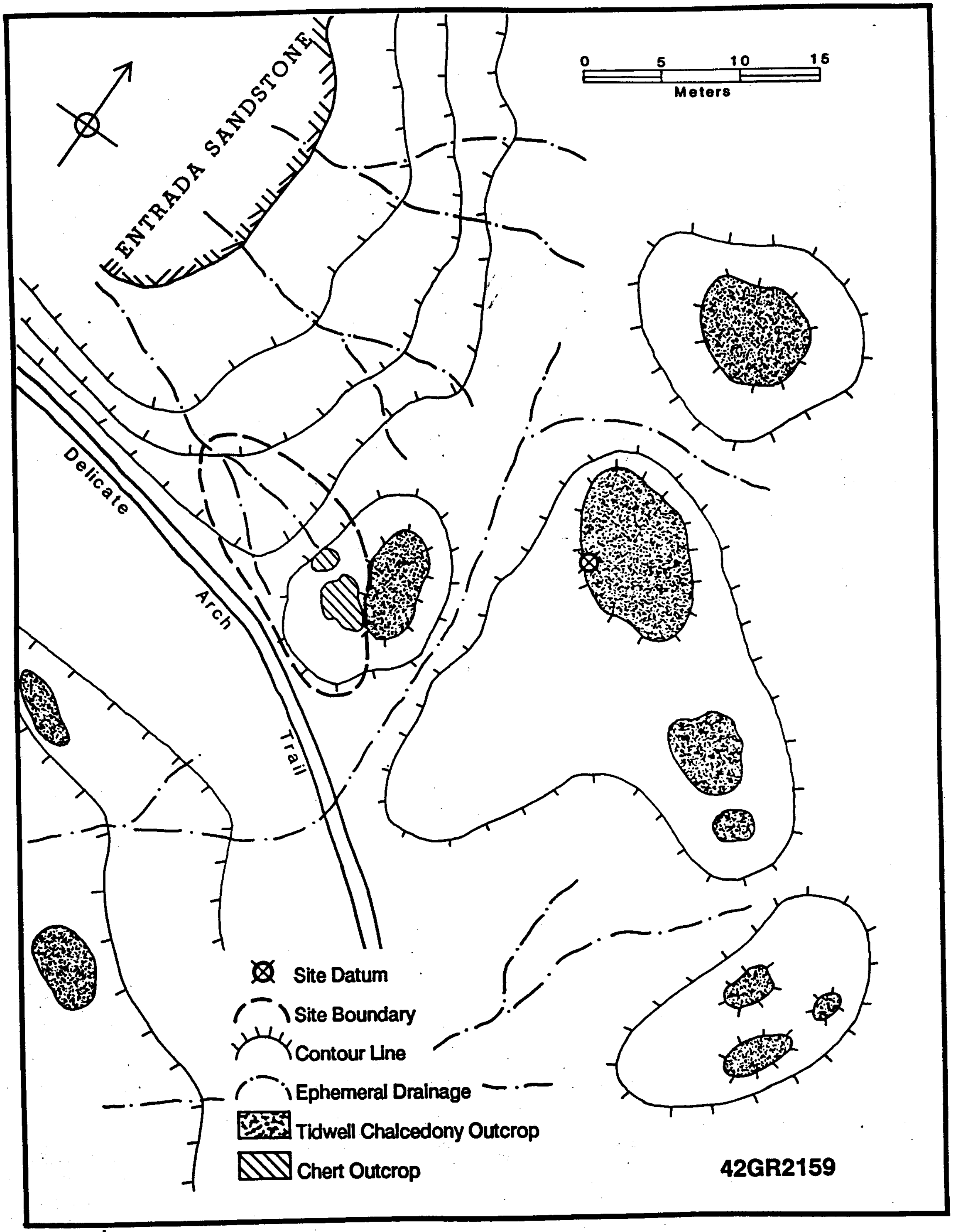

Figure 19. 42GR2159; site map.

Three artifact concentrations were identified. They are on surfaces where the cryptogamic soils have not formed. Assemblage clustering may be an artifact of surface exposure.

The debitage sample consists mostly of Tidwell chalcedony interior flakes. Some Brushy Basin chalcedonies are also present. The closest exposures are in Cache Valley, a kilometer to the east. Some Morrison quartzites are also present in the assemblage. Material diversity is relatively high. Most of these materials are locally available.

The debitage sample includes all reduction stages as well as angular debris. Most common are interior flakes. Large primary flakes were not noted, although some smaller flakes had dorsal surface cortex. However, no cores were present. This suggests that although the white chalcedony is in very immediate proximity, nodules were partially reduced elsewhere and transported back to the site for further reduction. Biface flakes were of the same materials as larger percussion flakes, indicating that the materials selected for tool production were similar.

A biface fragment was of local chalcedony. The reduction was formalized; the cross section is thin and regular, and the margins have a shallow edge angle.

Site: 42GR515
Field designation: UNL24
Location: T24S, R21E, Section 26; NW1/4 of NW1/4 of NW1/4
Elevation: 4,960 ft 1,512 m
Area: 600 sq m
General landform: Ridge
Specific landform: Rock shelter

This dense lithic scatter is distributed under a shallow south facing overhang and on the surrounding ledge (Figure 20). The overhang is situated in a series of north-south trending Entrada outcrops. A level area extends south 20 m from the widest part of the overhang. Past this ledge, the terrain drops southward into a badland/rocky topography. The shelter is about 20 m long with the dripline about five meters from the back wall. Provision for shelter is not extensive. To the southeast, the valley floor is about 100 m below the site. The location offers an overview to the east and south. Ephemeral drainages flow southeast from the overhang. Much of the site surface is highly deflated. Cultural material is interspersed with natural Dewey Bridge chert shatter.

The distribution is densest along the dripline. Density ranges up to 50 artifacts per meter square. Artifacts are very sparse under the overhang itself. Scattered artifacts were located in the dunal areas surrounding the overhang. The assemblage consists of debitage, cores, and informal and formal tools. This scatter is one of the densest recorded in the

Figure 20. 42GR515; overview.

project area. No features were identified, but thermal evidence included some charcoal, burned bone, and fire-cracked stones.

The debitage sample includes all reduction stages and a range of material types. Most common are interior flakes, but decortication and biface reduction evidence are present. Evidence of heat treating is present in that some pieces were ineffectually altered and have crazed surfaces.

Present is debitage from white and pastel chalcedonies, cherts, quartzite, green volcanic ash, and a green amber chert. This is the only occurrence of this material, aside from that at site 42GR2159 which surrounded an outcrop. No noticeable Tidwell outcrops are in the area. However, Dewey Bridge cherts are eroding out of the bedrock outcrop.

Several retouched flakes of different material types were unidirectionally retouched. One large, white chalcedony flake was bidirectionally retouched.

At least six cores were recorded. Some were exhausted of flake potential. All multiplatform cores were of white chalcedony. One exhausted bifacial core was of a Dewey Bridge pink chert.

Two bifaces and a uniface were inventoried. A Dewey Bridge chert biface midsection was thin and had a regular cross section, and shallow edge angles. A small, thin white chalcedony projectile point was basally notched (Appendix F, Specimen A). The haft element, the very tip, and one barb were missing.

A large white chalcedony uniface was unifacially worked, but was bidirectionally retouched along two margins. The edges appeared to have been reworked. All tools had a fair amount of retouch investment in them.

Several pieces of bone were recorded. One deer bone was identifiable. A burned long bone and two burned flat bone fragments were inventoried.

The assemblage was characterized by a diversity of material and artifact types. The tool frequency was relatively high for assemblages in the project area. The co-occurrence of larger interior flakes, primary flakes, and cores was of particular note.

The site was previously identified by Pierson in 1958. He mentions the exposure of ash in a shallow fill. Artifacts include "oval manos, parts of points and blades, knives." He also noted an extensive cow dung deposit (site forms are on file at the Midwest Archeological Center, Lincoln, Nebraska). Some bovine disturbance was currently evident.

Site: 42GR544
Field designation: UNL25
Location: T25S, R21E, Section 3; SE1/4 of NW1/4 of SW1/4
Elevation: 4,240 ft 1,292 m
Area: 16,000 sq m
General landform: Valley
Specific landform: Rock overhang

This recent historic site is at the east base of an Entrada cliff face (Figure 21). The cliff wall is about 76 m (250 ft) high and is facing east. A drainage is parallel to the cliff face, about 20 m in front of it. This drains into another wash about 50 m to the north. The wash flows east, downslope and away from the cliff face.

The site is distributed along 160 m of the cliff base. The cliff face provides an integral component to the site as a natural barrier for an animal containment feature (Feature 1). The historic components include a containment feature, a series of fence posts, and historic artifacts. Feature 1 is at the northern end of the site in a recess in the cliff face. Feature 2 is at the southern end of the site and is a collection of logs and planks fastened with wire.

A series of juniper posts runs north-south the length of the site. They appear to circumscribe an area along the cliff face. The posts are two to three meters high. Chicken wire is attached to one post in front of the recess/containment area.

Another less defined fence line, consisting of three juniper posts, runs perpendicular from the cliff face. The furthest fence post is 60 m east of Feature 1.

Some historic artifacts are distributed downslope east of Feature 1. These include a paint can, a large baking soda can, and a lard bucket. Construction related materials include nails and cut juniper posts.

Several link chains, about 30 cm long, with a straight nail at one end and a bent nail at the other were located. One was found with the straight nail pounded into a two-inch-diameter round stake which was driven into the ground. Another was driven into a meter-long juniper branch. These may represent hobbling devices.

Cultural affiliation can not be ascertained. The condition of the site and the construction of associated materials suggest a fairly recent, circa 1920s, use of the locale.

Pierson documented the site in 1959. He describes it as being at the "head of gully in a cave where water comes over edge of cliff. Cleared platform present in cave with crude mortarless wall. Loose wood in site. Shallow fill. Platform about 12 x 10'. Drill holes about 1/4" to 1/2" diameter." (Site form on file at the Midwest Archeological Center, Lincoln, Nebraska).

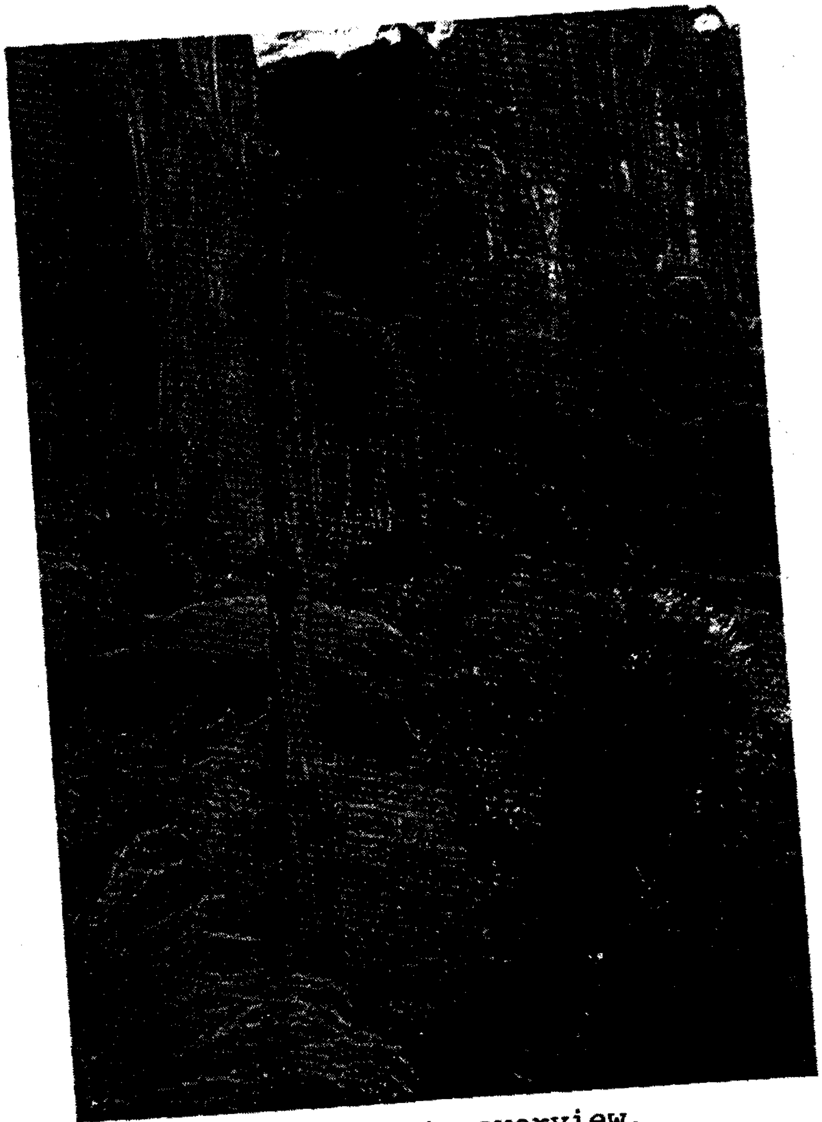

Figure 21. 42GR544; overview.

Feature 1. A probable animal containment area is in a shallow recess in the base of an Entrada cliff face. The natural recess faces south and is 7 m north-south x 10 m east-west. The overhang provides a shelter about 10 m deep.

The cliff face forms the western margin of the containment area. On the north is a natural sandstone rubble mound about 4 m high. The height has been increased by juniper brush piled on top of the mound. The south barrier is a small, unmortared wall consisting of 18 sandstone block elements. The ground surface in the recess is a steep, 12-degree slope. Sheep dung is scattered on the enclosure floor.

Three juniper posts about five meters apart are aligned about 10 m in front of the cliff face. Chicken wire is attached to the northernmost post. A pile of juniper brush is between the post and the cliff face. Two other log and brush piles are located 15 m to the south.

Several cans were located 15 m east of the containment. The construction elements, location, associated artifacts, and dung suggest that the locality was utilized for animal containment and other husbandry activities.

Feature 2. This feature is at the southern end of the site. It consists of logs/posts and planks piled at the top of the talus slope at the base of the cliff face. Two posts are 12 cm in diameter. These posts and three small, unsplit logs are wired together. Other elements are lengthwise split logs. These are two to four meters in length.

At the bottom of the talus slope are several posts wired together. The longest post has a nail and a wire tied around the base. A meter-long plank is also nailed to the top of it. A chain with a small loop in it is nailed to one end of the plank. These materials appear to be either a discard pile or recycling stock pile.

Site: 42GR290
Field designation: UNL26
Location: T25S, R21E, Section 9; SW1/4 of NW1/4 of NE1/4
Elevation: 4,160 ft 1,268 m
Area: 8,450 sq m
General landform: Valley
Specific landform: Rock overhang

This pictograph panel with associated artifacts is at the base of a cliff about 300 m east of Courthouse Wash. The east facing cliff face is about 60 m (200 ft) high and is formed by the Entrada sandstone. The site is under a shallow overhang and extends to the east about 65 m (Figure 22). The overhang provides about 10 m of shelter between the cliff wall and the dripline.

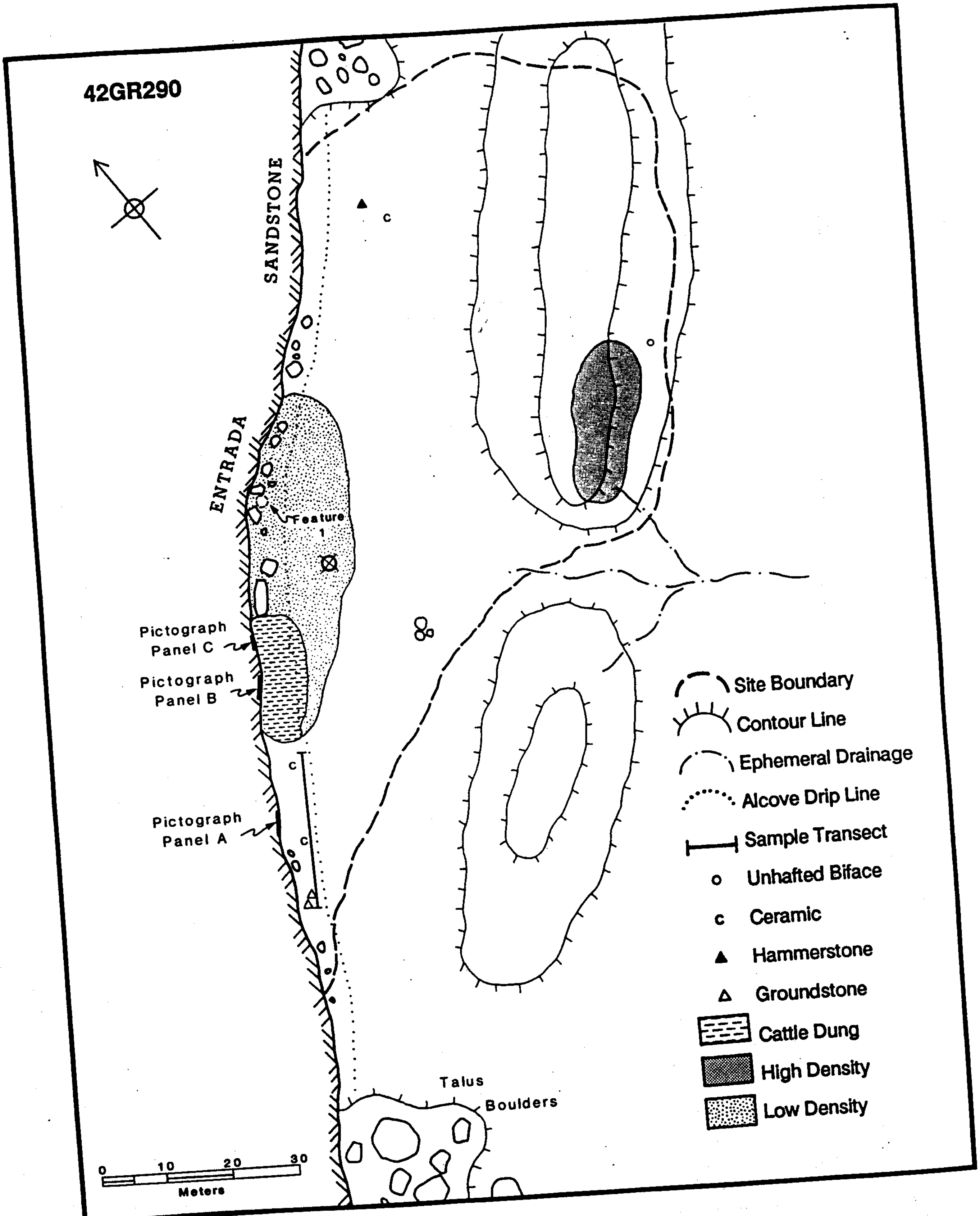

Figure 22. 42GR290; site map.

The area to the east of the cliff face allows a good overview to the north, south, and east. Courthouse Wash is a major, though intermittent, water source.

The assemblage includes debitage, chipped stone tools, ground stone, and ceramics. The scatter is highly diverse and sparse. However, the densest distribution is under the overhang within the dripline. The lithic content here is notably different. It consists of small finishing flakes. The material diversity is also high at this location and includes most local varieties of knappable materials.

Charcoal is very sparsely scattered along the southern end of the overhang area. To the north end is a solidified charcoal midden that is beginning to erode (Feature 1).

There are several possible prehistoric pictographs and two modern contributions on the cliff wall. It is difficult to assess if the several faint, white paint pictographs are modern or prehistoric. These include a concentric circle, several animal forms, and an anthropomorph. When the site was previously recorded in 1958, no mention was made of these pictographs.

Two definitively modern contributions include "FUCK J. HARPOLE" and "HOAR HOUZE." Below the latter a female figure is depicted in black paint.

The artifact scatter is very sparse. The distribution is densest under the overhang. It extends very intermittently to the east. This area is thickly vegetated and is in the Courthouse Wash flood plain. It is likely that the distribution is either very disturbed here or has just begun to erode.

The debitage sample consists of interior flakes of local material. Some bifacial reduction is evident as is interior angular debris, although no decortication flakes or cores were noted. Material types include Tidwell and Brushy Basin chalcedonies, quartzite, Dewey Bridge chert, basalt, and red chert. The relative proportion of the few ceramics and tools to the debitage is high.

The Dewey Bridge biface fragment was broken along three margins. However, the reduction was not formalized as exemplified by the irregular cross section. A flat, less than 15 cm thick, broken quartzite cobble has been battered along one remnant margin. Two bifacially ground and pecked block metate fragments were manufactured from local sandstone. These may be portions of the same ground stone. A third metate margin fragment was unifacially pecked and ground. All the ground stones were within 50 cm of each other.

The ceramics, three corrugated sherds, all had a crushed rock temper, which consisted mostly of quartzite. The relief was intermediate. The plain grayware was thin and polished with smoothing striations on the interior and exterior surfaces. The temper was an abundant, dark, crushed igneous rock, probably basalt. All were very fragmentary and within 15 m of the cliff face.

Pierson recorded the site in 1957. He collected two additional sherds. He refers to it as a campsite under an overhang. Mention was made on his site form of abundant cow dung. Some bovine activity was noted at the north end of the overhang. Modern impact has been indicated by vandalism of the cliff wall. Thus, it is likely that the assemblage has been collected.

Feature 1. This stained area is located in the central portion of the overhang. The stain is exposed between two large rocks, or roof fall and is at the base of a shelf in the cliff face. Smaller cobbles are eroding to the east. The stained area is confined to 90 cm north-south x 140 cm east-west. The cobbles surrounding the stain appear to have been heat altered. A few white chalcedony interior flakes are present. Charcoal is eroding out of the stained area. The presence of subsurface carbon samples is likely.

Isolated Occurrences

Isolated occurrences cannot always be assumed to represent activity loci. Postdepositional processes, both cultural and natural, affect surface visibility. In a depositional context, an isolated artifact may indicate a subsurface deposit, while in erosional contexts, they may represent the limits of alluvial action. On stable surfaces, individual artifacts may indicate the minimal units of landscape use. Their location and visibility result from active participation in cultural and natural processes.

Isolates are often not examined in the same detail as artifact clusters. Small sample size and a lack of understanding concerning how isolates are integrated into the overall pattern of cultural landscape use preclude consideration beyond descriptive summary. Commonly, isolate occurrences are envisioned as delimiting the pathway between one "site" and another.

Isolates tend to occur in erosional contexts and probably represent secondary deposits. Often isolates are located in proximity to known assemblage localities, specifically in run-off paths downslope from them. This distribution likely indicates not a cultural catchment, but an alluvial one.

Observational constraints may produce an inadequate representation of isolated artifact distributions. The role of the areas between sites as part of the overall land-use system may therefore be overlooked or minimized. Furthermore, varying intensities of archeological survey provide different estimates of site frequencies and complexities. For example, the Seedskadee Project, in an effort to quantify the role of the archeologists' bias, found certain thresholds in observational skills. Artifacts tended to be recorded in clustered situations much more frequently than isolated ones (68 percent to 16 percent). Artifact type, color, and time of day were other variables affecting observational resolution. However, clustered versus isolated distributions had the most significant affect on visibility (Wandsnider and Ebert 1986).

Sixty-nine isolated occurrences were recorded. All but one of these were lithics (Table 1 and Appendix G). One horseshoe was located on a ridge crest. Artifact types and technologies employed did not vary appreciably between artifacts located in assemblage contexts and those in isolated ones.

By definition, an isolated occurrence has a limited sample size. However, in some cases several artifacts may be considered an isolated occurrence. Seventy percent of the isolated occurrences consisted of one artifact. Two artifacts occurred in 16 percent of the isolated recordings. Other multiple artifact isolates consisted of three to 12 artifacts.

Of the 69 isolated observations, 84 percent were debitage. Of the total frequency of isolates, 91 percent were debitage. The proportion of debitage from the transect data was slightly higher, 98 percent of all artifacts. Decortication flakes contributed more than twice as much to the proportion of artifact types in isolated occurrences as in assemblage contexts. Interior flake proportions of debitage were similar between isolated and assemblage contexts. Biface flakes were slightly more common, while angular debris were considerably less common in isolated occurrences.

Tools occurred equally as single and as multiple artifact isolates. Tools were with debitage in four percent of the isolated occurrences. Single tools were recorded in another four percent of the isolates. Although few tools were recorded in either the transect or isolated samples, unifaces and bifaces occurred more commonly in isolated contexts. Five percent of the isolated occurrences were bifaces, while less than one percent were inventoried in transect samples. Unifaces tended to occur more frequently in assemblage contexts than isolated ones.

Three cores occurred as isolated artifacts. Two cores were of white chalcedony and one of quartzite. This was the only quartzite core located during this survey. White chalcedony cores were most common in assemblage contexts.

The material types from which isolated occurrences were produced reflect similar patterns as artifacts recorded in sites (Table 2). All isolates were of locally available material. Two

Table 1. Artifact types for isolated occurrences (see Appendix H for artifact codes).

SPECNO	DECORT	INTER	BIFFLK	ANGDEB	CORE	BIF	UNI	GS	HI-START	ART-TYPE	TOTAL
1	-	-	1	-	-	-	-	-	-	DEB	1
2	-	-	-	-	1	-	-	-	-	CORE	1
3	-	6	-	-	-	-	-	-	-	DEB	6
4	1	4	-	-	-	-	-	-	-	DEB	5
5	-	1	-	-	-	1	-	-	-	DEB/TOOL	2
6	-	8	4	-	-	-	-	-	-	DEB	12
7	-	-	1	-	-	-	-	-	-	DEB	1
8	-	1	-	-	-	-	-	-	-	DEB	1
9	-	2	-	-	-	-	-	-	-	DEB	2
10	-	1	-	-	-	-	-	-	-	DEB	1
11	1	-	-	-	-	-	-	-	-	DEB	1
12	1	-	-	-	-	-	-	-	-	DEB	1
13	-	1	-	-	-	-	-	-	-	DEB	1
14	-	1	-	-	-	-	-	-	-	DEB	1
15	-	3	-	-	-	-	-	-	-	DEB	3
16	-	1	-	-	-	-	-	-	-	DEB	1
17	-	2	-	-	-	-	-	-	-	DEB	2
18	1	-	-	-	-	-	-	-	-	CORE	1
19	-	-	-	-	1	-	-	-	-	DEB	1
20	1	-	-	-	-	-	-	-	-	DEB	1
21	-	2	-	-	-	-	-	-	-	DEB	2
22	1	-	-	-	-	-	-	-	-	DEB	1
23	-	1	-	-	-	-	-	-	-	DEB	1
24	-	2	-	-	-	1	-	-	-	DEB/TOOL	3
25	-	-	-	-	-	-	1	-	-	TOOL	1
26	-	2	-	-	-	-	-	-	-	DEB	2
27	-	-	-	-	1	-	-	-	-	CORE	1
28	-	-	-	-	-	-	-	-	1	HIST	1
29	-	2	-	-	-	-	-	-	-	DEB	2
30	-	1	-	-	-	-	-	-	-	DEB	1
31	-	2	-	-	-	-	-	-	-	DEB	2
32	1	2	-	-	-	-	-	-	-	DEB	3
33	1	-	-	-	-	-	-	-	-	DEB	1
34	-	1	-	-	-	-	-	-	-	DEB	1
35	-	1	-	-	-	-	-	-	-	DEB	1
36	-	1	-	-	-	-	-	-	-	DEB	1
37	-	1	-	-	-	-	-	-	-	DEB	1
38	-	1	-	-	-	-	-	-	-	DEB	1
39	-	-	2	-	-	-	-	-	-	DEB	2
40	-	1	2	1	-	-	-	-	-	DEB	4
41	-	-	-	-	-	1	-	-	-	TOOL	1
42	-	-	1	-	-	-	-	-	-	DEB	1

Table 1. Continued.

SPECNO	DECORT	INTER	BIFFLK	ANGDEB	CORE	BIF	UNI	GS	HI-START	ART-TYPE	TOTAL
43	-	1	1	-	-	-	-	-	-	DEB	2
44	-	3	5	-	-	-	-	-	-	DEB	8
45	-	-	1	-	-	-	-	-	-	DEB	1
46	-	-	-	1	-	-	-	-	-	DEB	1
47	-	1	-	-	-	-	-	-	-	DEB	1
48	-	-	1	-	-	-	-	-	-	DEB	1
49	-	-	3	-	-	-	-	-	-	DEB	3
50	-	-	-	-	-	1	-	-	-	TOOL	1
51	-	1	-	-	-	-	-	-	-	DEB	1
52	-	1	-	-	-	-	-	-	-	DEB	1
53	-	1	-	-	-	-	-	-	-	DEB	1
54	1	-	-	-	-	-	-	-	-	DEB	1
55	-	1	-	-	-	-	-	-	-	DEB	1
56	-	-	-	1	-	-	-	-	-	DEB	1
57	-	-	1	-	-	-	-	-	-	DEB	1
58	3	2	-	-	-	-	-	-	-	DEB	5
59	1	-	-	-	-	-	-	-	-	DEB	1
60	-	2	-	-	-	-	-	-	-	DEB	2
61	-	1	-	-	-	-	-	-	-	DEB	1
62	-	1	-	-	-	-	-	-	-	DEB	1
63	1	-	-	-	-	-	-	-	-	DEB	1
64	-	1	-	-	-	-	-	-	-	DEB	1
65	-	1	-	-	-	-	-	-	-	DEB	1
66	-	1	-	-	-	1	-	-	-	DEB/TOOL	2
67	-	1	-	-	-	-	-	-	-	DEB	1
68	-	1	-	-	-	-	-	-	-	DEB	1
69	-	1	-	-	-	-	-	-	-	DEB	1
TOTAL	14	72	23	3	3	5	1	0	1		122
*** Total ***											244

Table 2. Raw material type for isolated chipped stone artifacts.

Chipped Stone Category	Lithic Raw Material Type								TOTAL
	WC	OCH	RC	VA	BB	DB	QTZ	UNK	# %
Decortication flake	13	1	-	-	-	-	-	-	14 (11)
Interior flake	66	2	-	2	1	1	1	-	73 (60)
Biface flake	18	3	-	1	-	-	-	-	22 (18)
Angular debris	3	-	-	-	-	-	-	-	3 (2)
Core	2	-	-	-	-	-	1	-	3 (2)
Biface	2	-	1	1	-	-	-	2	6 (5)
Uniface	1	-	-	-	-	-	-	-	1 (1)
Total	105(86)	6(5)	1(1)	4(3)	1(1)	1(1)	2(2)	2(2)	122(100)

Material Types:
WC = Tidwell chalcedony
OCH = Other chert
RC = Red chert
VA = Green volcanic ash
BB = Brushy Basin chalcedony
DB = Dewey Bridge chert
QTZ = Quartzite
UNK = Unknown

artifact material types were unidentifiable, however. The proportion of white chalcedony is similar in the isolated and assemblage samples. Brushy Basin chalcedonies are less well represented in the isolated sample, while the volcanic ash has a higher representation. No red/amber chert was located in isolated finds. These variances may be biased in part by color and visibility. Artifacts which do not contrast with the ground surface are more likely to be noticeable in assemblage contexts than isolated ones.

Although common in assemblage contexts, angular debris is negligible in the isolated sample. However, three pieces of angular debris were recorded. This may indicate that the by-products of specific reduction stages or technologies are more likely to be confined to assemblage situations. In these contexts, greater quantities of material are produced (or are visible) during reduction episodes. The absence of angular debris as isolates may, in part, be an observational bias. Confidence in distinguishing between natural and cultural shatter diminishes when angular debris is not located in association with an artifact assemblage.

ASSEMBLAGE OBSERVATIONS

Introduction

The following analysis of artifact assemblage variability consists of two components. First, artifact assemblages from all sites will be summarized in descriptive statistical form. Assemblage data is derived from sample transects and from tool descriptions. The transects represent a sample of site assemblage diversity. The tool inventory includes all tools observed at each site. This data is presented in Table 3 and Appendix H. Appendix E is the definitions of artifact types and descriptive terms. In addition is a discussion of lithic technology, site location, and raw material distributions.

Second, artifact assemblage variation will be estimated based on data from the sample transects discussed above. Artifact assemblage diversity will be estimated using the Shannon-Weaver information statistic. The information statistic provides a simultaneous measure of artifact class richness and proportional distribution across these classes. This measure of artifact assemblage diversity enables us to monitor archeological variability in a very general way and to examine its relationship to other variables including site size, environmental setting, and raw material availability.

Technological Concerns

Technology as a subcomponent of human adaptive systems includes raw material selection, manufacture, use, and discard of implements. Technology can be seen as the mechanical articulation between humans and their environment (White 1949). Technology actually refers to human behavior that involves tool use and which is designed to obtain essential energy, nutrients, matter, and information for survival (and reproduction). Technology is reflected in the archeological record in the form of tools used for extraction and processing, as well as by-products related to tool manufacture/use/discard and resource processing.

Since technology is closely interconnected to resource extraction and processing, archeologists can expect to observe a number of correlations between tools and debris and environmental factors. In turn, since technology facilitates adaptive responses to environmental problems, we would expect lithic artifact assemblages and distributions to vary with the organizational properties of land-use.

Frequently, artifacts are interpreted as functional indices of a system's needs. Traditional morphological classifications reflected specific, and often singular, functional uses. More recently, both archeological and ethnographic data have demonstrated that function and morphology do not co-vary in simple and regular relationships. Therefore, an expanded interpretation of

Table 3. Attribute data for the total tool sample.

SITE	BIF	UNI	CORE	GS	OTHER	MATL TYPE	COMP	PLAN	USE WEAR	COR-TEX	SUR TREAT	TEMP SITENO	COM-MENTS
42GR0539	1	0	0	0	0	1	1	0	0	2	0	UNL 5	
42GR0539	1	0	0	0	0	3	1	0	0	2	0	UNL 5	
42GR0539	2	0	0	0	0	1	2	0	0	1	0	UNL 5	
42GR0539	0	1	0	0	0	3	0	0	3	2	0	UNL 5	
42GR0539	0	0	2	0	0	5	1	0	0	2	0	UNL 5	
42GR0539	0	1	0	0	0	1	0	0	3	2	0	UNL 5	
42GR2144	2	0	0	0	0	5	1	0	0	2	0	UNL 6	
42GR2144	2	0	0	0	0	5	2	0	0	2	0	UNL 6	
42GR2144	2	0	0	0	0	1	2	0	0	2	0	UNL 6	
42GR2144	0	0	1	0	0	1	1	0	3	2	3	UNL 6	
42GR2144	0	0	0	1	0	10	1	0	2	2	3	UNL 6	
42GR0565	2	0	0	0	0	1	2	0	0	2	0	UNL 8	
42GR0565	2	0	0	0	0	3	2	0	0	2	0	UNL 8	
42GR0565	0	3	0	0	0	1	1	0	0	2	0	UNL 8	
42GR0565	2	0	0	0	0	3	2	0	0	2	0	UNL 8	
42GR0565	2	0	0	0	0	3	1	0	0	2	0	UNL 8	
42GR0565	0	0	0	3	0	10	2	0	1	2	2	UNL 8	
42GR0565	1	0	0	0	0	1	1	0	0	2	0	UNL 8	
42GR0565	0	1	0	0	0	1	1	0	0	2	0	UNL 8	
42GR2146	1	0	0	0	0	1	1	0	0	2	0	UNL 9	
42GR2146	0	3	0	0	0	1	1	0	3	2	0	UNL 9	
42GR2147	1	0	0	0	0	1	2	0	0	0	0	UNL10	
42GR2147	2	0	0	0	0	1	2	0	0	2	0	UNL10	
42GR2147	2	0	0	0	0	1	2	0	0	2	0	UNL10	
42GR2147	0	0	1	0	0	1	1	0	0	2	0	UNL10	
42GR2147	0	2	0	0	0	9	1	0	0	2	0	UNL10	
42GR2147	0	2	0	0	0	1	1	0	0	2	0	UNL10	
42GR2148	2	0	0	0	0	1	2	0	0	2	0	UNL11	
42GR2148	0	0	0	0	1	8	1	0	4	1	0	UNL11	Matl type 8=Rhyolite
42GR2148	0	2	0	0	0	1	1		3	2	0	UNL11	
42GR2148	0	1	0	0	0	1	1	0	3	2	0	UNL11	
42GR2148	0	0	1	0	0	1	1	0	0	2	0	UNL11	
42GR2149	2	0	0	0	0	5	2	0	0	2	0	UNL12	
42GR2149	0	0	0	0	2	4	1	0	0	1	3	UNL12	
42GR2151	0	0	1	0	0	1	1	0	0	0	0	UNL14	
42GR2151	0	0	3	0	0	1	1	0	0	1	0	UNL14	
42GR2154	0	4	0	0	0	1	1	0	3	2	0	UNL17	
42GR2157	2	0	0	0	0	1	2	0	0	0	0	UNL20	
42GR2157	2	0	0	0	0	1	2	0	0	1	0	UNL20	
42GR2158	2	0	0	0	0	1	2	0	0	0	0	UNL21	
42GR2160	2	0	0	0	0	3	2	0	0	0	0	UNL23	
42GR0515	0	0	1	0	0	1	1	0	0	0	0	UNL24	
42GR0515	0	0	1	0	0	1	1	0	0	0	0	UNL24	
42GR0515	0	0	1	0	0	1	1	0	0	0	0	UNL24	
42GR0515	0	0	1	0	0	1	1	0	0	0	0	UNL24	

Table 3. Continued.

SITE	BIF	UNI	CORE	GS	OTHER	MATL TYPE	COMP	PLAN	USE WEAR	COR-TEX	SUR TREAT	TEMP SITENO	COM-MENTS
42GR0515	0	0	1	0	0	1	1	0	0	0	0	UNL24	
42GR0515	0	0	4	0	0	2	1	0	0	0	0	UNL24	
42GR0515	0	2	0	0	0	1	0	0	0	0	0	UNL24	
42GR0515	0	2	0	0	0	5	0	0	3	0	0	UNL24	
42GR0515	0	2	0	0	0	5	0	0	3	0	0	UNL24	
42GR0515	0	2	0	0	0	1	0	0	3	0	0	UNL24	
42GR0515	2	0	0	0	0	2	2	0	0	2	0	UNL24	
42GR0515	1	0	0	0	0	1	2	0	0	2	0	UNL24	
42GR0515	0	3	0	0	0	1	1	0	4	2	0	UNL24	
42GR0290	0	0	0	2	0	10	2	0	2	0	2	UNL26	
42GR0290	0	0	0	2	0	10	2	0	2	0	2	UNL26	
42GR0290	0	0	0	2	0	10	0	0	1	0	1	UNL26	
42GR0290	2	0	0	0	0	2	2	0	0	0	0	UNL26	
42GR0290	0	0	0	0	2	4	1	0	0	1	3	UNL26	
*** Total***													
	42	33	18	10	5	165	73	0	49	74	19		

technology and its role in culture is necessary in order to expand our view of technology. How technology and its organization vary to accommodate various adaptations and environmental constraints has been a focus of recent archeological research.

Human mobility conditions technologically mediated responses to certain environmental problems. Torrence (1983) suggests that transport costs in mobile hunter-gatherer societies restrict the size and complexity of the technological aids. Tools will tend to be multipurpose and less task-specific as a direct function of group mobility. Multiuse tools should then vary directly with degree of human mobility. Transport costs limit the indefinite development of functionally specific technologies (Torrence 1983).

Technology and mobility are closely, but not simply, interrelated. Although there is a general inverse relationship between hunter-gatherer mobility and tool (implement and facility) diversity, we can expect to observe considerable variation within specific hunter-gatherer societies on a seasonal and/or long-term basis. Variable patterns of land-use and site history can be expected to create a complex material record of past technological systems. Portions of this technological system remain fixed on the landscape as human groups and more mobile components of the system are transported from place to place. For example, Binford (1979) points out that less portable technological aids (e.g., site furniture including metates, storage vessels, or large cores) are left at fixed points or locations, whereas more portable items (e.g., personal gear including knives, axes, or projectiles) are transported over great distances. In addition, more expedient responses to given technological problems may be carried out using situational gear. Residential moves and logistical forays will require a technological diversity that will vary along different dimensions (Shott 1986).

Geographical patterns of archeological site distribution can provide correlative evidence for the technological aspects of past strategies of aboriginal land-use. The position of forager residential sites on the landscape is expected to correlate closely with the location of high bulk critical resources such as plant/animal foods, fuel, and/or water. Constraints imposed by the quality, quantity, and/or accessibility of such critical resources can be circumvented via residential moves. The probability for site reuse is low. These residential sites for foragers would exhibit interassemblage variability primarily as a function of seasonal variations in resource availability. Intersite and/or interassemblage variability for foraging groups would be marked given seasonal variation in critical resource availability. Artifactual assemblages would exhibit greater redundancy if seasonality were slight or if they represented similar seasons of use or occupation. There should be few, if any, specialized activity sites present in forager land-use systems.

As Binford has pointed out, logistically organized hunter-gatherers produce a more complex archeological "landscape." Residential sites tend to be highly visible archeologically given the dependence on bulk storage, attendant storage facilities, domestic structures, midden accumulations, and so forth. Like foragers, collectors also generate locations or places at which resources are procured and/or processed. In addition, storage-dependent hunter-gatherers also produce field camps for extra-residential site occupation, stations for resource monitoring, and caches for storing tools and food.

Given these generalizations regarding hunter-gatherer land-use, what might archeologists expect regarding differential strategies for lithic resource procurement? Foragers are expected to procure lithic raw materials for stone tool production in the context of residential mobility associated with food-getting strategies. Given forager mobility constraints and low bulk processing responses, we would expect relatively low inputs of lithic debris into the archeological record at any one time. Absolute lithic assemblage size can be expected to vary as a function of the frequency of reoccupation or use of a given location. Raw material sources including surface and subsurface deposits would be visited by residential groups. Lithic resources would be tested, procured, and modified in relatively limited quantities in the context of associated occupational activities, e.g., food, fuel, and water procurement; food processing and consumption; shelter construction; and tool maintenance.

On the other hand, collectors are expected to obtain lithic materials in the context of logistically-organized activities. Binford (1979:270) states that for, ". . . systems organized logistically . . . raw materials or tools are rarely obtained through direct procurement strategies . . . ." Kelly (1983:298) states, "There is more to logistical mobility . . . than the direct acquisition of resources . . . . Many stationary nonfood resources, such as material for stone tools, can be collected during successful or unsuccessful logistical forays." Lithic procurement for collectors is not expected, then, to occur in association with residential activities. Binford (1979) argues that lithic raw material procurement would most probably be embedded within multipurpose logistical trips.

Finally, archeologists must be cognizant of the fact that "an assemblage (is) something in the process of being generated" (Ammerman and Feldman 1974:610). Assemblage variability results from the complex interaction of factors governing tool manufacture, use, maintenance, caching, and discard. An "assemblage" of artifactual and ecofactual remains can be the result of a number of these behavioral factors that are ultimately conditioned by economic organization at a regional level. Additionally, the distributional, morphological, and compositional aspects of these static items and "assemblages" are then modified by natural processes such as erosion, deposition, thermal fracture, chemical alteration, or bioturbation. As a result, artifacts that occur together, regardless if time is held constant, can not be assumed to have been used together.

Lithic Artifacts

Prehistoric artifacts are present on 24 (92 percent) of the sites recorded. Sites without associated artifacts are a pictograph/petroglyph panel (42GR297) and an historic site (42GR544). All assemblages are lithic scatters except at one rock overhang where a few corrugated grayware sherds were recorded. Fifty-eight percent of the lithic scatters contain chipped and/or ground stone tools. However, projectile points were recorded on five sites. Few of these artifacts should be considered as reliable temporal indicators. Some diagnostic artifacts are deposited at different times during a site's use history. Others are probably deposited in the same cultural context as the assemblages with which they are spatially associated.

Four sites are in rock shelters. These overhangs are shallow and provide limited sheltered area. Eighty-five percent (22) of the scatters are located in open areas. Of these, 38 percent are on dunal surfaces and 27 percent in ridge/drainage locations, eight percent on gentle sandy slopes, and eight percent in direct proximity to raw material outcrops. Except for one historic artifact, all isolated occurrences are lithics, most of which is debitage.

Debitage

The transect data provided a debitage sample consisting of 67 percent interior flakes, 14 percent biface flakes, 13 percent angular debris, and six percent decortication flakes (Table 4). However, the proportion of cortical flakes may not be as instructive as flake size and dorsal surface scars in determining primary reduction intensity. Potential decortication flake frequencies are relative to the cortical surface area of the lithic resource utilized. If a resource is procured from an outcrop with little cortical surface per volume, then the lack of primary flakes may be explained by the low proportion of cortex to interior workable material. Conversely, cobble resources have a high cortical surface area per interior volume. Locally, materials are available as both cobbles and outcrops. Decortication flakes produced from cobble resources have a 50 percent greater occurrence than in the overall proportional distribution of debitage material types. Decortication flakes occurred on 46 percent of lithic scatters. Decortication flakes were of one material type in all assemblages except two. Sites that were directly associated with material sources (42GR565, 42GR2159) did not exhibit greater proportions of decortication flakes. Neither did these sites deviate above the mean of decortication frequencies. Tidwell outcrops have large quantities of natural shatter. Procurement would not necessarily

Table 4. Lithic raw material type for debitage.

Raw Material Type	Debitage Category				Total
	Decortication flakes	Interior flakes	Biface flakes	Angular debris	# %
WC	44	487	110	101	742(86)
DB	1	2	3	1	7 (1)
BB	5	30	5	5	45 (5)
QTZ	-	10	-	1	11 (1)
OCH	-	12	3	-	15 (2)
SW	-	9	1	2	12 (1)
VA	-	-	1	1	2(.2)
OTH	-	1	-	-	1(.1)
ACH	-	30	-	2	32 (4)
SS	-	-	-	-	0 (0)
Total	50(6)	581(67)	123(14)	113(13)	867(100)

Lithic raw material types:

WC= Tidwell white chalcedony
DB= Dewey Bridge chert
BB= Brushy Basin chalcedony
QTZ= quartzite
OCH= other chert
SW= silicified wood
VA= altered volcanic ash
OTH= other
ACH= green/amber chert
SS= sandstone

entail quarrying and decortication preparation of flakes and cores at source loci.

Biface flakes are of the same materials as other debitage. Material types reflect similar proportional representation of local material types as other debitage. Biface flakes are of a greater variety of material types than decortication flakes. However, no exotic materials were recognized. Maintenance or production of tools from materials transported into the area does not appear to have occurred at these loci. The high frequency of biface flakes at site 42GR2156 may be the ultimate result of visitor impact; larger items have likely been systematically collected from the surface.

Angular debris is assumed to be the product of technological inadequacies or ineffectual flaking of poor quality material. Angular debris represents 13 percent of the debitage sample and was present at 86 percent of the lithic scatters, although overall material quality can be held constant across the project area. Variation in angular debris frequencies may represent differences in technological responses to raw material abundance and accessibility. The greatest portion of angular debris is of Tidwell chalcedony, the most prevalent material in the study area. It also exhibits uniform quality throughout this area. Since it is abundant, reduction by shattering, rather than systematic or conservative flake removal, may have been employed. We might expect that this reduction strategy would be more prevalent at procurement loci. In highly mobile adaptations, expedient core reduction resulting in high quantities of waste material tends to occur where material is abundant (Parry and Kelly 1987).

However, none of the five sites with high proportions of angular debris are located within 1,000 m of Tidwell outcrops. Only Tidwell chalcedony shatter occurs in four of these assemblages. The fifth assemblage contains several material types and occurs at a rock shelter. This site and another rock shelter account for all the angular debris not produced from Tidwell chalcedony. In general, angular debris is more likely to be of Tidwell chalcedony than are other flake types. Few other local materials are present as shatter.

Cores

The core sample from all sites consisted of 11 specimens. Core morphology exhibited little variability (Table 5). Eighty-two percent (9) of the cores had multiple platforms, one core had a single platform, and one was a tested cobble. No bifacial cores were inventoried. No exhausted cores were noted.

Multidirectional reduction of lithic raw material requires less technical or anticipated investment than other reduction strategies. Therefore, bifacial cores reflect a more planned reduction sequence. They provide a flake source and a core that

Table 5. Lithic raw material type for cores.

Core Type	WC	BB	DB	OCH	QTZ	Total # %
	Lithic Ray Material Type					
Multiplatform	9	-	-	-	-	9(60)
Single platform	- [1]	-	-	1	-	2(13)
Bifacial	-	-	1	-	-	1 (7)
Tested cobble	1 [1]	-	-	-	- [1]	3(20)
Total	12(80)	0	1(7)	1(7)	1(7)	15(100)

Material types: WC = Tidwell white chalcedony; BB = Brushy Basin chalcedony; DW = Dewey Bridge chert; OCH = Other chert/chalcedony; QTZ = Quartzite

All cores included from site assemblages and isolated occurrences. Numbers [#] in brackets are isolated occurrences.

can be further utilized as a formal biface. Multiplatform cores do not have this dual potential. In these assemblages exhausted, multiplatform cores are commonly battered and perhaps had a composite use as hammerstones. Formal tools are not easily manufactured from multiplatform cores.

Bifacial cores are useful in mobile strategies because of their composite nature. Taylor (1986:144) suggests that they ". . . may be a product of delayed reduction strategies as opposed to immediate ones . . . we can view bifaces as a special kind of personal gear designed to be responsive to situations as they arise in highly mobile context. . . ." Binford (1979), in his work with the Nunamiut, mentions a similar artifact as mobile personal gear that was used as a core and/or tool.

The presence of multiplatform cores in these assemblages is not necessarily indicative of an expedient lithic technology. A lack of bifacial cores is curious in assemblages in which bifaces are the only tool type occurring with any frequency. Given the frequency of bifaces, one might expect a higher proportion of bifacial cores. However, bifacial cores may be scarce due to raw material availability. The articulation between lithic and resource procurement may account for the preponderance of multi-platform cores in this situation. Also, transportation costs or material efficiency may be less of a restrictive cost in certain systems than expected. Thus, a cost/benefit perspective may not pertain to certain resource distribution contexts, specifically those with high availability and accessibility. All cores in this sample were of local, white Tidwell chalcedony, which falls into the latter description. This material is abundant and is available in island outcrops distributed throughout this area (Figure 8).

The relatively low ratio of cores to debitage may suggest that partially reduced materials were transported. Eleven cores were distributed over six sites (Table 6). One locality accounts for much of this overall frequency. Almost 50 percent (5) of the cores were located in one rock shelter site. This scatter also had a wider range of material types present. All other assemblages with cores had low material diversity and a tendency for high artifact diversity values. All assemblages with cores include other tool types, average or above average decortication flake proportions, and low biface flake proportions.

Tools

Forty chipped stone tools were distributed across 14 sites (Tables 3 and 5). Tools, when present, tended to occur in numbers. Of the chipped stone tools, 60 percent are bifacial and 40 percent unifacial. Two hammerstones and a bifacial cobble were also recorded.

Bifacial tools included 23 percent hafted bifaces and 77 percent unhafted bifaces (Table 7). Six bifaces, one of which was a small, broken, hafted projectile point, were recorded as

Table 6. Summary of lithic tool frequencies for sites in Arches National Park, Utah.

Site (42GR-)	Tool Type: Biface	Uniface	Core	Ground stone	Other	Total #
539	3	2	1	-	-	6
2144	3	-	1	1	-	5
565	5	2	-	1	-	8
2146	1	1	-	-	-	2
2147	3	2	1	-	-	6
2148	1	2	1	-	1*	5
2149	1	-	-	-	1**	2
2151	-	-	2	-	-	2
2154	1	-	-	-	-	1
2157	2	-	-	-	-	2
2158	1	-	-	-	-	1
2160	1	-	-	-	-	1
515	2	6	6	-	-	14
290	1	-	-	3	1**	5
Total	25(40)	15(27)	12(20)	5(8)	3(5)	60

* bifacial cobble
** hammerstone

Table 7. Raw material type for bifacial tools.

Biface Type	Lithic Raw Material Type							
	WC	BB	DB	OCH	ACH	VA	UNK	Total # %
Hafted biface	5 [1]	1	-	-	-	-	-	7 (24)
Unhafted biface	9 [1]	4	2	3	-	[1]	[2]	22 (76)
Total	16(55)	5(17)	2(7)	3(10)	0	1(3)	2(7)	29(100)

isolated occurrences. Bifaces of less common material types were more common as isolated occurances than in site contexts. Unhafted bifaces tended to be broken (82 percent), while projectiles were complete (71 percent).

Two projectile points were missing the extreme distal portion or tip. One projectile point lacked the proximal portion, or stem, and had been reworked along one of the lateral margins. All recorded projectile points were associated with lithic assemblages that contained bifacial and unifacial tools. Incomplete bifaces tended to be broken at the tip; but, proximal portions, or hafting elements, were present.

Discarded, complete projectiles may occur due to manufacture failures, loss/discard, or transport via prey animals. In the latter case, complete points in broken shafts are discarded during processing at butchering loci (Bamforth 1983). Bifaces broken at the use end are likely to be discarded at use loci. Transporting broken bifaces for reworking or retooling may not occur when raw material is readily available. Retouch investment on both the unhafted and hafted bifaces suggests that these were not rejected manufacture failures. All assemblages with complete projectile points included broken bifaces. This association may suggest that gearing up, retooling, or maintenance of projectile points did not occur at these sites, but that bifaces and projectiles were discarded in the context of processing. More extensive wear analysis is necessary to substantiate these patterns.

Seventy-one percent of the projectile points were of Tidwell chalcedony. Marginal and facial retouch investments vary. Two small points without haft elements resemble Cottonwood Triangular points (Appendix F; Specimens E and F). These have a temporal span from late prehistoric to protohistoric (circa A.D. 1300 to 1630). The typology of a small, corner notched triangular point with steep angle margins is unknown (Appendix F, Specimen C). A corner notched Elko-Eared point is broken at the very tip (Appendix F, Specimen D). The long temporal span during which these were produced does not render them sensitive temporal indicators. Two more amorphous side notched points are complete (Appendix F, Specimens B and G).

Unifacial tools included scrapers (18 percent), extensively retouched flakes (24 percent), retouched flakes (47 percent), a utilized flake, and a uniface (Table 8). Unifacial tools tend to exhibit less retouch investment than the bifacial tools. They are more evenly distributed across sites than bifaces. One rock shelter site (42GR515) exhibits a disproportional frequency of unifaces and a high incidence of cores. Unifacial tools primarily were retouched flakes with little facial retouch; however, these tools are complete in all cases. They do not appear to have been discarded prior to breakage during use or manufacture. Unifacial tools occurred on all sites except one which contained other bifacial tools.

Unifacial and bifacial tools were of locally obtained materials (Tables 7 and 8). No tools were produced from exotic materials. Some proportional variation is exhibited between materials utilized for tools and debitage materials. Bifacial tools are of greater proportions of Brushy Basin chalcedony and lesser proportions of Tidwell chalcedony. Other less common material types (e.g., volcanic ash, Dewey Bridge chert, red/amber chert, and other cherts) tend to be slightly more prevalent in bifacial tool than in debitage samples. Proportions of unifacial tool material types approximate those for debitage material types.

Ground stone

The ground stone sample consisted of five artifacts distributed across three sites (Table 6). One mano, three metates, and an unidentified ground stone fragment were recorded. Sites upon which ground stone artifacts are present include a small, open lithic scatter (42GR2144), a very extensive lithic scatter associated with several Tidwell outcrops (42GR565), and a rock shelter (42GR290). These sites exhibit a relatively high artifact diversity with substantial tool and debitage samples.

These three sites are located on ridge, or overlook, situations. Two are on the northeast bench of Salt Valley. The rock shelter overlooks the Courthouse Wash drainage system. Three metates are present on this site. The drainage location augments productive plant communities. This might be one of few areas in the Park where plant growth is predictable. These factors may effect the disproportional representation of ground stone. Metates in this context may be interpreted as site furniture that remained in place for anticipated activities.

Table 8. Lithic raw material type for unifacial tools.

Unifacial tool type	Lithic Raw Material Type					Total # (%)
	WC	BB	DB	OCH	ACH	
Scraper	3	-	-	-	-	3 (18)
Extensively retouched flake	3	1	-	-	-	4 (24)
Retouched flake	5	-	-	2	1	8 (47)
Utilized flake	1	-	-	-	-	1 (6)
Uniface	[1]					1 (6)
Total	13(76)	1(6)	0	2(12)	1(6)	17 (100)

Material types: WC = Tidwell white chalcedony; BB = Brushy Basin chalcedony; DB = Dewey Bridge chert; OCH = other chert/chalcedony; ACH = amber chert; VA = green volcanic ash.

All chipped stone tools included from artifact scatter and isolated occurrences. Numbers (#) in brackets are from isolated occurrences.

All ground stone was of sandstone, which is available throughout the Park. The mano and two of the metates were bifacially ground. One metate and the unidentifiable ground stone were unifacially worked.

Ceramics

Four grayware ceramic fragments were recorded from one assemblage (42GR290). The site is situated adjacent to a rock overhang just north of Courthouse Wash. All sherds were within 15 m of the cliff face. The three corrugated sherds had crushed rock temper that was predominately quartzite. The indentations were intermediate in relief. One plain grayware was thin and polished. Smoothing striations were present on the interior and exterior surfaces. The temper was abundant; a crushed, dark igneous rock, probably basalt. All sherds were very fragmentary and unidentifiable on any criteria except temper.

Summary of Locational Data

Certain situational parameters for site locations are summarized in Tables 9 and 10. All sites were located between 1,250 m (4,100 ft) and 1,658 m (5,440 ft); the natural range of elevations within the Park. Sites in this sample occur equally at higher and lower elevations. Site size and elevation did not appear to be correlated. The largest sites, dimensions greater than 10,000 sq m, tended to be as equally located at lower elevations as they were at higher ones. Small sites, dimensions less than 1,000 sq m, exhibited no locational patterning. The largest sample sizes are at higher elevations, but smaller assemblages are likely to be at these elevations as well. Neither did sample size have a regular pattern in relation to elevation.

Sites tend to be distributed equally between valley floors and highlands. Forty-six percent of all sites were in dunal contexts. The postdepositional processes in dunes have been an issue in recent work. The effects of aeolian sand substrate on archeological assemblage "composition" will be discussed later. Finally, site size and sample size do not increase in a regular relationship.

Lithic Assemblage Diversity

Various comparative statistics have been developed by ecologists and geographers to describe and explain properties of spatial distribution. Methods used to identify and quantify this variability seek to recognize patterning, or redundancies, among data sets. One measure of variability is diversity. Diversity studies in communication prompted expansion of information theory, which "provides a means of analyzing closed number sets compare two or more distributions" (Johnston and Semple 1983:1).

Table 9. Site elevation and area information for Arches National Park, Utah.

Site (42GR-)	Elevation (Feet/Meters)	Area (sq m)	Area Rank*
297	4320'/1317m	24	1
2141	5120'/1560m	444	1
2142	5440'/1658m	3,200	2
2143	5440'/1658m	1,880	2
539	5360'/1634m	33,000	4
2144	5120'/1560m	1,200	2
2145	5200'/1585m	560	1
565	4720'/1439m	426,800	4
2146	4480'/1365m	2,000	2
2147	4480'/1365m	6,300	3
2148	4960'/1512m	2,250	2
2149	4320'/1317m	3,200	2
2150	4240'/1292m	3,000	2
2151	4560'/1390m	9,000	3
2152	5200'/1585m	9,900	3
2153	5200'/1585m	5,250	3
2154	5120'/1560m	7,800	3
2155	5120'/1560m	800	1
2156	5040'/1536m	2,625	2
2157	5120'/1560m	2,800	2
2158	5080'/1548m	28,600	4
2159	4320'/1317m	105	1
2160	4320'/1317m	4,350	2
515	4960'/1512m	600	1
544	4240'/1292m	16,000	4
290	4160'/1268m	8,450	3

* Area Ranked

1= less than 1000 m2
2= more than 1000 m2 and less than 5000 m2
3= more than 5000 m2 and less than 10,000 m2
4= more than 10,000 m2

Table 10. General site setting information for Arches National Park, Utah.

Site	General Landform		Specific Landform				
(42GR-)	Ridge	Valley/Canyon	Dune	Overhang	Ridge*	Outcrop	Slope
297		+		+			
2141		+			+		
2142	+		+				
2143	+		+				
539		+	+				
2144		+					+
2145	+		+				
565	+				+		
2146		+			+		
2147		+			+		
2148	+				+		
2149		+	+				
2150		+	+				
2151	+						+
2152	+		+				
2153	+		+				
2154		+	+				
2155		+	+				
2156	+		+				
2157	+						+
2158	+		+				
2159	+					+	
2160		+			+		
515	+			+			
544		+		+			
290		+		+			

*Ridge landform includes terraces or benches.

The information index of diversity, as discussed by Shannon and Weaver (1949),

> is a measure of population heterogeneity or dual-concept diversity in which the number of observational categories (diversity) and their proportional representations (evenness) are monitored simultaneously . . . (the) statistic has been utilized by ecologists to simultaneously monitor community/collection diversity and information content . . . Information content, assemblage diversity, and uncertainly are, in turn, closely linked to the concepts of entropy and the organization of physical and living systems [Osborn et al. 1987:52-53].

Information theory and statistics, as they are applicable to geographic analyses, have been outlined by R.W. Thomas (1981). Information theory and the Shannon-Weaver index are discussed in ecological terms by Margalef (1958, 1963, 1968), Pielou (1966a, 1966b, 1975), and Peet (1974).

Information statistics have been used archeologically to monitor diversity among assemblages (Hruby 1986; Osborn et al. 1987). The Shannon-Weaver index is useful in summarizing archeological assemblage diversity by enabling investigators to:

> 1) . . . monitor lithic assemblage richness i.e., number of artifact categories; 2) to express evenness among artifact categories; 3) to exhibit limited sensitivity to sample size variation; and, 4) to monitor assemblage diversity independent of the specific observation categories used [Osborn et al. 1987:52].

Variability as measured by the diversity index allows patterning to be observed at the level of the assemblage, rather than the artifact. Diversity values derived from archeological data are commonly a measure of richness--the number of artifact classes represented--which does not reflect proportional abundance. Diversity as richness is measured by the presence or absence of various artifact classes.

Jones et al. (1983), D.H. Thomas (1983), and Kelly (1985) found that diversity among assemblages could be almost exclusively explained by sample size. The issue of sample size as it biases diversity has recently been reviewed and evaluated. In these studies diversity is measured by richness which does not reflect proportional abundance. Artifact assemblage diversity, when quantified using the Shannon-Weaver information statistic, is not related to sample size in at least two survey areas in southeastern Utah. Data from these samples do not conform to the tenet that diversity is a linear function of sample size (Osborn et al. 1987).

The Shannon-Weaver statistic is useful in this capacity because it does not reflect sample size (Pielou 1966a). The information statistic accounts for diversity because it "is a measure of population heterogeneity or dual-concept diversity in which the number of observational categories (diversity) and their proportional representations (evenness) are monitored simultaneously" (Osborn et al. 1987:52).

The following analysis makes use of four indices including the Shannon-Weaver information statistic, maximum information, evenness, and redundancy. Diversity is calculated as follows:

$$H' = -\Sigma \; p_i \log_2 p_i \quad \text{or}$$

$$H' = \Sigma \; p_i \log_2 1/p_i$$

(where H′ is equal to the information content per individual; p_i is the proportion of the ith category, or the sum of frequency values of all categories)

This equation is computed for each assemblage. A zero value indicates that no diversity is present, or that all artifacts are present in a single artifact class. The information content, or diversity statistic, will be high if a high number of artifact classes are represented and the frequencies are equally apportioned among them. The diversity values for the 24-site sample, then, is a relative expression of the variance among artifact class frequency observations.

H_{max} represents the maximum information value possible for each sample. This is an expected value of maximum diversity per assemblage. It is calculated as follows:

$$H_{max} = \log_2 N$$

(where N is the number of artifact classes represented in each assemblage sample; H_{max} is computed for each sample)

The distribution of the frequency among these classes is stated by a measure of evenness. Evenness is expressed by the following formula:

$$J' = H/\log_2 S \quad \text{or}$$

$$J' = H/H_{max}$$

(where J′ is equal to evenness; S is the number of artifact classes, or the richness expressed by each sample; H is the Shannon information index; H_{max} is the maximum information value).

According to the Shannon-Weaver index, evenness and richness will increase as diversity approaches H_{max}.

Redundancy is evaluated by the following expression:

$$R = 1 - H/H_{max} \quad \text{or}$$

$$R = 1 - H/\log_2 S$$

Redundancy in a sample increases as the information index, H, diverges from H_{max} (Osborn et al. 1987).

Transect sample data (Appendix H) were used in calculating the information index. Diversity, evenness, maximum information value, and redundancy were calculated for all lithic scatters. These results are summarized in Table 11.

The relationship between sample size and site size relative to assemblage diversity was examined using regression analyses (Table 12). Nominal variables were analyzed using cross tabulations and Chi Square statistics. The diversity values were divided into three categories (i.e., low, medium, and high) based on the range of values and their distribution.

Diversity and Sample Size

Linear regression analyses of diversity indices and sample size for each assemblage demonstrated no correlation. Less than one percent of the variance in diversity, as measured by the information statistic, is accounted for by sample size (r^2 = 0.0015). Scatter plots reveal that most sites cluster within a median diversity range and around small sample sizes. Outliers appear to exhibit no patterns in terms of assemblage and locational attributes. Site 42GR2159 exhibits no diversity and a mean range sample size. The site has a limited distribution downslope from a chert outcrop and contains primarily quarrying by-products. Site 42GR2158 has a very small sample size and no diversity. The assemblage is highly dispersed across a dunal ridge. Sample size and diversity may be an artifact of a highly scattered and sparse distribution.

Assemblages with large samples are closely distributed around the regression plane. The site with the greatest diversity value has a very small sample size. The lack of relationship between diversity and sample size has been evident in several data sets from southern Utah. These include both lithic assemblages similar to the Arches materials as well as more complex artifact assemblages. As a test for this data, diversity as evaluated by richness was also examined. Bivariate regression analyses of the Arches samples based on "richness" also exhibited little correlation with sample size, site area, and material type (Table 12). It remains unclear whether assemblage variability is, in some cases, a function of sample size (Conkey 1980; Elston and Juell 1987; Jones et al. 1983; D.H. Thomas 1983, 1984). Given the present study results, it would be useful to re-evaluate the conclusions reached by these investigators using the information statistic.

Table 11. Diversity, Hmax, evenness, and redundancy values for lithic scatters.

Site (42GR-)	Diversity (H')	Hmax	Evenness	Redundancy
297*	--	--	--	--
2141	0.820441	1.585140	0.517583	0.482417
2142	1.072201	1.585140	0.676408	0.323592
2143	0.773315	1.585140	0.487853	0.512147
539	1.386172	2.585252	0.536184	0.463816
2144	1.553683	2.322188	0.669060	0.330940
2145	1.352181	2.000224	0.676015	0.323985
565	1.229165	2.000224	0.614514	0.385486
2146	0.922031	1.585140	0.581672	0.418328
2147	1.072222	2.000224	0.536051	0.463949
2148	2.405908	2.585252	0.930628	0.069372
2149	1.156909	1.585140	0.729847	0.270153
2150	1.382592	1.585140	0.872221	0.127779
2151	1.599169	2.000224	0.799495	0.200505
2152	1.234348	1.585140	0.778700	0.221300
2153	1.422634	1.585140	0.897482	0.102518
2154	1.014211	1.585140	0.639824	0.360176
2155	1.140243	1.585140	0.719333	0.280667
2156	1.366468	1.585140	0.862049	0.137951
2157	1.717109	2.322188	0.739436	0.260564
2158	0.000000	0.000000	0.000000	0.000000
2159	0.000000	0.000000	0.000000	0.000000
2160	0.910922	2.000224	0.455410	0.544590
515	1.332269	2.322188	0.573713	0.426287
544**	--	--	--	--
290	1.773336	2.000224	0.886569	0.113431

* Rock art panel at which no lithics were recorded.
** Historic site.

A diversity (H') value of 0.000000 indicates that only one artifact class was present in the sample.

Table 12. Results of bivariate regression analyses.

Variables	r*	R**	p***
Diversity and Distance to Tidwell	0.3212	0.1032	0.1259
Diversity and Distance to Brushy Basin	0.3680	0.1352	0.0769
Diversity and Distance to Dewey Bridge	-0.3728	0.1390	0.0728
Diversity and Sample Size	-0.0389	0.0015	0.8570
Diversity and Site Area	-0.0020	0.0000	1.0000
Sample Size and Site Area	0.0551	0.0030	1.0000
Sample Size and Site Area****	0.3422	0.1171	0.1289
Diversity and Material Types	0.1099	0.0121	0.6091
Material Types and Sample Size	0.4115	0.1693	0.0457
Richness and Sample Size	0.0902	0.0081	0.6751
Richness and Site Area	0.1398	0.0195	1.0000
Richness and Material Type	0.0929	0.0086	0.6660

The first variable listed in each case is the dependent variable

r* = correlation coefficient

R** = determination coefficient or r^2
p*** = Level of significance based on a one-tailed test
**** = Site area minus the three largest sites

Diversity and Site Size

Sample size is often assumed to increase as a function of site area. Larger sites are often described as residential rather than logistical loci and indicate a greater complexity of site use, greater numbers of inhabitants, and longer occupational histories (Schiffer 1975). While the latter problems can not be addressed with temporally and spatially undifferentiated surface samples, site area and sample size can be examined.

The regression analysis of site area and sample size exhibits no correlation ($r = 0.0551$). Less than one percent of sample size variation is accounted for by site area ($r^2 = .0030$). The regression analyses of artifact diversity and site area produced a correlation coefficient of -0.0020; this explains none of the variation between assemblage diversity and site area. This correlation coefficient increases only slightly when the aberrant site areas are eliminated from the regression. Sites 42GR539, 42GR565, and 42GR2158 are large, dispersed scatters with a range of assemblage diversity values. When smaller, less dispersed sites are included, the 12 percent variance in sample size is explained by site area ($r^2 = 0.1171$).

Diversity and Landform

Postdepositional processes resulting in artifact movement may bias surface assemblage contents (Wood and Johnson 1978). In dunal environments, artifact settling processes affect a size sorting in surface assemblages (Gifford 1978; Noeyersons 1978; Wandsnider 1987). Artifacts in sandy matrices are more affected by vertical displacement whereas artifacts in loamy soils exhibit greater horizontal movement (Gifford et al. 1985). Experiments in dunal environments suggest that larger flakes settle at a faster rate than smaller flakes. Thus, gravity, rather than aeolian action, appears to be the more important causal agent in dune site formational processes. Larger flakes tend to be more prevalent in the lower substrate. However, a great deal of continual mixing occurs in the upper few centimeters of an unstable surface. If larger objects are being systematically obscured from surface assemblages, artifact diversity may be biased. Low diversity values may be explained by the lack of larger debitage.

Fifty percent of the lithic scatters were distributed in dunal contexts (Table 13). However, the highest artifact assemblage diversity values are more prevalent on nondunal surfaces. Extreme high and low diversity values may in part be explained by the presence of small debris. Assemblages with high frequencies of small interior and biface flakes are in dunes in 75 percent of sites. The inverse is true for assemblages that have low, small debitage frequencies; 63 percent of such scatters are in nondunal situations. The diversity in dunal depositional contexts does not reflect the absence of smaller artifacts. Four sites are on a dunal slope in a broad valley on the northeast margin of Salt Valley. Although these sites exhibit different

Table 13. Variation of artifact assemblage diversity (ranked) in relation to dune and ridge settings.

Site Setting	Artifact Assemblage Diversity			Total Sites per Case
	Low*	Medium*	High*	
Dunes Presence	3	6	3	12
Dunes Absence	4	3	5	12
Total	7	9	8	24
Ridge Presence	6	7	4	17
Ridge Absence	1	2	4	7
Total	7	9	8	24

* Diversity rank order derived from absolute values in Table 11.
Low = 0-1.01
Medium = 1.02-1.37
High = 1.38-2.5

diversity values, the proportion of biface flakes remains fairly constant, about the mean value for all assemblages (five biface flakes per assemblage; or 13 percent of the debitage sample).

Seventy-one percent of sites were on ridges (Table 13). The local topography offers substantial topographic relief including low terrace remnants and ridges several hundred meters above Salt Valley. The ridges offer some advantage of overview but are limited in area. They frequently emerge as areas with higher concentrations of archeological materials, relative to the more ambiguous surrounding landscape. The stable surface of a ridge crest also tends to conserve the archeological remains from erosion and/or deposition. Higher densities may, then, reflect geological processes more than patterns of aboriginal land-use.

Ridge top locations do not exhibit artifact assemblages that are either characteristically low or high diversity collections. This may suggest that these ridge top sites were not used redundantly for functionally specific purposes. Sites located in other topographic contexts e.g., valley floors and rock shelters produced more diverse artifact assemblages. This was the case for 50 percent of the sites not located on ridge tops.

LITHIC PROCUREMENT AND ASSEMBLAGE DIVERSITY

Lithic raw materials vary in certain properties from other resources. Characteristics of these raw materials dictate that lithic procurement is likely to differ from other resource acquisition strategies. In particular, although material quality in this study area can essentially be held constant, lithic resources exhibit different forms of "packaging." Specifically, similar quality chalcedonies are available as outcrops and as cobbles. The distribution and accessibility of these materials also vary. The research posed here concerns the effect that availability and "packaging" of lithic raw materials might have had on procurement strategies.

The following chapter consists of two components. First, a brief discussion of lithic procurement will summarize the development of ideas in archeology regarding raw material procurement.

Second, an examination of the ways in which such differences might be reflected in the archeological record is presented using the Shannon-Weaver information statistic.

Previous Discussion of Lithic Procurement

Interest in quarries and raw material procurement patterns received little attention in archeology until economic models were applied to these problems during the late 1960s and 1970s. Lithic procurement then provided an ideal forum for the cost/benefit analyses. Early considerations of quarries centered on extensive extractive areas such as Spanish Diggings in Wyoming, the Alibates quarries in Texas, and the obsidian quarries in northern New Mexico. These works were largely descriptive (Arnold 1983). Organizational or technological aspects of procurement have not been an integral part of discussions until more recently.

Around the turn of the century, Holmes proposed that quarries were loci of an extractive industry that functioned solely to produce cores, blanks, or blades. These were transported elsewhere for further reduction and use. Holmes's view of direct access procurement and his view of quarries as functionally limited and specific site types pervaded the only literature on lithic procurement. Holmes's view was criticized by Bryan (1950:20) as follows:

> Holmes' assumption that all the quarrying was for the production of an exportable type of flint object ignores the great mass of utilized flint fragments found in quarry debris. Further it ignores a general principle in industry. Hand tools and light or conveniently carried tools are taken to the job. If heavy tools or

> tedious processes are involved, the material to be worked is brought to the tool or to the labor supply . . . . For economy of effort it is necessary to balance the carrying of the raw material to the flint or the flint to the raw material or to some other working place.

He posits that the availability of other resources would condition the occupational investment at a quarry and, hence, the associated artifact assemblages. Bryan's work anticipates the later focus on economic and scheduling concerns.

White's energy-based view of culture and its evolution provided an appropriate analytical framework within which archeologists could view the organizational properties of human adaptation. Culture could now be seen as a material-based adaptive system; all components or subsystems are interrelated. As a result, all aspects of human behavior could be expected to exhibit material correlates that could be monitored by archeologists. Such a view was based on the principles of energy flow and thermodynamics (White 1949, 1959). This aspect of White's culture theory would later allow anthropologists and archeologists to link their research to ecological energetics and to begin to explain human behavior in much broader biological terms.

The Southwest Anthropological Research Group (SARG) formalized the economic maximization model in archeological studies of resource procurement and site location (Gumerman 1971, 1972). These works succinctly stated both the problems and assumptions regarding resource distribution and acquisition. These patterns are assumed to be reflected archeologically in the differential distribution of sites across the landscape. Variability in site types and site distribution are interpreted as settlement patterns.

Human behavior has been examined from an economic perspective involving the minimization of effort. Efficiency models were derived from postulates developed in geography (Chisholm 1962; Garner 1967; Haggett 1972; Hamilton 1967), while locational models emphasized the significance of geographic distance between various resource areas or "patches." Chisholm (1962:11) stated, in this regard, that "many observable variations of phenomena in space are attributable to relative locations rather than intrinsic qualities of individual places." Locational models were found to be effective in providing a means to approach archeological distributions as representing the material correlates of past economic behavior.

The underlying assumption is that extractive sites were located near critical resources in order to minimize acquisition costs. Such critical resources could then be ranked with respect to subjective or quantitative measures such as distance, areal extent, abundance, caloric value, and so forth. Therefore, the more critical the resource was to past societies, the more site location was determined by the resource's distribution (Gumerman 1971, 1972; Jochim 1976).

Cost/benefit analyses pervade current studies of resource acquisition. These investigations frequently argue that causal relationships account for correlations between settlement patterns and resource distributions. Jochim (1976), in a consideration of "economic seasons," suggests that there are a number of different factors that affect resource procurement and utilization. Jochim (1976:16) states, for example,

> The primary function of economic activities is the provision of the necessary sustenance for the population. This is a biological fact, not a cultural value, although the structuring of the provision is governed by many other culturally defined objectives.

Lithic raw material procurement has been viewed from several different perspectives. Traditionally, archeologists have assumed that lithic raw materials were frequently obtained directly from source areas by task-specific groups.

For example, Jochim (1976:44) states,

> It was argued . . . that resource use decisions tend to be relatively independent and tend to structure the spatial and demographic arrangements of a population of hunter-gatherers. The view taken here is that the procurement schedule assumes a sequence of configurations, each with a different combination and emphasis of resources . . .

Binford (1979) challenged this strict interpretation of direct procurement among logistically organized hunter-gatherers or collectors. In these instances, lithic procurement, as well as additional resource acquisition, was conducted as an "embedded strategy."

Gould and Saggers (1985) substantiate that procurement in Central Australia generally occurs in the context of other activities. They argue that Binford views food resource acquisition apart from that related to other critical resources. Gould (1980) has argued that the differential mechanical qualities of raw materials also form an important factor that conditions resource acquisition strategies.

Renfrew (1969, 1975) posits a relationship between raw material availability and material densities within assemblages. This idea has been termed the lithic acquisition "fall-off" model. Renfrew suggests that material abundance varies with distance from source areas. In other words, particular lithic raw materials should be less prevalent the further they are from their source. However, the availability and accessibility of raw material, the geographic landscape, and resource constraints are anticipated to affect fall-off rates. In addition, organizational properties of procurement activities will affect any strict adherence to economizing behavior in terms of simple distance measures such as geographical space (Binford 1980; Chapman 1977; Reher 1977).

Others propose that when multiple raw material loci are exploited, procurement strategies should be reflected in intra-assemblage material ratios and distances to resources. Assemblage content should then denote a minimization of transportation costs. (Transportation cost is based on the assumption that core reduction occurs at the raw material source in order to minimize the material bulk.) Reduction sequences are expected to vary with distance to resource. The amount of debitage produced per tool and flake size should decrease as distance to source increases (Findlow and Bolognese 1984).

Variations in the relationships between distance to raw material source(s) and specific sites, as well as waste-to-tool ratios, represent a directional trend toward more optimal procurement patterns (Findlow and Bolognese 1984). In such a model raw material selection is seen to vary primarily with respect to the reduction of transportation costs. Transportation cost is the only variable employed in testing the effect of raw material variation in artifact assemblages. Over time, less lithic waste is produced as procurement and reduction become more efficient. However, seasonal and long-term shifts in food-getting activities, raw material quality, and site (re)use are also related to raw material choices.

Based on Central Australian quarry data, Gould and Saggers (1985) were able to recognize two different types of quarries (Gould et al. 1971). Reduction strategies appeared to co-vary with the energy investment required to access the material. Readily accessible, exposed outcrops were quarried with block-on-block percussion which produced a high ratio of debitage to usable material. Buried outcrops, requiring digging to extract the material, were not readily accessible. Direct percussion was used also in quarrying and the ratio of debitage to usable material was substantially lower.

On the basis of Australian data, O'Connell (1977) posits that stone tool variability co-varies with distance to lithic and biotic resources and is not an indication of seasonality. Differences in material accessibility were demonstrated to be reflected in the ratios of tool material types present on sites. Sites near quartzite sources, for example, were characterized by disproportionate ratios of quartzite to chert tools. Thus, certain tool classes conformed closely to the "fall-off" model of procurement. On the other hand, the mechanical properties of certain raw materials appeared to override resource proximity. The implications of these Australian studies is that tool content is not a sensitive indicator of seasonal occupation.

The presence of exotic and nonexotic materials at quarries has been employed to make predictions concerning residential strategies. Little variation in tool raw material type is expected for sedentary populations using quarries. Procurement in a sedentary adaptation is a direct access, logistical activity. However, highly mobile groups that carry their entire tool kit with them are not expected to transport material surpluses. Procurement would be embedded in other resource activities (Gramly 1980).

Gramly (1984) observed variation in the frequencies and percentages of tools manufactured from nonlocal sources in a study of rhyolite quarries in the White Mountains of New Hampshire. Ranges in the extent to which rhyolite was quarried and changes over time are contingent on the ability to manage surpluses, accessibility, and seasonal resource schedules. Gramly (1984) contends that population movements can be monitored by the distribution of curated tools manufactured from extralocal materials present at quarry loci. The variability in extensively used exotic material tools discarded at the quarries suggests that tool kits were literally cleaned out at the point where new material becomes available. Discarded tools tend to be highly maintained, resharpened, expended, and small in size. The degree of mobility is reflected in the relative number of tools of exotic material (Gramly 1980).

In the High Plains of east central New Mexico, Jemez obsidian and Alibates chert were rare in assemblages, but when they were present they always co-occurred as retouch flakes. The assemblages in which they were present tended to exhibit considerable evidence for bifacial reduction. Such tool maintenance or final manufacture appeared to have been the dominant activity at these locations (Acklen et al. 1987; Kramer et al. 1986). The Jemez obsidian source is located 200 miles west of these sites, while the Alibates quarry is about 100 miles east of them. Evidence of maintenance of tools manufactured from such distant resources suggests a highly mobile system and a complex pattern of lithic procurement, manufacture, and maintenance. While retooling of tool kits may occur at some quarries (Gramly 1980), other exotic materials are extensively conserved.

Quarries may produce assemblages which represent different reduction strategies (Torrence 1986). While all stages of core production are evident on Aegean obsidian quarries and surrounding sites, flake size and type tend to decrease with distance from the point of procurement. Different reduction sequences appear to reflect different procurement strategies. More systematic core production was inferred to be intended for exchange, while less skillfully reduced material was the by-product of direct consumption (Torrence 1986). Torrence emphasizes that the degree to which quarrying behavior is efficient is a measure of input, expressed by time, labor, and technology, and not necessarily the absolute quantity of material extracted.

Time budgeting has been suggested to be a salient factor in conditioning technological variability. Scheduling of resource procurement, tool manufacture, and maintenance are affected by time stress. Torrence (1983:13) states that when the "maximization in the efficient use of time is to be expected because of its adaptive consequences, then one outcome that could be predicted is the scheduling of the procurement, production and discard of tools." Cost minimization is not necessarily a function of absolute time, but it may be anticipated when several activities must occur simultaneously. Time budgeting will vary in accordance with season and activity (Jochim 1976; Torrence 1983). Technologies may be flexible in response to different anticipated budgeting constraints. Variability in reduction strategies represented across the project area may reflect responses to different scheduling needs with respect to food resource availability and lithic procurement.

The energy expended in resource procurement is seen to vary with the nature and distribution of the specific material source (Jochim 1976; Torrence 1983). From an ecological perspective, resource procurement strategies can be partitioned into search costs and handling cost (pursuit, capture, processing). Lithic raw materials are fixed and predictable resources. Search costs for raw materials, therefore, are low once their location is known. Search costs would increase, however, if the raw material was distributed as scattered, isolated cobbles. "Pursuit" costs would be greater if the lithic material had to be obtained from subsurface deposits.

Lithic Procurement within the Project Area

Local sources occur both as island outcrops (Tidwell chalcedony) and as intermittent cobbles (Dewey Bridge chert and Brushy Basin chalcedony) eroding from exposed strata. The outcrop sources are patchy but highly reliable in quality and quantity. Cobble resources are intermittently distributed and variable in quality.

Not all materials suit all tasks. Fracture mechanics operate differently in different material types. Certain properties, or material types, will be selected to best accommodate certain activities (Chapman 1977; Dibble and Whittaker 1981; Goodman 1944; Speth 1972). Thus, resource proximity, or ease of access, is not the only variable acting in material selection.

Edge durability and maintenance are primarily a function of the structural composition of the lithic raw material. Fine-grained, cryptocrystalline stone is preferable to coarser grained materials for certain tasks which require frequent edge resharpening. Compositional and mechanical properties of various raw materials may, in fact, crosscut standard material categories used by archeologists. Similar tasks might, then, be carried out with tools manufactured from different standard types of lithic material, e.g., chalcedonies versus obsidian. Similar debitage and tool material type proportions for the common materials support this inference. If specific sources were being locally selected for bifacial tool manufacture, we would expect disproportionate biface-to-debitage-material-type ratios.

Similar quality chalcedonies occur at Arches both as outcrops and cobbles. These source types are spatially discrete. Local raw material selection appears to be correlated to accessibility rather than to quality. One might expect that lithic procurement was embedded within other subsistence pursuits as a function of raw material location and accessibility. For example, procurement of the Tidwell chalcedony might differ from that of other chalcedonies since it is widely available and not more limited in distribution. Differential accessibility of lithic raw material might be monitored in terms of outcrops or seams, as opposed to cobble or gravel deposits.

Lithic Procurement and Diversity

Local lithic sources occur as discrete locations, rather than as continuously exposed gravel beds. Specifically, Tidwell chalcedony is distributed in topographically fixed locations which are highly visible. If these lithic sources were logistically exploited, one would expect that associated archeological sites would have been reused and that they would exhibit more redundant, homogeneous assemblages.

The information statistic is employed to measure the range of artifact assemblage variability for all observed sites. The diversity index is used to test implications of previous work regarding aboriginal land-use systems. If a consistent and redundant pattern of task-specific procurement occurred, one would then anticipate that assemblages would exhibit low diversity\high redundancy values. This study will examine the relationships between the content of assemblages and distance to resources.

Artifact assemblage diversity values are utilized in an examination of the relationship(s) between content variability and locational variables. The relationship between distance, sample size, and assemblage diversity was examined using regression analysis. Artifact diversity and raw material quality were analyzed using cross tabulations and Chi Square statistics. Site assemblage diversity was ranked into three categories i.e., low, medium, and high, based on the multimodal distribution of values (Tables 11, 12, and 13).

Distances between source locations and sites were derived from areal photographs and geologic strata maps (Doelling 1985). Distance was measured on a horizontal plane and has not been adjusted for topographic variation. The relationship between material sources and scatter locations are depicted in Figure 8.

Specific nonadjusted distances to sources are summarized in Table 14.

Material Type and Artifact Diversity

Fifty percent of the observed lithic scatters had only one material type present, white chalcedony (Appendix H). Less than four material types are present in 75 percent of the assemblages. Debitage, and most often interior flakes, account for the presence of additional material types. The outcrop of the Dewey Bridge Member contains variable quality chert and is located within 1,000 m of 85 percent of all lithic scatters. Fifty percent of lithic scatters are within 2,000 m of the Tidwell chalcedony outcrops while only two scatters are less than 1,000 m away. Scatters are not directly associated with the outcrop of the Brushy Basin Member and tend to be established at some distance from this source.

The diversity of artifact types and the number of material types present in each assemblage show little direct relationship (Table 15). Material diversity does not tend to increase as artifact diversity increases. This supports the notion that material types are not being specifically selected for their mechanical qualities. If specific materials were being utilized for certain tool classes, we would expect that as the number of artifact classes present increases, the number of material types present would also increase.

The greatest range of artifact diversity is in assemblages with low material type diversity. Artifact diversity appears to vary independently of raw material type(s). The greatest number of material types occur in assemblages which exhibit intermediate ranges of artifact diversity. The high diversity of material types is not justified by the presence of tools or biface flakes but by interior flakes. This suggests that complete tools from nonlocal materials were not manufactured, maintained, or discarded in these localities. The assemblage with the greatest artifact diversity contains only one raw material type.

The assemblages with the greatest number of material types present are associated with rock shelters. Diversity tends to be high in these instances as well. This suggests that assemblage and material type diversity vary directly in this case for this particular site type. Rock shelters represent point locations in an otherwise undifferentiated landscape. This pattern may be explained in terms of multiple, yet functionally distinct, uses of these sheltered locations.

On the other hand, low diversity in assemblage and material type may result from repeated, task-specific use of a given location. This pattern might be expected at point resource locations like springs or at quarries. Therefore, a small, very spatially limited chert procurement locus (42GR2159) exhibited no diversity in artifact or material type. No diversity in one

Table 14. Distances between sites and lithic raw material sources.

Site (42GR-)	Minimal Distance to Lithic Raw Material Sources* Tidwell	Brushy Basin	Dewey Bridge	Altered Volcanic	Other**
297***					
2141	1800	4500	50	11,300	
2142	2300	5200	0	10,700	
2143	2100	5100	50	10,800	
539	2300	4800	100	11,500	
2144	2000	3500	0	7800	
2145	1800	2200	200	6300	
565	0	400	500	4400	
2146	1300	600	1800	1700	
2147	1500	1000	1500	1800	
2148	5500	5000	150	6400	
2149	3000	8400	100	9500	
2150	3000	9400	50	11,800	
2151	1700	11,400	50	14,800	
2152	1200	3300	700	6600	
2153	1400	3300	400	6900	
2154	1700	2700	400	6600	
2155	1500	3000	400	6500	
2156	4500	4300	0	5500	
2157	4800	4300	100	5000	
2158	5300	4800	200	5100	
2159	0	500	1300	800	0
2160	300	400	1600	500	300
515	4700	5200	0	6600	
544****					
290	2600	8800	300	12,000	

* Minimal distance from center of site to lithic raw material source (meters).

** Other lithic raw material is high quality red/amber chert that occurs below the Tidwell chalcedony.

*** Rock art panel that had no associated lithic artifacts.

**** Historic site.

Table 15. Variation in artifact assemblage diversity and lithic raw material type for sites in Arches National Park, Utah.

Number of Lithic Raw Materials	Artifact Assemblage Diversity			Total Sites per Case
	Low*	Medium*	High*	# %
1	3	4	5	12 (50)
2	2	1	2	5 (21)
3	-	1	-	1 (4)
4	2	2	-	4 (17)
5	-	1	-	1 (4)
6	-	-	-	0 (0)
7	-	-	1	1 (4)
Total	7	9	8	24(100)

* Diversity rank order derived from absolute values in Table 11.

Diversity statistic ranking: Low = 0-1.01; Medium = 1.02-1.37; High = 1.38-2.5

other assemblage (42GR2158) is partially explained by a very sparse and dispersed distribution.

Material Diversity and Sample Size

Sample size and material diversity illustrate a similar ambiguous relationship. Assemblages with the smallest sample sizes exhibit little or no material diversity (Table 16). However, larger samples do not necessarily manifest a greater material diversity. The greatest range of material types are in those assemblages which have middle range artifact frequency values. Regression analyses indicate that 16 percent of the variance in material type across sites can be explained by sample size (Table 12). This is the most significant statistical correlation between material sources and other variables.

Artifact Diversity and Distance to Lithic Sources

Distance to and diversity of raw material sources were considered in both continuous and discrete variable analyses. The relationship between artifact assemblage diversity and distance to the nearest raw material source was examined in two ways. First, both assemblage diversity values and distances to various raw material sources were ranked and tabulated. A Chi Square test revealed that these variables were not associated (Table 17). Regression analyses revealed that less than 14 percent of the variance in artifact assemblage was explained by distance to nearest raw material source (Table 12). Site 42GR159 is located close to a raw material source; it exhibits evidence for associated quarrying activities and assemblage diversity is low.

The assemblages less than 1,000 m from Tidwell outcrops have relatively low artifact diversity values. One of these sites (42GR565) has a large and complex distribution, which in subsurface investigation may yield a greater variability. Another site is a quarry in association with the chert deposits immediately below the Tidwell Member. The artifact variability of a third assemblage (42GR2160) is explained by flake, not tool, types. In addition, this location is in proximity to Brushy Basin chalcedonies, which may explain the material diversity. Sites 1,000 m to 3,000 m from Tidwell sources are the greatest in number and have the greatest range of diversity. Sites at greater distances from lithic sources tended to have higher diversity ranges.

No scatters in this sample are immediately associated with the exposed Brushy Basin chalcedony. However, scatters in closest proximity to the Tidwell chalcedonies tend to exhibit low artifact diversity and those at extreme distances tend to have greater artifact diversity. Due to the very dispersed cobble distribution within the strata of the Brushy Basin chalcedonies, we might expect that site locations would tend to be more random.

Table 16. Lithic raw material diversity and artifact sample size for sites in Arches National Park, Utah.

Artifact Sample Size*	Number of Lithic Raw Materials							
	1	2	3	4	5	6	7	Total # %
1	2	1	-	-	-	-	-	3(13)
2	4	1	1	1	-	-	-	7(29)
3	3	1	-	-	-	-	-	4(17)
4	1	-	-	-	-	-	1	2 (8)
5	-	1	-	-	-	-	-	1 (4)
6	1	-	-	1	-	-	-	2 (8)
7	-	-	-	-	1	-	-	1 (4)
8	1	1	-	-	-	-	-	2 (8)
9	-	-	-	2	-	-	-	2 (8)
Total	12(50)	5(21)	1(4)	4(17)	1(4)	0	1(4)	24(100)

* Artifact Sample size:

1= 1-10
2= 11-20
3= 21-30
4= 31-40
5= 41-50
6= 51-60
7= 61-70
8= 71-80
9= more than 81

Table 17. Variation in artifact assemblage diversity (ranked) in relation to distance to nearest lithic raw material source.

Artifact Assemblage Diversity (ranked)*	Distance to the Tidwell Member**								Total Sites per Case
	1	2	3	4	5	6	7	8	
Low	1	1	3	1	-	-	1	-	7
Medium	1	-	4	1	1	2	-	-	9
High	-	-	2	3	1	1	1	-	8
Total	2	1	9	5	2	3	2	-	24

	Distance to Brushy Basin								
	1	2	3	4	5	6	7	8	
Low	-	3	-	1	-	2	1	-	7
Medium	-	1	1	1	2	1	2	1	9
High	-	-	-	-	2	2	1	3	8
Total	0	4	1	2	4	5	4	4	24

	Distance to Dewey Bridge								
	1	2	3	4	5	6	7	8	
Low	-	4	3	-	-	-	-	-	7
Medium	3	5	1	-	-	-	-	-	9
High	1	7	-	-	-	-	-	-	8
Total	4	16	4	0	0	0	0	0	24

*Artifact assemblage diversity (H') ranked; see Table 15.
**Distance ranks: 1=0; 2=1-999; 3=1000-1999; 4=2000-2900; 5=3000-3900; 6=4000-4900; 7=5000-5900; 8=¶6000 meters.

Table 17, continued.

Distance measured by air dimensions

Diversity rank values	Distance Rank Values (in meters)		
Low = 0-1.01	1 = 0	4 = 2000-2900	7 = 5000-5900
Medium = 1.02-1.37	2 = 1-999	5 = 3000-3900	8 = greater than 6000
High = 1.38-2.5	3 = 1000-1999	6 = 4000-4900	

sites near Brushy Basin sources are more likely to be related to other resources. Tidwell chalcedony is accessible in large quantities in highly predictable localities, thus, site locations may be specific, or mapped on to this resource. However, palimpsest scatters are more likely associated with the Tidwell outcrops than the Brushy Basin because they are a point resource location.

All assemblages in this sample are located within 2,000 m of Dewey Bridge exposures. Eighty-three percent of these sites are within 1,000 m. Artifact diversity tends to be higher in scatters closer to these strata, while those at greater distances tend to have a lower diversity. Middle range distances exhibit the greatest number of sites and variability in diversity. Regression analyses of absolute distance and diversity demonstrate similar results. Dewey Bridge chert however is highly variable in quality. Frequently, these cobbles do not produce conchoidal fractures. Therefore, site location most likely is not conditioned by lithic procurement of the Dewey Bridge but by other environmental considerations.

Directions for Further Research

Lithic procurement has been the primary focus of this study. Previous archeological work in Arches National Park has addressed additional aspects of prehistoric quarrying activities. However, archeological evidence also suggests that a range of prehistoric activities was conducted within the study area in addition to lithic procurement. While lithic procurement certainly occurred, it does not appear to have been a primary determinant in site location. Under such conditions, it is expected that assemblage diversity would vary with quarrying loci; specifically, that repetitive, singular activity episodes would create redundant assemblages. At this level of inquiry, no pattern was observed between artifact diversity, distance to resources, and material diversity.

Artifact assemblage diversity reflects not only the range of activities carried out at specific locations but also patterns of site use. Site history can be quite complex; present-day artifact scatters may have been utilized for similar or quite different purposes over long periods of time. These complex composites have also been modified by various natural processes including erosion, deposition, trampling, and soil creep. Artifact assemblage diversity, raw material diversity, and distance to raw material sources exhibit complex relationships. This fact suggests that sites observed in this study were produced via complex use/reuse histories.

Very few tools of extralocal material, or evidence of their maintenance, were recorded. This suggests that these procurement areas did not function as retooling loci upon which expended tool kits were discarded and subsequently replaced by local materials (Gramly 1984). The lack of extralocal material suggests that the subsistence network was highly confined, or that these sites represent logistical, short-term use. Although mobile hunter-gatherers might be expected to utilize a greater range of lithic materials, only local sources are evidenced.

This dearth of extralocal materials might be explained in two ways. First, aboriginal land-use patterns were small scale and required the use of resources found within small home ranges. This is unlikely since the home range sizes for historic hunter-gatherers in arid lands (like the Southern Paiute) were relatively large. Second, and most likely, aboriginal activities conducted in this area did not require significant maintenance of chipped stone tools transported over great distances.

Assemblage diversity is not explained by distance to lithic resources. Diversity is likely conditioned by extractive strategies which focused on other resources. Lithic artifacts represent only a portion of the tool kit used by aboriginal peoples. Primary use of this area may have involved extractive tasks such as plant procurement and processing that produced no chipped stone.

Dispersal patterns of Tidwell and Brushy Basin chalcedonies outside the project area would lend some insight into how these scatters might correlate with the greater landscape. The scale of home ranges must be appreciated in considering resource procurement strategies. Distance and resource distribution arbitrate logistical/residential mobility. The project area is situated within a day's walk of a broad range of environmental strata. Quantifying other ecological parameters would be useful in looking at how assemblage distributions and content may vary with environmental strata.

MANAGEMENT RECOMMENDATIONS

Twenty-six sites and 69 isolated occurrences were recorded during the 1987 field season. Six of these sites had been previously inventoried by Lloyd Pierson and Michael Berry (Berry 1975). The site information collected by Pierson is on file at the Midwest Archeological Center, National Park Service, Lincoln, Nebraska. The 1987 inventory included 24 lithic scatters, a pictograph/petroglyph panel, and one historic site. One assemblage from within a rock overhang included several sherds. No other ceramics were recorded. All isolated occurrences were debitage or chipped stone tools, except for one historic metal artifact. Assemblages varied considerably in terms of density, spatial organization, distribution, and artifact content. Sites were located throughout the range of elevations within the Park and in various depositional contexts.

The lithic assemblages are not temporally specific. Assemblages generally contain few tools but exhibit variable quantities and kinds of debitage. Very few diagnostic artifacts are present, although all artifacts were produced from local sources. Similar quality cherts and chalcedonies, available as outcrops and cobbles, are distributed throughout the area. Artifact material types reflect the relative accessibility of the sources. However, selection for specific quality materials is not reflected in assemblage content. Certain materials do not tend to be overrepresented by specific artifact classes.

Prior research emphasized that raw material availability and the paucity of other local resources determined prehistoric land-use patterns. The current analyses, however, did not support this inference. Repetitive, task-specific area-use would tend to produce redundant assemblage contents. Therefore, assemblage variability does not appear to reflect aboriginal activities focused primarily on lithic procurement.

Sites located during this survey are likely to have been impacted during road and trail construction. Increased accessibility to these areas in recent years has facilitated visitor access and increased the potential for unauthorized artifact collection. The general paucity of formalized tools may be attributable in part to these collections. Impact from unauthorized collectors is largely unknown or not quantifiable. The Park was once known for its abundance of prehistoric artifacts (Berry 1975). Survey procedures were designed to monitor resources in the event of minor maintenance activities to roads and trails. If major improvements are planned, such as widening or paving, these areas will require further investigation. The Delicate Arch road was surveyed with the objective that it will be paved.

Almost 40 percent of all sites were on dunal surfaces. However, postdepositional factors cause a natural size sorting of artifact assemblages deposited in these contexts. This may justify the high proportion of small interior flakes in these assemblages. Most of these dunal sites probably contain subsurface deposits.

Present impacts due to road or trail location affect 16 of the 26 sites. The main paved road bisects five sites (42GR565, 42GR2147, 42GR2148, 42GR2151, 42GR2157). A remnant two-track bisects site 42GR2158. Foot trails bisect four sites (42GR539, 42GR2153, 42GR2154, 42GR2156). Seven additional sites are immediately adjacent to these trails. A flood control feature was excavated through site 42GR2150. The extent of damage to these sites from construction is unknown. The three sites in rock shelters (42GR515, 42GR544, 42GR290) are visible from the road and are susceptible to unauthorized artifact collecting.

Cut banks, formed by road construction, create erosional surfaces. Slope wash, caused by these features, continues to impact sites. In addition, visitor access will adversely affect sites bisected by the trails. The absence of tools and larger debitage may reflect such impacts resulting from casual collecting by Park visitors. These sites should be protected by rerouting trails to avoid further impact to surface assemblages.

Site 42GR539 is bisected by three roads: the main road, the Salt Valley overlook road, and the road into Fiery Furnace. Although this site is vast, large portions of it have already been destroyed. Site 42GR2157 is bisected by the Windows Section road and the turnout overlooking the Garden of Eden. The remaining artifact assemblage has little integrity; the surface scatter appears to be a secondary deposit from slope wash. Site 42GR2156 is especially susceptible to visitor disturbance. The trail to Balanced Rock circumscribes this site. Visitor impact is a daily threat. It is likely that little of the assemblage is intact. This site should be tested for subsurface deposits.

The archeological record in Arches National Park is a valuable resource that possesses considerable scientific research potential. Sparse vegetation and active erosional processes insure that much of the archeological record is visible on the surface.

In addition, geologic areas of resource materials used by aboriginal peoples occur within the park boundaries. Such lithic raw material source areas might be developed as points of interest for visitors. Research involving spatial and distributional analysis of resources and lithic assemblages is encouraged.

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APPENDIX A
An Outline of Previous Work Accomplished within the Park

Date	Investigator	Location of Work Accomplished
1934	Frank Beckwith	Description of large rock art panel near the mouth of Courthouse Wash (42GR605) now listed on the National Register (Beckwith 1934:177-178).
1949-1952	Alice Hunt	Archeological reconnaissance in La Sal Mountain area of southeastern Utah. Eight sites were recorded at the southern end of the park (Hunt 1953).
1956-1972	Lloyd Pierson	Recorded 51 archeological sites; the majority of these sites are located in the southern half of the park (Anderson 1978).
1973	La Mar Lindsay Rex E. Madsen	Survey of Delicate Arch road project and Monument headquarters sewage disposal area (Lindsay and Madsen 1973:15). No sites found.
1974	Mike Berry	Survey of eastern central portion of the park. Thirty sites were recorded (Berry 1975).
1982	Ralph Hartley Robert Nickel	Systematic archeological survey of area surrounding Devil's Garden campground and trail head area and archeological reconnaissance in Arches headquarters area. Seven new sites and the remains of a site previously recorded by Pierson were recorded (Calabrese 1982; Griffin 1985).
1983	Ralph Hartley Susan Vetter	Survey of fence line along portions of the east and west boundaries of the park. Seven sites and six isolated artifacts were recorded (Calabrese 1984).

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APPENDIX B
Data Base Files from Previously Collected Data

Arches Museum Collections Codes

FIELDS	CODES
ACCESS-Accession number	
CATALOG-Catalog number	
ARTTYPE-Artifact type	C=chipped stone G=ground stone P=ceramic B=bone W=woven material, fiber H=historic O=other
ARTFORM-Artifact form	PP=projectile point KN=knife SC=scraper AX=ax CO=core BI=biface UN=uniface MF=modified flake UF=utilized flake DB=debitage MA=mano SH=sherd ME=metal GL=glass PH=photograph PM=printed material (newspapers, postcards, mining claims, etc.) OT=other

LENTHHT-Length/Height (in centimeters; photographs in inches)
WIDTHDIA-Width/Diameter (in centimeters; photographs in inches)
THICK-Thickness (in centimeters)

FIELDS	CODES
CURLOCAL-Current location	AMS=Arches Museum Storage ODA=On display at Arches MBM=Loaned to Moab Museum NOR=Not recorded UNK=Unknown
LOCALE-Locality	Area or nearest landmark where artifact was found

Appendix B

Arches National Park Collections

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick- ness (cm)	Current Location	Locality	Remarks
1	1A-53A	O	OT	0.00	0.00	0.00	AMS	FIELD COLLECTIONS	ONLY CAT.#45A DESCRIBED
1	45A	G	MA	0.00	0.00	0.00	AMS	MOAB QUAD-24S 21E, SEC. 16 AND 21	PART OF FIELD COLLECTIONS BY L.PIERSON, 1957-1959
2	1-434	O	OT	0.00	0.00	0.00	NBM	NOT RECORDED	ARTIFACTS AND HISTORICAL ITEMS
3	435	C	PP	6.51	2.70	0.40	ODA	GRAND VIEW POINT	ORANGE QUARTZ, FINE CHIPPING, GOOD CONDITION
4	436	C	PP	3.18	1.27	0.32	ODA	NEAR STATION 255.5 ON ROUTE 1A, ENTRANCE ROAD	WHITE CHERT
5	437	O	OT	26.67	15.24	0.00	ODA	CORD MINE, BIG INDIAN DISTRICT	URANINITE ORE SAMPLE-TRIANGULAR, BLACK
6	438	O	OT	12.70	15.24	0.00	UNK	MORRISON FORMATION, DALTON WELLS, GRAND CO., UTAH	FOSSIL DINOSAUR BONE, SMALL JOINT, SPECIES UNKNOWN
6	439	C	KN	13.97	7.62	0.00	ODA	DEVIL'S GARDEN-ARCHES NATIONAL MONUMENT	PINK/WHITE/BEIGE CHERT, PATINATED ON ONE SIDE
7	440	H	ME	34.93	0.00	0.00	ODA	CAVE IN SECOND SIDE CANYON OF COURTHOUSE WASH	GEOLOGIST'S PICK, IRON HEAD, WOOD HANDLE
8	441	C	PP	5.08	4.29	1.11	AMS	KEY HOLE BRIDGE-NW 1/4, SEC.35, RANGE 21E, T. 23S	BOTTOM HALF, WHITE STONE
8	442	C	PP	3.18	1.91	0.48	AMS	UP SALT WASH FROM TURNBOW CABIN-W. OF TURNBOW SPG.	WHITE STONE
8	443	C	PP	6.83	5.08	1.11	AMS	SEC. 32 & 33, 1/4 CORNER NW-NE 1/4 32 & 33	BROWN STONE
8	444	C	PP	5.08	1.91	0.32	AMS	SE 1/4 OF NW 1/4 OF SEC. 5, RANGE 22E, TOWNSH. 24S	PINKISH
8	445	O	OT	1.43	2.86	0.48	AMS	COURTHOUSE TOWERS SEC., BEHIND MAJOR FIN, PARK AVE	RECTANGULAR STONE, BROKEN IN HALF, PINKISH
8	446	C	SC	8.89	6.35	1.11	UNK	THOMPSON QUAD-WINTER CAMP CANYON ON BENCH 30 FT UP	OVAL SHAPED, WHITE WITH BROWN AND GREEN CHERT
8	447	C	PP	7.62	5.08	1.27	AMS	COURTHOUSE WASH-WEST OF BRIDGE	WHITE STONE
8	448	C	KN	13.34	8.89	3.18	AMS	500 YDS. NW OF TURNBOW CABIN ON TOP OF RIDGE	WHITE STONE
8	449	G	MA	12.07	5.72	5.08	AMS	RIGHT SIDE OF MOUTH OF PARK AVENUE	RED SANDSTONE
8	450	G	MA	10.16	8.89	3.81	AMS	NEAR SOUTH BOUNDARY NEAR VISITOR CENTER	RED SANDSTONE
8	452	G	AX	10.42	0.00	0.00	AMS	UP COURTHOUSE-1/2 TO 3/4 MI. UPSTREAM FROM BRIDGE	REDDISH, LENGTH IS APPROXIMATE
8	453	G	AX	15.24	0.00	0.00	AMS	UP COURTHOUSE-1/2 TO 3/4 MI. UPSTREAM FROM BRIDGE	BLACK, LENGTH IS APPROXIMATE
9	455-478	O	OT	0.00	0.00	0.00	AMS	DONORS UNKNOWN-FIELD COLLECTION	ROCKS, MINERALS AND FOSSILS-GEOLOGY (CURLOCAL ?)
10	479-816	O	OT	0.00	0.00	0.00	ODA	RECEIVED FROM BRIGHAM YOUNG UNIVERSITY, 1963-1964	PLANTS-CURRENT LOCATION UNCERTAIN
11	817-848	O	OT	0.00	0.00	0.00	ODA	RECEIVED FROM BRIGHAM YOUNG UNIVERSITY	BIRDS-CURRENT LOCATION UNCERTAIN
12	849-888	O	OT	0.00	0.00	0.00	ODA	RECEIVED FROM PRIVATE DONORS	MAMMAL COLLECTION-CURRENT LOCATION UNCERTAIN
13	889-906	O	OT	0.00	0.00	0.00	ODA	UNKNOWN	REPTILES-CURRENT LOCATION UNCERTAIN
14	907	O	OT	0.00	0.00	0.00	ODA	UNKNOWN	WHITE-BELLIED GARTER SNAKE-CUR. LOCATION UNCERTAIN
15	908	O	OT	0.00	0.00	0.00	ODA	UNKNOWN	MIDGET FADED RATTLER-CURRENT LOCATION UNCERTAIN
16	909	O	OT	0.00	0.00	0.00	ODA	UNKNOWN	GOPHER-CURRENT LOCATION UNCERTAIN
17	910	O	OT	0.00	0.00	0.00	ODA	RECEIVED FROM PRIVATE DONORS	FLATHEAD MINNOW-CURRENT LOCATION UNCERTAIN
18	911	O	OT	0.00	0.00	0.00	ODA	RECEIVED FROM PRIVATE DONORS	SPECKLED DACE-CURRENT LOCATION UNCERTAIN

Arches National Park Collections (continued)

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick-ness (cm)	Current Location	Locality	Remarks
19	912	G	MA	12.50	9.50	4.00	AMS	ARC SITE 41	RED SANDSTONE
20	913	G	MA	13.80	6.80	3.70	AMS	COURTHOUSE WASH, SOUTH OF PARK BRIDGE	GRAY-BROWN, NOT A SANDSTONE
21	914	G	MA	9.00	4.70	3.30	AMS	WILLOW SPRINGS, 2 MI. NORTH OF FOUR-WHEEL DRIVE RD	RED SANDSTONE, BROKEN, HALF OF MANO EXTENT
22	915	C	OT	11.43	4.45	0.48	AMS	EAGLE PARK	SPEAR, GRAY FLAKED FLINT
23	916	H	ME	7.62	11.43	0.00	AMS	NOT RECORDED	2 KNIFE PUNCTURES IN TOP, SOLDERED HOLE IN BOTTOM
24	917	G	AX	0.00	0.00	0.00	AMS	NW 1/4, SEC. 20, T25S, R21E BASE OF PETROGLYPHS	GREEN STONE
25	918	O	OT	0.00	0.00	0.00	AMS	NEAR DEVIL'S GARDEN	SANDSTONE OBJECT, COVERED WITH LICHENS, 2 PIECES
26	919	H	GL	0.00	0.00	0.00	AMS	FOUND AT DUMP IN PETRIFIED DUNES AREA	SMALL GLASS BOTTLE, MARKED (LYRIC)
27	920	O	OT	8.89	11.43	0.00	AMS	1/8 MI. N. OF SLICKROCK RT. TOWARD COURTHOUSE WASh	OBLONG STONE, MOTT. GREY, GLAZED, GROOVED, FOSSIL?
28	921	H	OT	0.00	0.00	0.00	AMS	FOUND AT WOLFE CABIN DURING RESTORATION	CHINKING FROM WOLFE CABIN-FABRIC PIECES FROM RANCH
29	922	H	ME	36.83	0.00	0.00	AMS	FOUND AT WOLFE CABIN DURING RESTORATION	FILE
30	923	H	ME	0.00	0.00	0.00	AMS	FOUND DURING WOLFE CABIN RESTORATION, UNDER WINDOW	HORSESHOE
31	924	H	ME	0.00	0.00	0.00	AMS	FIELD	NAILS, BOLT, CARTRIDGE, WASHER, BUTTON, HANDLE PT.
32	925	H	ME	0.00	0.00	0.00	AMS	FIELD	SPOONS, 12"NAIL, HANDLES, STEEL PIECE, IRON SCRAPS
33	926	H	PM	0.00	0.00	0.00	AMS	FIELD	NEWSPAPER FRAGS, DATED OCT.1907, MASTHEAD REPUBLIC
34	927	H	ME	0.00	0.00	0.00	AMS	FRESH WATER CANYON	SPOON
35	928	H	GL	0.00	0.00	0.00	AMS	WOLFE CABIN ROOT CELLAR	GLASS, SIX FRAGMENTS
36	929	O	OT	10.92	4.57	2.03	UNK	ARCHES, CHIPPING GROUND, FIELD	ROUNDED SANDSTONE,2 GROOVES, POSSIBLE ARROW SHAPER
37	930	H	GL	0.00	0.00	0.00	AMS	FOUND AT WOLFE CABIN DURING RESTORATION	BEER BOTTLE, BELIEVED TO BE CIRCA 1900
38	931	C	PP	2.54	0.00	0.00	ODA	NOT RECORDED	WHITE, COMPLETE
39	932	C	PP	2.06	1.43	1.27	AMS	1/4 MI. NORTH OF V.C., NW OF PARK AVENUE	RED CHERT
40	933	O	OT	0.00	0.00	0.00	AMS	FOUND NEAR DELICATE ARCH	PETRIFIED DINOSAUR BONE, 1 OF 2
40	1213	O	OT	0.00	0.00	0.00	AMS	FOUND NEAR DELICATE ARCH	PETRIFIED DINOSAUR BONE, 2 OF 2 PIECES
41	934	C	PP	3.02	1.91	0.00	AMS	FOUND IN FIERY FURNACE	YELLOW CHALCEDONY
42	935	O	OT	10.48	1.91	0.00	AMS	APPROX. 100 YDS. NORTH OF SITE 49 IN CAMPGROUND	CORN COB, 14 ROWS OF KERNALS
43	936	H	ME	0.00	0.00	0.00	AMS	FIELD COLLECTION	TOBACCO CAN W/ MINING CLAIM, CAT.#1214
43	1214	H	PM	0.00	0.00	0.00	AMS	FIELD COLLECTION	MINING CLAIM, RED HOT #2, 5/3/41, P.& H. SHUMWAY
44	937	C	PP	3.33	2.86	0.00	AMS	DARK ANGEL	DARK BROWN CHERT, TIP BROKEN OFF
45	938	W	OT	0.00	45.72	0.00	AMS	FIELD COLLECTION	VINE HOOP
46	939	W	OT	4.76	1.27	0.00	AMS	42GR538/ARC-42	POSSIBLE SANDAL FRAG.-DK. BROWN, 3 ROWS OF WEAVING
48	1206	H	ME	0.00	0.00	0.00	AMS	ELEPHANT BUTTE	TIN CAN REGISTER CONTAINER WITH LID
48	1207-12 09	H	PM	0.00	0.00	0.00	AMS	ELEPHANT BUTTE	3 PAPER ENTRIES FOUND INSIDE CAT.#1206
49	1210	O	OT	0.00	0.00	0.00	AMS	DONATED BY HARPERS FERRY MAP DEPARTMENT	ARCHES COLOR BROCHURE, FIRST COPY OFF PRESS

Arches National Park Collections (continued)

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thickness (cm)	Current Location	Locality	Remarks
50	1211-12 12	H	GL	0.00	0.00	0.00	AMS	DONATED BY YOSEMITE NATIONAL PARK	GLASS LANTERN SLIDES, 2, WINDOWS SEC
51	1215-12 17	O	OT	0.00	0.00	0.00	AMS	TWO JUNIPER BUTTE	PETRIFIED DINOSAUR BONE, 3 PIECES
52	1218	H	ME	0.00	0.00	0.00	AMS	FIELD COLLECTION	METAL SHEEP BELL AND ATTACHED LEATHER STRAP
53	1219	H	GL	0.00	0.00	0.00	AMS	FIELD COLLECTION	BOTTLE, TOILET ARTICLE CONTAINER, 2" SG
54	1220	H	ME	0.00	0.00	0.00	AMS	FIELD COLLECTION	TOBACCO CAN, SIR WALTER RALEIGH, ORANGE/BLACK/WHIT
55	1221	H	ME	0.00	0.00	0.00	AMS	BROKEN ARCH	PIE PAN
56	1222-12 23	H	PH	7.50	5.50	0.00	NOR	PRIVATE DONOR	DELICATE ARCH, MADE 1906 BY F.W. STANLEY-INC. NEG.
57	1224	H	PH	4.50	4.50	0.00	NOR	PRIVATE DONOR	KODAK COLOR PRINT OF ESTHER RISON, NO DATE RECORD.
58	1225	H	PH	3.50	3.50	0.00	NOR	PRIVATE DONOR	COLOR PRINT-NO DATE RECORDED
58	1226	H	PH	3.50	3.00	0.00	NOR	PRIVATE DONOR	B/W IMPRINTED "SEASONS GREETINGS", NO DATE RECORD.
58	1227	H	PH	2.00	2.00	0.00	NOR	PRIVATE DONOR	WOLFE RANCH DEDICATION, NO DATE RECORDED
59	1228	H	PH	4.50	4.50	0.00	UNK	PRIVATE DONOR	B/W OF LYDIA WOLFE, INSCRIBED "GRANDMA WOLFE"
59	1229	H	PH	4.50	4.50	0.00	NOR	PRIVATE DONOR	COPY OF CAT.#1228
60	1230	H	PH	4.00	4.00	0.00	NOR	PRIVATE DONOR	OF PRIMITIVE PAINTING OF WOLFE RANCH BY E. RISON
60	1231	H	PH	2.00	2.00	0.00	NOR	PRIVATE DONOR	COPY OF COLOR PRINT, CAT.#1230
61	1232	H	PH	4.25	3.25	0.00	NOR	PRIVATE DONOR	POSTCARD OF MOAB COURTHOUSE, 1910, NO POSTMARK
62	1233	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	"THE SETTEE", MADE BY F.H. STANLEY, 1901, BR. TONE
63	1234	H	PH	3.50	3.50	0.00	NOR	PRIVATE DONOR	IN COLOR, OF FEROL STANLEY, NO DATE RECORDED
64	1235	H	PH	3.25	5.25	0.00	NOR	PRIVATE DONOR	BROWN TONE, ESTHER RISON AS A CHILD, NO DATE REC.
65	1236-12 38	H	PH	5.25	6.25	0.00	NOR	PRIVATE DONOR	BRN.TONE-E.& F.STANLEY AT WOLFE RANCH-2 BLUE NEG.
66	1239	H	PH	7.00	5.00	0.00	NOR	PRIVATE DONOR	BROWN TONE ON CARDBOARD, THE STANLEY FAMILY, 1906
67	1240	H	PH	7.00	5.00	0.00	NOR	PRIVATE DONOR	SAME AS CAT.#1239, WITH INSCRIPTION "J.C. STANLEY"
68	1241	H	PH	3.50	5.00	0.00	NOR	PRIVATE DONOR	P.C.-BRN.TONE-E.& F.STANLEY @ WOLFE CABIN-12/10/06
69	1242-12 43	H	PH	5.00	3.00	0.00	NOR	PRIVATE DONOR	B/W COPIES OF CAT.#1241
69	1244	H	PH	7.00	5.00	0.00	NOR	PRIVATE DONOR	B/W COPY OF CAT.#1241
70	1245	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	BRNTONE-CARDBOARD BACKED-E.& F.STANLEY @ WOLFE CAB
71	1246	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	BLUE NEGATIVE OF CAT.#1245-INSCRIPTIONS ON BACK
72	1247	H	PH	5.50	3.50	0.00	NOR	PRIVATE DONOR	B/W COPY OF CAT.#1245-HIST.INSCRIPTIONS ON BACK
72	1248	H	PH	7.00	5.00	0.00	NOR	PRIVATE DONOR	B/W COPY OF CAT.#1245-HIST. INSCRIPTIONS ON BACK
73	1249	H	PH	10.00	8.00	0.00	NOR	PRIVATE DONOR	BROWNTONE, CARDBOARD OF JOHN WESLEY WOLFE, NO DATE
74	1250-12 51	H	PH	10.00	8.00	0.00	NOR	PRIVATE DONOR	TWO B/W COPIES OF CAT.#1249-ONE W/ INSCRIPTION
74	1252	H	PH	4.50	3.00	0.00	NOR	PRIVATE DONOR	B/W COPY OF CAT.#1249-HIsTORIC INSCRIPTION ON BACK

Arches National Park Collections (continued)

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick-ness (cm)	Current Location	Locality	Remarks
75	1253	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	BLUE NEGATIVE, E.& F.STANLEY AT CABIN
75	1254-12 55	H	PH	5.00	3.50	0.00	NOR	PRIVATE DONOR	TWO B/W COPIES OF CAT.#1253-INSCRIPTIONS ON BACK
76	1256	H	PH	10.00	8.00	0.00	NOR	PRIVATE DONOR	B/W OF "OLD CABIN" AT WOLFE RANCH, NO ORIGINAL REC
77	1257-12 59	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	THREE B/W PRINTS OF CAT.#1256
78	1260	O	OT	10.16	12.70	0.00	NOR	DONATED BY NATIONAL PARK SERVICE	POST CARD-COLOR-SOLD IN V.C. 1970'S-HIST. LEGEND
79	1261	H	PH	5.00	3.50	0.00	NOR	PRIVATE DONOR	P.C., BROWNTONE OF F.,E.,F.STANLEY, 12/10/07, MOAB
80	1262	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	COLOR, OF ESTHER RISON AND OLDEST HOUSE IN MOAB
81	1263	H	PH	4.00	4.00	0.00	NOR	PRIVATE DONOR	COLOR-OF E.RISON, F.STANLEY AND WIFE-INSCRIPTION
82	1264	H	PH	5.00	4.00	0.00	NOR	PRIVATE DONOR	B/W, OF EDWARD ANDREW STANLEY, DOC. INSCRIPTION
83	1265	H	PH	4.25	2.50	0.00	NOR	PRIVATE DONOR	B/W, OF JOHN WESLEY WOLFE HOME IN ETNA, OHIO, 1913
83	1266	H	PH	3.50	3.50	0.00	NOR	PRIVATE DONOR	B/W, OF JOHN WESLEY WOLFE HOME IN ETNA, OHIO, 1913
84	1267	H	PH	4.00	4.00	0.00	NOR	PRIVATE DONOR	COLOR, OF JOHN W. WOLFE'S TOMBSTONE IN ETNA, OHIO
85	1268	H	PH	4.00	4.00	0.00	NOR	PRIVATE DONOR	B/W-OF ESTHER RISON, W/ HORSE AT WOLFE RANCH, 1956
86	1269	H	PH	5.00	4.00	0.00	NOR	PRIVATE DONOR	B/W, OF FLORA AND EMMA STANLEY, DOC. INSCRIPTION
87	1270	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	LETTER, UNDATED, FROM E. RISON TO B. WILSON
88	1271	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	TINTYPE-OF JOHN, LYDIA WOLFE AND TWO CHILDREN
89	1272	H	PH	8.89	15.24	0.00	NOR	PRIVATE DONOR	ENVELOPE TO LETTER FROM T.F. WOLFE TO W.E. WOLFE
89	1273-12 75	H	PH	12.70	20.32	0.00	NOR	PRIVATE DONOR	3-PAGE LETTER, DATED 2/27/32, SEE CAT.#1272
90	1276	H	ME	6.99	3.81	1.27	NOR	PRIVATE DONOR	MATCHSAFE-SILVER W/ BRASS ENDS-HOLDS 2 UNUSED MAT.
91	1277	H	PH	6.25	5.50	0.00	NOR	PRIVATE DONOR	CARDBOARD BACK, FRED WOLFE ON HORSE AT RANCH, 1908
92	1278	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	FIELD REP. FOR FOOT TRAIL, DELICATE ARCH, 4/19/48
93	1279	H	PH	0.00	0.00	0.00	NOR	UNKNOWN	ART.-1958 DESERT MAGAZINE-2ND CLIMBING, LAND. ARCH
93	1280-12 81	H	PH	7.00	5.00	0.00	NOR	UNKNOWN	2 B/W, FROM DESERT MAGAZINE ARTICLE, SEE CAT.#1279
94	1282	H	ME	19.05	9.40	6.35	NOR	FOUND WHILE HIKING	COW BELL MINUS CLAPPER, W/ LEATHER STRAP ON TOP
95	1283	H	PH	0.00	0.00	0.00	NOR	FOUND IN PARK FILES	LETTER ON CARDBOARD PHOTO FRAME BACK FROM E. RISON
96	1284	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	TINTYPE, OF FRED & WM. WOLFE , ID ON NOTE
97	1285	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	P.C., ADDRESSED TO UNCLE WILL FROM FEROL, NO POSTM
98	1286	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	P.C., TO TRUMAN WOLFE FROM FEROL, POSTMARK 11/1914
99	1287	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	P.C., MRS.L. WOLFE, FROM ESTHER & FEROL, POSTMARK?
100	1288	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	POST CARD, TO TRUMAN FROM FEROL, NO POSTMARK
101	1289	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	B/W, VOLNA, ON LEFT, AND HER SISTER KATHERINE
102	1290	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	OBIT IN MOAB TIMES-IND. FOR ESTHER RISON, 11/14/77
102	1291	H	PH	0.00	0.00	0.00	NOR	PRIVATE DONOR	FUNERAL PROGRAM FOR ESTHER RISON, 11/14/77

Arches National Park Collections (continued)

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick-ness (cm)	Current Location	Locality	Remarks
103		H	OT	0.00	0.00	0.00	AMS	PRIVATE DONOR	VARIOUS ITEMS, BEING HELD FOR EVALUATION
104	1292	H	PM	0.00	0.00	0.00	NOR	PRIVATE DONOR	BIBLE, TESTAMENT, BELONGED TO FRED WOLFE
104	1293	H	PM	0.00	0.00	0.00	NOR	PRIVATE DONOR	TITHING TICKET INSIDE CAT.#1292
104	1294	H	PM	0.00	0.00	0.00	NOR	PRIVATE DONOR	WN COLLOM BUSINESS CARD, WOLFE'S BIRTHDATE, ETC.
105	1295	H	PM	0.00	0.00	0.00	NOR	PRIVATE DONOR	POST CARD, BROWNTONE, POSTMARKED 12/10/07, MOAB
106		C	OT	0.00	0.00	0.00	AMS	FOUND IN WASH BEHIND V.C. BY VISITOR	5 PIECES OF MODIFIED CHERT, HELD FOR EVALUATION
107	1296	P	SN	2.54	5.08	0.00	AMS	DELICATE ARCH AREA, IN CAVE ABOVE ARCH	GRAY, DIAMOND-SHAPED, IMPRINTED SQUARE DESIGN
107	1297	W	OT	10.16	12.70	0.00	AMS	DELICATE ARCH AREA, IN CAVE ABOVE ARCH	BASKET FRAG., POSS. NECK PORTION OF H2O CONTAINER
108	1298	O	OT	0.00	0.00	0.00	NOR	ARCHES H-FILE	BROCHURE, WOLFE RANCH ESA. 5/18/71
109	PENDING	O	OT	0.00	0.00	0.00	NOR	COURTHOUSE WASH	SACK OF SHERDS, LITHICS, SHELL ORNAMENT FRAGMENT
110	PENDING	O	OT	0.00	0.00	0.00	NOR	V.C., DELICATE ARCH, BALANCED ROCK, FROM WACC	LITHICS AND TWO ARROW FORESHAFTS
111	PENDING	O	OT	0.00	0.00	0.00	NOR	UNKNOWN, RECEIVED FROM SW REGIONAL OFFICE (WACC)	SHAFT SMOOTHER AND BASKET FRAGMENT
112	1299-13 01	H	PM	0.00	0.00	0.00	AMS	FOUND IN ARCHES FILES	LETTER FROM E. RISON RE. WOLFE RANCH, 1906-1908
47	940	C	PP	2.54	1.43	0.00	AMS	42GR577	LIGHT RED CHERT, 1 BARB BROKEN OFF
47	941	G	MA	15.24	8.89	5.39	AMS	42GR560	TWO FACETS, NOT SANDSTONE
47	942	C	BI	5.21	3.10	0.00	AMS	42GR560	BIFACIAL TOOL FRAGMENT, WHITE CHALCEDONY
47	943	C	BI	5.33	2.79	0.00	AMS	42GR560	BIFACIAL TOOL FRAGMENT, WHITE GRANULAR STONE
47	944	C	UF	3.17	2.92	0.00	AMS	42GR560	WHITE CHALCEDONY
47	945	C	DB	2.54	2.67	0.00	AMS	42GR560	UNMODIFIED FLAKE, RED CHALCEDONY
47	946	C	BI	5.14	2.79	0.00	AMS	42GR560	BIFACIAL TOOL FRAGMENT, WHITE CHERT
47	947	C	PP	1.43	1.43	0.00	AMS	42GR575	DESERT SIDE-NOTCHED, WHITE CHERT, TIP BROKEN OFF
47	948	C	PP	1.43	3.04	0.00	AMS	42GR575	DESERT SIDE-NOTCHED, OBSIDIAN, TIP BROKEN OFF
47	949	C	DB	5.08	2.79	0.00	AMS	42GR575	UNMODIFIED FLAKE, WHITE CHERT
47	950	C	MF	3.29	2.73	0.00	AMS	42GR575	DARK BROWN CHERT
47	951	C	DB	0.88	2.54	0.00	AMS	42GR575	UNMODIFIED FLAKE, GREY BANDED CHERT
47	952	C	DB	2.54	1.27	0.00	AMS	42GR575	UNMODIFIED FLAKE, YELLOW CHERT
47	953	C	DB	4.45	0.88	0.00	AMS	42GR575	UNMODIFIED FLAKE, WHITE CHERT
47	954	C	DB	1.91	1.91	0.00	AMS	42GR572	UNMODIFIED FLAKE, BROWN CHERT
47	955	C	MF	2.54	0.88	0.00	AMS	42GR572	GREEN CHERT
47	956	C	UF	3.81	2.54	0.00	AMS	42GR572	YELLOW CHALCEDONY
47	957	C	DB	2.54	1.91	0.00	AMS	42GR572	UNMODIFIED FLAKE, BROWN CHERT
47	958	C	DB	4.45	2.54	0.00	AMS	42GR572	UNMODIFIED FLAKE, BROWN CHERT

Arches National Park Collections (continued)

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick-ness (cm)	Current Location	Locality	Remarks
47	959	C	UF	3.81	3.81	0.00	AMS	42GR572	WHITE CHERT
47	960	C	DB	3.18	3.18	0.00	AMS	42GR572	UNMODIFIED FLAKE, WHITE CHERT
47	961	C	UF	3.18	2.86	0.00	AMS	42GR572	RED CHALCEDONY
47	962	C	BI	4.76	4.45	0.00	AMS	42GR572	BIFACIAL TOOL FRAGMENT, WHITE CHALCEDONY
47	963	C	DB	3.54	2.22	0.00	AMS	42GR572	UNMODIFIED FLAKE, BROWN CHERT
47	964	C	UF	3.81	4.13	0.00	AMS	42GR572	WHITE CHALCEDONY
47	965	C	UF	4.45	4.45	0.00	AMS	42GR572	BROWN MOTTLED CHERT
47	966	O	OT	6.03	6.67	0.00	AMS	42GR572	ROUNDED STREAM COBBLE, BATTERED AT ONE END
47	967	C	UF	6.67	6.67	0.00	AMS	42GR566	RED CHALCEDONY
47	968	C	CO	9.53	7.62	0.00	AMS	42GR566	UTILIZED CORE FRAGMENT, RED CHALCEDONY
47	969	C	UF	6.35	4.76	0.00	AMS	42GR566	RED CHALCEDONY
47	970	C	DB	6.99	4.45	0.00	AMS	42GR566	UNMODIFIED FLAKE, BROWN CHERT
47	971	C	BI	4.13	4.45	0.00	AMS	42GR566	BIFACIAL TOOL FRAGMENT, BROWN CHALCEDONY
47	972	C	UF	6.03	2.22	0.00	AMS	42GR566	YELLOW CHALCEDONY
47	973	C	UF	5.72	4.45	0.00	AMS	42GR566	RED CHALCEDONY
47	974	C	UF	5.40	3.81	0.00	AMS	42GR566	WHITE CHALCEDONY
47	975	C	UF	4.45	3.18	0.00	AMS	42GR566	WHITE CHALCEDONY
47	976	C	UF	4.45	3.18	0.00	AMS	42GR566	RED CHALCEDONY
47	977	C	DB	2.54	1.91	0.00	AMS	42GR566	UNMODIFIED FLAKE, BROWN CHERT
47	978	C	DB	2.54	2.54	0.00	AMS	42GR566	UNMODIFIED FLAKE, RED CHERT
47	979	C	UF	3.81	1.91	0.00	AMS	42GR566	YELLOW CHALCEDONY
47	980	C	DB	2.86	1.91	0.00	AMS	42GR566	UNMODIFIED FLAKE, WHITE CHERT
47	981	C	DB	3.81	2.54	0.00	AMS	42GR566	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	982	C	DB	3.18	2.22	0.00	AMS	42GR566	UNMODIFIED SHATTER, DARK BROWN CHERT
47	983	C	MF	4.45	2.86	0.00	AMS	42GR566	BROWN CHALCEDONY
47	984	C	DB	2.06	0.94	0.00	AMS	42GR566	UNMODIFIED FLAKE, BROWN CHERT
47	985	C	BI	3.49	2.54	0.00	AMS	42GR566	BIFACIAL TOOL FRAGMENT, PURPLE CHERT
47	986	C	UF	3.18	1.59	0.00	AMS	42GR566	DARK BROWN CHERT
47	987	C	UF	3.49	2.22	0.00	AMS	42GR566	GRAY CHERT
47	988	C	DB	3.18	2.54	0.00	AMS	42GR577	UTILIZED SHATTER, BROWN CHERT
47	989	C	UF	2.54	2.54	0.00	AMS	42GR566	DARK RED CHERT
47	990	C	DB	2.22	2.54	0.00	AMS	42GR567	UNMODIFIED FLAKE, BROWN CHALCEDONY
47	991	C	BI	6.35	4.76	0.00	AMS	42GR567	BIF. WORKED FLAKE, WHITE CHAL., LENGTH UNCERTAIN

Arches National Park Collections (continued)

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick-ness (cm)	Current Location	Locality	Remarks
47	992	C	BI	5.08	4.45	0.00	AMS	42GR567	BIFACIALLY WORKED FLAKE, WHITE CHALCEDONY
47	993	C	DB	5.08	3.81	0.00	AMS	42GR567	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	994	C	DB	6.35	5.08	0.00	AMS	42GR567	UNMODIFIED FLAKE, BROWN CHERT
47	995	C	DB	5.72	4.45	0.00	AMS	42GR567	UNMODIFIED FLAKE, BROWN CHALCEDONY
47	996	C	UF	6.03	3.81	0.00	AMS	42GR567	RED CHALCEDONY
47	997	C	UF	6.35	3.49	0.00	AMS	42GR567	RED CHALCEDONY
47	998	C	DB	5.40	2.86	0.00	AMS	42GR567	UNMODIFIED FLAKE, RED CHALCEDONY
47	999	C	DB	3.18	3.18	0.00	AMS	42GR567	UNMODIFIED FLAKE, WHITE CHERT
47	1000	C	DB	4.45	2.86	0.00	AMS	42GR567	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	1001	C	UF	3.18	2.86	0.00	AMS	42GR567	GREEN CHERT
47	1002	C	UF	4.45	3.49	0.00	AMS	42GR567	GREEN CHERT
47	1003	C	DB	6.35	1.91	0.00	AMS	42GR567	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	1004	C	UF	4.45	1.91	0.00	AMS	42GR567	RED CHERT
47	1005	C	UF	3.81	2.54	0.00	AMS	42GR567	WHITE CHALCEDONY
47	1006	C	UF	4.13	2.54	0.00	AMS	42GR567	GREEN CHERT
47	1007	C	DB	3.49	3.49	0.00	AMS	42GR567	UNMODIFIED FLAKE, RED AND WHITE MOTTLED CHALCEDONY
47	1008	C	DB	2.86	2.54	0.00	AMS	42GR567	UNMODIFIED FLAKE, GREEN CHERT
47	1009	C	UF	2.22	2.22	0.00	AMS	42GR567	GREEN CHERT
47	1010	C	DB	4.45	3.81	0.00	AMS	42GR567	UNMODIFIED FLAKE, GREEN CHERT
47	1011	C	DB	3.49	1.91	0.00	AMS	42GR567	UNMODIFIED FLAKE, GREEN CHERT
47	1012	C	UF	3.18	2.22	0.00	AMS	42GR567	RED CHALCEDONY
47	1013	C	UF	3.18	1.91	0.00	AMS	42GR567	WHITE CHALCEDONY
47	1014	C	UF	3.81	2.22	0.00	AMS	42GR567	GREEN CHERT
47	1015	C	MF	2.54	1.59	0.00	AMS	42GR567	WHITE CHERT
47	1016	C	MF	11.43	5.08	0.00	AMS	42GR557	UNIFORMALLY WORKED, WHITE CHERT
47	1017	C	MF	7.94	6.99	0.00	AMS	42GR557	WHITE CHERT
47	1018	C	UF	6.03	4.45	0.00	AMS	42GR557	WHITE COARSE-GRAINED CHALCEDONY
47	1019	C	UF	6.35	3.81	0.00	AMS	42GR557	RED CHALCEDONY
47	1020	C	UF	3.81	3.18	0.00	AMS	42GR557	WHITE CHALCEDONY
47	1021	C	DB	3.49	5.08	0.00	AMS	42GR557	UNMODIFIED FLAKE, RED CHALCEDONY
47	1022	C	BI	9.21	5.72	0.00	AMS	42GR565	BIFACIALLY WORKED FLAKE, RED CHERT
47	1023	C	BI	6.03	7.62	0.00	AMS	42GR565	BIFACIALLY WORKED FLAKE, WHITE CHERT
47	1024	C	UF	6.03	3.81	0.00	AMS	42GR565	RED CHERT

Arches National Park Collections (continued)

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick-ness (cm)	Current Location	Locality	Remarks
47	1025	C	DB	6.35	4.76	0.00	AMS	42GR565	UNMODIFIED FLAKE, WHITE CHERT
47	1026	C	UF	6.35	4.13	0.00	AMS	42GR565	WHITE CHERT
47	1027	C	UF	6.99	3.81	0.00	AMS	42GR565	WHITE CHERT
47	1028	C	UF	5.08	2.86	0.00	AMS	42GR565	RED CHALCEDONY
47	1029	C	DB	3.49	1.59	0.00	AMS	42GR565	UNMODIFIED SHATTER, WHITE CHERT
47	1030	C	UF	4.45	3.49	0.00	AMS	42GR565	RED CHERT
47	1031	C	UF	5.40	3.18	0.00	AMS	42GR565	RED CHALCEDONY
47	1032	C	DB	4.45	3.18	0.00	AMS	42GR565	UNMODIFIED FLAKE, RED AND BROWN MOTTLED CHERT
47	1033	C	UF	3.49	2.86	0.00	AMS	42GR565	RED CHERT
47	1034	C	DB	3.49	1.91	0.00	AMS	42GR565	UNMODIFIED FLAKE, RED CHERT
47	1035	G	MA	7.94	6.35	0.00	AMS	42GR569	SANDSTONE, TWO FACETS, EDGES ALSO GROUND
47	1036	C	UF	4.76	2.54	0.00	AMS	42GR569	WHITE CHALCEDONY
47	1037	C	UF	3.49	2.54	0.00	AMS	42GR569	CHALCEDONY
47	1038	G	MA	10.16	4.76	0.00	AMS	42GR559	SANDSTONE, TWO FACETS, EDGES ALSO GROUND
47	1039	C	DB	4.45	4.13	0.00	AMS	42GR559	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	1040	C	UW	4.45	5.40	0.00	AMS	42GR559	UNIFACIALLY WORKED FLAKE, RED CHALCEDONY
47	1041	C	DB	3.18	2.22	0.00	AMS	42GR559	UNMODIFIED FLAKE, WHITE COARSE-GRAINED CHERT
47	1042	C	DB	3.49	3.18	0.00	AMS	42GR559	UNMODIFIED FLAKE, WHITE COARSE-GRAINED CHERT
47	1043	C	DB	2.86	2.54	0.00	AMS	42GR559	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	1044	C	DB	3.18	3.18	0.00	AMS	42GR559	UNMODIFIED FLAKE, WHITE CHERT
47	1045	C	DB	1.91	1.91	0.00	AMS	42GR559	UNMODIFIED FLAKE, WHITE CHERT
47	1046	C	BI	9.53	5.40	0.00	AMS	42GR551	BIFACIALLY WORKED FLAKE, WHITE CHERT
47	1047	C	UF	6.67	3.81	0.00	AMS	42GR551	WHITE CHERT
47	1048	C	UF	6.35	3.49	0.00	AMS	42GR551	WHITE CHERT
47	1049	C	UF	4.45	4.13	0.00	AMS	42GR551	WHITE CHERT
47	1050	C	MF	4.45	2.54	0.00	AMS	42GR551	WHITE CHALCEDONY
47	1051	C	DB	3.81	2.22	0.00	AMS	42GR551	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	1052	C	DB	3.18	3.49	0.00	AMS	42GR551	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	1053	C	DB	3.49	1.91	0.00	AMS	42GR551	UNMODIFIED FLAKE, WHITE CHERT
47	1054	C	DB	3.81	2.54	0.00	AMS	42GR551	UNMODIFIED FLAKE, WHITE CHERT
47	1055	C	DB	3.49	1.91	0.00	AMS	42GR551	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	1056	C	DB	1.98	2.54	0.00	AMS	42GR551	UNMODIFIED FLAKE, WHITE CHALCEDONY

Arches National Park Collections (continued)

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick-ness (cm)	Current Location	Locality	Remarks
47	1057	C	DB	1.91	1.59	0.00	AMS	42GR551	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	1058	C	DB	2.54	1.91	0.00	AMS	42GR551	UNMODIFIED FLAKE, WHITE CHERT
47	1059	C	DB	2.54	1.91	0.00	AMS	42GR551	UNMODIFIED FLAKE, WHITE CHERT
47	1060	C	DB	2.86	1.91	0.00	AMS	42GR551	UNMODIFIED FLAKE, WHITE CHERT
47	1061	C	DB	2.54	1.59	0.00	AMS	42GR551	UNMODIFIED FLAKE, RED CHERT
47	1062	O	OT	15.88	2.54	0.00	AMS	42GR551	CORN COB, 16 ROWS OF KERNALS, BOTH ENDS PIERCED
47	1063	C	CO	10.16	7.62	0.00	AMS	42GR555	UNIFACIALLY FLAKED FRAGMENT, WHITE CHERT
47	1064	C	BI	9.53	5.72	0.00	AMS	42GR555	BIFACIALLY WORKED FLAKE, WHITE CHERT
47	1065	C	UF	4.13	3.49	0.00	AMS	42GR555	WHITE CHALCEDONY
47	1066	C	DB	3.81	3.49	0.00	AMS	42GR555	UNMODIFIED FLAKE, WHITE CHERT
47	1067	C	DB	4.45	2.54	0.00	AMS	42GR555	UNMODIFIED SHATTER, WHITE CHERT
47	1068	C	DB	1.91	1.59	0.00	AMS	42GR555	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	1069	C	UF	2.22	2.54	0.00	AMS	42GR555	WHITE CHALCEDONY
47	1070	C	DB	2.86	1.59	0.00	AMS	42GR555	UNMODIFIED SHATTER, WHITE CHALCEDONY
47	1071	C	UF	2.86	1.91	0.00	AMS	42GR555	WHITE CHALCEDONY
47	1072	C	UN	4.45	3.49	0.00	AMS	42GR576	UNIFACIALLY WORKED FLAKE, WHITE CHERT
47	1073	C	UF	3.49	2.86	0.00	AMS	42GR576	RED CHERT
47	1074	C	DB	3.81	2.22	0.00	AMS	42GR576	UNMODIFIED FLAKE, WHITE CHERT
47	1075	C	BI	2.54	0.95	0.00	AMS	42GR576	PROJ.PT? MIDSECT., BRN.CHERT, SER.EDGES, NO BARBS
47	1076	C	MF	3.35	2.22	0.00	AMS	42GR576	RED CHERT
47	1077	C	DB	2.54	2.54	0.00	AMS	42GR576	UNMODIFIED FLAKE, WHITE CHERT
47	1078	C	DB	2.22	2.54	0.00	AMS	42GR576	UNMODIFIED FLAKE, BROWN CHALCEDONY
47	1079	C	DB	2.54	1.91	0.00	AMS	42GR576	UNMODIFIED FLAKE, WHITE CHERT
47	1080	C	MF	2.86	1.91	0.00	AMS	42GR576	PINK CHERT
47	1081	C	DB	2.22	2.22	0.00	AMS	42GR576	UNMODIFIED FLAKE, PINK CHERT
47	1082	C	DB	2.54	1.27	0.00	AMS	42GR576	UNMODIFIED FLAKE, WHITE CHERT
47	1083	C	UF	2.22	1.91	0.00	AMS	42GR549	WHITE CHERT
47	1084	C	DB	0.00	0.00	0.00	AMS	42GR549	7 FLAKES OF CHERT AND CHALCEDONY
47	1085	C	MF	1.59	1.27	0.00	AMS	42GR549	WHITE CHALCEDONY
47	1086	C	PP	6.35	3.49	0.00	AMS	42GR554	WHITE CHALCEDONY, NO BARBS OR NOTCHES
47	1087	C	UF	4.45	5.08	0.00	AMS	42GR554	WHITE CHALCEDONY
47	1088	C	DB	4.45	3.18	0.00	AMS	42GR554	UNMODIFIED FLAKE, WHITE CHERT
47	1089	C	UF	3.81	3.81	0.00	AMS	42GR554	WHITE CHALCEDONY

Arches National Park Collections (continued)

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick-ness (cm)	Current Location	Locality	Remarks
47	1090	C	DB	3.81	2.22	0.00	AMS	42GR554	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	1091	C	UF	5.40	3.18	0.00	AMS	42GR554	WHITE CHALCEDONY
47	1092	C	DB	4.45	2.86	0.00	AMS	42GR554	UNMODIFIED FLAKE, WHITE COARSE-GRAINED CHALCEDONY
47	1093	C	MF	3.81	2.54	0.00	AMS	42GR554	RED AND WHITE MOTTLED CHALCEDONY
47	1094	C	UF	2.86	3.18	0.00	AMS	42GR554	RED CHERT
47	1095	C	DB	2.54	1.91	0.00	AMS	42GR554	UNMODIFIED FLAKE, WHITE CHERT
47	1096	C	DB	2.54	1.59	0.00	AMS	42GR554	UNMODIFIED FLAKE, RED AND WHITE MOTTLED CHERT
47	1097	C	UF	2.22	1.59	0.00	AMS	42GR554	WHITE CHALCEDONY
47	1098	C	DB	1.59	1.91	0.00	AMS	42GR554	UNMODIFIED FLAKE, YELLOW CHALCEDONY
47	1099	C	UF	7.94	6.35	0.00	AMS	42GR561	WHITE CHERT, UNIFACIALLY WORKED
47	1100	C	UF	7.62	6.03	0.00	AMS	42GR561	WHITE COARSE-GRAINED CHALCEDONY
47	1101	C	UP	6.35	5.40	0.00	AMS	42GR561	WHITE CHERT
47	1102	C	BI	6.67	6.03	0.00	AMS	42GR561	BIFACIALLY WORKED FLAKE, WHITE CHERT
47	1103	C	UF	6.35	4.76	0.00	AMS	42GR561	WHITE CHALCEDONY
47	1104	C	UF	6.03-	4.45	0.00	AMS	42GR561	WHITE CHERT
47	1105	C	MF	5.08	4.45	0.00	AMS	42GR561	RED CHALCEDONY
47	1106	C	BI	4.45	2.54	0.00	AMS	42GR561	BIFACIALLY WORKED FLAKE, WHITE CHERT
47	1107	C	UP	5.40	3.49	0.00	AMS	42GR561	WHITE CHALCEDONY
47	1108	C	BI	6.03	2.22	0.00	AMS	42GR561	BIFACIALLY WORKED FLAKE, WHITE CHERT
47	1109	C	UN	5.08	2.86	0.00	AMS	42GR561	UNIFACIALLY WORKED FLAKE, RED CHERT
47	1110	C	UF	5.72	3.81	0.00	AMS	42GR561	BROWN CHALCEDONY
47	1111	C	UF	4.45	1.59	0.00	AMS	42GR561	WHITE CHALCEDONY
47	1112	C	UF	2.22	1.91	0.00	AMS	42GR561	GREY CHERT
47	1113	C	PP	3.81	2.54	0.00	AMS	42GR561	WHITE CHERT, BASE BROKEN OFF
47	1114	C	UF	4.45	2.54	0.00	AMS	42GR561	WHITE CHALCEDONY
47	1115	C	DB	2.54	1.59	0.00	AMS	42GR561	UNMODIFIED FLAKE, RED CHERT
47	1116	C	DB	3.18	1.59	0.00	AMS	42GR561	UNMODIFIED FLAKE, YELLOW CHERT
47	1117	C	DB	0.00	0.00	0.00	AMS	42GR550	24 FLAKES OF CHERT AND CHALCEDONY
47	1118	C	BI	2.54	3.49	0.00	AMS	42GR550	BIFACIALLY WORKED FLAKE, WHITE CHERT
47	1119	C	UF	4.45	3.81	0.00	AMS	42GR550	GRAY QUARTZITE
47	1120	C	UF	3.81	3.49	0.00	AMS	42GR550	GRAY QUARTZITE
47	1121	C	BI	4.45	1.59	0.00	AMS	42GR550	BIFACIALLY WORKED FLAKE, WHITE CHALCEDONY

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick- ness (cm)	Current Location	Locality	Remarks
47	1122	C	DB	0.00	0.00	0.00	AMS	42GR570	9 FLAKES OF CHERT AND CHALCEDONY
47	1123	C	CO	9.53	6.67	0.00	AMS	42GR570	UNIFACIALLY FLAKED CORE, WHITE CHERT
47	1124	G	MA	6.67	7.30	0.00	AMS	42GR570	SANDSTONE, TWO FACETS
47	1125	G	OT	6.03	4.76	0.00	AMS	42GR570	SANDSTONE, BLACKENED ON ONE SIDE
47	1126	B	OT	8.89	2.22	0.00	AMS	42GR570	UNIDENTIFIABLE LONG BONE FRAGMENT
47	1127	P	SH	0.00	0.00	0.00	AMS	42GR570	THREE SHERDS OF CORRUGATED UTILITY WARE
47	1128	P	SH	0.00	0.00	0.00	AMS	42GR570	BLACK SMOOTHED UTILITY WARE
47	1129	C	DB	4.45	4.03	0.00	AMS	42GR570	SHATTER, WHITE CHERT
47	1130	C	UF	4.76	3.81	0.00	AMS	42GR570	WHITE CHERT
47	1131	C	UF	5.08	2.54	0.00	AMS	42GR570	WHITE CHERT
47	1132	C	DB	6.67	3.18	0.00	AMS	42GR570	UNMODIFIED FLAKE, WHITE CHERT
47	1133	C	DB	3.81	2.86	0.00	AMS	42GR570	UNMODIFIED FLAKE, BROWN CHERT
47	1134	C	BI	3.49	3.81	0.00	AMS	42GR570	BIFACIALLY WORKED FLAKE, RED CHERT
47	1135	C	MF	3.18	3.18	0.00	AMS	42GR570	WHITE CHERT
47	1136	C	UF	3.49	3.18	0.00	AMS	42GR570	WHITE CHERT
47	1137	C	UF	3.18	3.49	0.00	AMS	42GR570	BROWN CHERT
47	1138	C	UF	4.13	2.86	0.00	AMS	42GR570	RED CHERT
47	1139	C	UF	2.86	1.91	0.00	AMS	42GR570	PURPLE CHERT
47	1140	C	UF	3.49	2.54	0.00	AMS	42GR570	GREY CHERT
47	1141	C	BI	3.18	2.86	0.00	AMS	42GR570	BIFACIALLY WORKED TOOL TIP, GREY CHERT
47	1142	C	MF	4.76	2.86	0.00	AMS	42GR556	RED AND YELLOW MOTTLED CHERT
47	1143	C	UF	2.86	2.54	0.00	AMS	42GR576	WHITE CHERT
47	1144	C	DB	2.86	1.91	0.00	AMS	42GR554	UNMODIFIED FLAKE, WHITE CHALCEDONY
47	1145	C	DB	2.54	1.59	0.00	AMS	42GR576	UNMODIFIED FLAKE, WHITE CHERT
47	1146	C	DB	0.00	0.00	0.00	AMS	42GR556	UNMODIFIED FLAKES OF CHERT AND CHALCEDONY
47	1147	C	BI	8.26	8.89	0.00	AMS	42GR556	BIFACIALLY WORKED FLAKE, WHITE CHERT
47	1148	C	BI	8.26	5.08	0.00	AMS	42GR556	BIFACIALLY WORKED FLAKE, WHITE CHERT
47	1149	C	UF	5.72	4.45	0.00	AMS	42GR556	WHITE CHERT
47	1150	C	UF	4.45	3.18	0.00	AMS	42GR556	WHITE CHALCEDONY
47	1151	C	UF	4.45	3.18	0.00	AMS	42GR556	WHITE CHERT
47	1152	C	UF	5.08	3.81	0.00	AMS	42GR556	RED CHERT
47	1153	C	UF	6.35	2.22	0.00	AMS	42GR556	RED CHERT
47	1154	C	BI	2.86	2.54	0.00	AMS	42GR556	BIFACIALLY WORKED FLAKE, RED CHERT, TOOL BLANK

Arches National Park Collections (continued)

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick- ness (cm)	Current Location	Locality	Remarks
47	1155	C	UF	4.13	2.86	0.00	AMS	42GR556	WHITE CHALCEDONY
47	1156	C	SC	3.49	2.86	0.00	AMS	42GR556	UNIFACIALLY WORKED, BROWN CHALCEDONY
47	1157	C	BI	3.49	2.86	0.00	AMS	42GR556	BIFACIALLY WORKED FLAKE, BROWN CHALCEDONY
47	1158	C	UF	5.72	2.22	0.00	AMS	42GR556	PURPLE CHERT
47	1159	C	UF	3.49	3.18	0.00	AMS	42GR556	RED CHERT
47	1160	C	BI	6.67	3.18	0.00	AMS	42GR556	BIFACIALLY WORKED FLAKE, WHITE CHALCEDONY
47	1161	C	UF	2.54	2.86	0.00	AMS	42GR556	WHITE CHALCEDONY
47	1162	C	UN	2.54	2.22	0.00	AMS	42GR556	UNIFACIALLY WORKED FLAKE, WHITE CHALCEDONY
47	1163	C	UF	4.76	3.49	0.00	AMS	42GR556	WHITE CHALCEDONY
47	1164	C	UF	4.76	3.49	0.00	AMS	42GR558	WHITE CHERT
47	1165	C	DB	6.67	3.81	0.00	AMS	42GR558	UTILIZED, RED CHALCEDONY
47	1166	C	UF	5.08	4.45	0.00	AMS	42GR558	WHITE CHERT
47	1167	C	UF	5.40	3.18	0.00	AMS	42GR558	WHITE CHALCEDONY
47	1168	C	DB	5.08	5.08	0.00	AMS	42GR558	UNMODIFIED FLAKE, WHITE CHERT
47	1169	C	DB	6.67	4.45	0.00	AMS	42GR558	SHATTER, WHITE CHERT
47	1170	C	DB	6.35	5.08	0.00	AMS	42GR558	UNMODIFIED FLAKE, BROWN CHERT
47	1171	C	CO	6.67	5.72	0.00	AMS	42GR558	RED CHERT
47	1172	C	DB	0.00	0.00	0.00	AMS	42GR552	12 FLAKES OF CHERT AND CHALCEDONY
47	1173	C	DB	4.45	2.22	0.00	AMS	42GR552	SHATTER, WHITE CHERT
47	1174	C	DB	3.49	3.18	0.00	AMS	42GR552	UNMODIFIED FLAKE, RED CHERT
47	1175	C	DB	4.45	3.18	0.00	AMS	42GR552	UNMODIFIED FLAKE, WHITE CHERT
47	1176	C	DB	2.22	3.49	0.00	AMS	42GR552	UNMODIFIED FLAKE, WHITE CHERT
47	1177	C	UF	3.18	4.13	0.00	AMS	42GR552	WHITE CHERT
47	1178	C	DB	9.53	4.76	0.00	AMS	42GR552	UNMODIFIED FLAKE, WHITE CHERT
47	1179	C	DB	6.03	3.18	0.00	AMS	42GR552	SHATTER, WHITE CHERT
47	1180	C	BI	9.21	5.72	0.00	AMS	42GR552	BIFACIALLY WORKED FLAKE, WHITE CHALCEDONY
47	1181	C	UF	8.89	5.08	0.00	AMS	42GR552	WHITE CHERT
47	1182	C	UF	6.99	6.03	0.00	AMS	42GR552	WHITE CHERT
47	1183	C	UF	5.72	4.13	0.00	AMS	42GR552	WORKED, BLACK CHERT
47	1184	C	UF	6.03	4.45	0.00	AMS	42GR552	WHITE CHERT
47	1185	C	UF	5.72	3.49	0.00	AMS	42GR552	WHITE CHERT
47	1186	C	BI	5.08	4.13	0.00	AMS	42GR552	BIFACIALLY WORKED FLAKE, WHITE CHERT

Arches National Park Collections (continued)

Accession No.	Catalog No.	Artifact Type	Artifact Form	Length/ Height (cm)	Width/ Diameter (cm)	Thick-ness (cm)	Current Location	Locality	Remarks
47	1187	C	MF	3.49	2.22	0.00	AMS	42GR552	WHITE CHERT
47	1188	C	MF	6.35	4.13	0.00	AMS	42GR552	WHITE CHERT
47	1189	C	UF	6.35	4.13	0.00	AMS	42GR552	WHITE CHERT
47	1190	C	UF	7.62	4.45	0.00	AMS	42GR552	WHITE CHERT
47	1191	C	UF	4.45	3.81	0.00	AMS	42GR552	WHITE CHERT
47	1192	C	DB	4.76	2.22	0.00	AMS	42GR552	WORKED, WHITE CHALCEDONY
47	1193	C	DB	6.99	4.45	0.00	AMS	42GR552	UNMODIFIED FLAKE, WHITE CHERT
47	1194	C	UF	5.08	3.39	0.00	AMS	42GR552	WHITE CHERT
47	1195	C	UF	5.08	3.18	0.00	AMS	42GR552	WHITE CHALCEDONY
47	1196	C	UF	3.81	3.18	0.00	AMS	42GR552	WHITE CHERT
47	1197	C	UF	3.81	3.18	0.00	AMS	42GR552	WHITE CHERT
47	1198	C	UF	3.81	2.22	0.00	AMS	42GR552	WHITE CHERT
47	1199	C	BI	4.13	2.54	0.00	AMS	42GR552	BIFACIALLY WORKED FLAKE, WHITE CHERT
47	1200	C	UF	3.81	3.18	0.00	AMS	42GR552	RED CHERT
47	1201	C	PP	2.86	1.91	0.00	AMS	42GR552	WHITE CHERT, POINT BROKEN OFF
47	1202	C	BI	20.00	5.08	0.00	AMS	42GR552	BIFACIALLY WORKED FLAKE, WHITE CHALCEDONY
47	1203	G	OT	0.00	5.72	0.00	AMS	42GR552	SANDSTONE, NEARLY SPHERICAL WITH 3 GROUND FACETS
47	1204	C	BI	5.40	4.45	0.00	AMS	42GR552	BIFACIALLY WORKED FLAKE, WHITE CHERT
47	1205	C	OT	0.00	0.00	0.00	AMS	GENERAL SURFACE COLLECTION	ASSORTED ARTIFACTS, PROVENIENCE UNKNOWN

APPENDIX C.

An Outline of Geologic Strata

APPENDIX D
SITE NUMBER
CONVERSION LIST

UNL1	42GR 297
UNL2	42GR 2141
UNL3	42GR 2142
UNL4	42GR 2143
UNL5	42GR 539
UNL6	42GR 2144
UNL7	42GR 2145
UNL8	42GR 565
UNL9	42GR 2146
UNL10	42GR 2147
UNL11	42GR 2148
UNL12	42GR 2149
UNL13	42GR 2150
UNL14	42GR 2151
UNL15	42GR 2152
UNL16	42GR 2153
UNL17	42GR 2154
UNL18	42GR 2155
UNL19	42GR 2156
UNL20	42GR 2157
UNL21	42GR 2158
UNL22	42GR 2159
UNL23	42GR 2160
UNL24	42GR 515
UNL25	42GR 544
UNL26	42GR 290

Note:
UNL numbers were temporary site designations used in identifying sites in the field. These numbers appear on tags at field sites. The Smithsonian trinomial numbers are the numbers used as permanent standarized reference designations.

APPENDIX E

Glossary of Technical Terms

ANGULAR DEBRIS: Debitage that exhibits no definable ventral surface, conchoidal fractures or other flake morphology. Also referred to as shatter.

BI-DIRECTIONAL: Edge retouch on two opposing margins of an artifact. Differs from bifacial retouch which extends onto the faces of the artifact.

BIFACE: A biface represents the product from any stage in the bifacial reduction strategy of producing flakes and manufacturing formalized tools. Bifaces are characterized by a single working edge around the perimeter of the tool. Marginal retouch extends at least one-third of the way onto the two opposing faces. Polymorphic biface types characterize different stages within the biface manufacturing continuum. Early biface production is represented by bifacial cores and late reduction by projectile points or other bifacial tools.

BIFACIAL: Modification on two opposing faces. When referring to retouch, at least one-third of two opposing surfaces are facially modified.

BIFACIAL COBBLE: A cobble that has flakes removed from opposing faces along the same margin. The worked margin forms a cutting or chopping edge. The term is intended to replace 'chopper' which implies a specific function that can not be implied from macroscopic analysis.

BIFACIAL CORE: A core that is reduced in a systematic fashion to produce a relatively flat, two-sided core. Reduction is regular, not random. These cores are considered to be compsite since they are able to produce flakes and serve as bifacial tools. They are sometimes referred to as thick bifaces.

BIFACE FLAKE: Thinning flakes exhibit an overall morphology indicating that they were removed from a bifacially flaked artifact during manufacture or resharpening. Polythetic attributes include retouched and multifaceted platforms, parallel dorsal surface scars, a convex flake curvature, and thinness.

CORES: Regular cores are debitage that exhibit negative scars originating from one or more platforms. They are of sufficient size to produce additional usable flakes. Exhausted cores retain no further flaking potential. They tend to have shorter scar lengths, which can be distinguished from retouching by a greater edge irregularity. Exhausted cores represent the maximum use of raw materials.

DECORTIFICATION FLAKE: A flake with dorsal surface cortex. These are produced during primary reduction phases.

DRILL: Drills exhibit bifacial retouch and/or extensive marginal retouch. The retouching produces a stable projection for rotary stress. When wear patterns are present, rotary wear (scarring or edge abrasion on the shaft perpendicular to the shank axis) can be identified. The tip may exhibit either crushing or rounding.

EXTENSIVELY RETOUCHED FLAKE: Similar in edge morphology to a uniface or scraper, however the retouch does not extend onto the faces, i.e., retouch is confined to the margins. Use is similar to more formalized unifaces and scrapers. Tool not to be confused with a retouched flake, which exhibits only several retouch scars.

FLAKE: A flake is a piece of debitage that exhibits definable ventral and dorsal surfaces. The ventral surface is that which was last attached to the larger rock from which it was removed.

FORMALIZED: A term used to describe tools that have a fair amount of investment in terms of reduction labor. A uniface is formalized, while a retouched flake, which may perhaps serve a similar function, is not.

GRAVER: Gravers are also projections; however, unlike drills, they do not require a long shaft. Gravers have a marginally retouched projection, which may exhibit step fractures on the tip. Presumably, their utility was as incising or piercing artifacts.

HAMMERSTONES: Hammerstones are artifacts which display either ring crack clusters or extensive battering along ridges or natural projections. They are frequently cobbles that have been pounded or battered on opposing ends.

INTERIOR FLAKE: A flake removed from a core that is generally thicker than a biface flake and has cortical, single faceted or multifaceted platforms. They usually lack the convex curvature typical of flakes removed from bifaces. Any flake that does not have dorsal surface cortex or biface flake qualities.

MANO: A grinding stone that is hand held and used in conjunction with another grinding stone. Manos may have convex or planoid working faces. The surfaces may be unifacially or bifacially ground.

METATE: The grinding platform across which a mano is worked. They may have a concave worn surface. Metate worked surfaces vary with the extent and type of use.

MULTIPLATFORM CORE: A core with more than one striking platform from which flakes are removed. Generally flakes are removed from any usable platform or surface, resulting in a random reduction technique that produces flakes of varied lengths, and angular or blocky cores.

POLISHING STONES: Pebbles, usually less than 10 cm in length, that have smoothed surfaces from a rubbing or light grinding motion.

PROJECTILE POINT: Projectile points are generally produced through bifacial core or flake reduction. They have thin, uniform cross sections, regular edges, no cortex, and prepared haft elements. They exhibit edge alteration or retouch scars. Their overall morphology is characterized by a point and two similar lateral sides that facilitate piercing and cutting.

RETOUCHED COBBLE: A tool manufactured from small, thin cobbles that are usually less than 10 cm in length. A margin(s) has been retouched but the surfaces have not been modified. Edge use may be similar to that of a uniface or biface.

SCRAPER: Scrapers are unifacial flake tools with relatively steep marginal retouch. The edge angle may vary in steepness. Scrapers are recorded as side, end, or side and end types depending upon location(s) of modified margins. Scrapers may be manufactured from a flake and retain some flake morphology (platform, bulb).

SINGLE PLATFORM CORE: A core that has a single striking surface which serves as the platform for flake removal. Flake removal generally results in a core that is conical in shape. Flakes removed from single platform cores are similar in length, suggesting a systematic technique of core reduction.

TESTED COBBLE: A cobble which retains cortex over most of the surface and has a minimal amount of flake removal. The flake scars are large, few in number (less than three), and usually are restricted to one area. There is no indication of shaping. These specimens represent initial modification.

UNIFACE: A uniface is a formal tool with facial retouch that extends over one-third or more of one surface of the artifact.

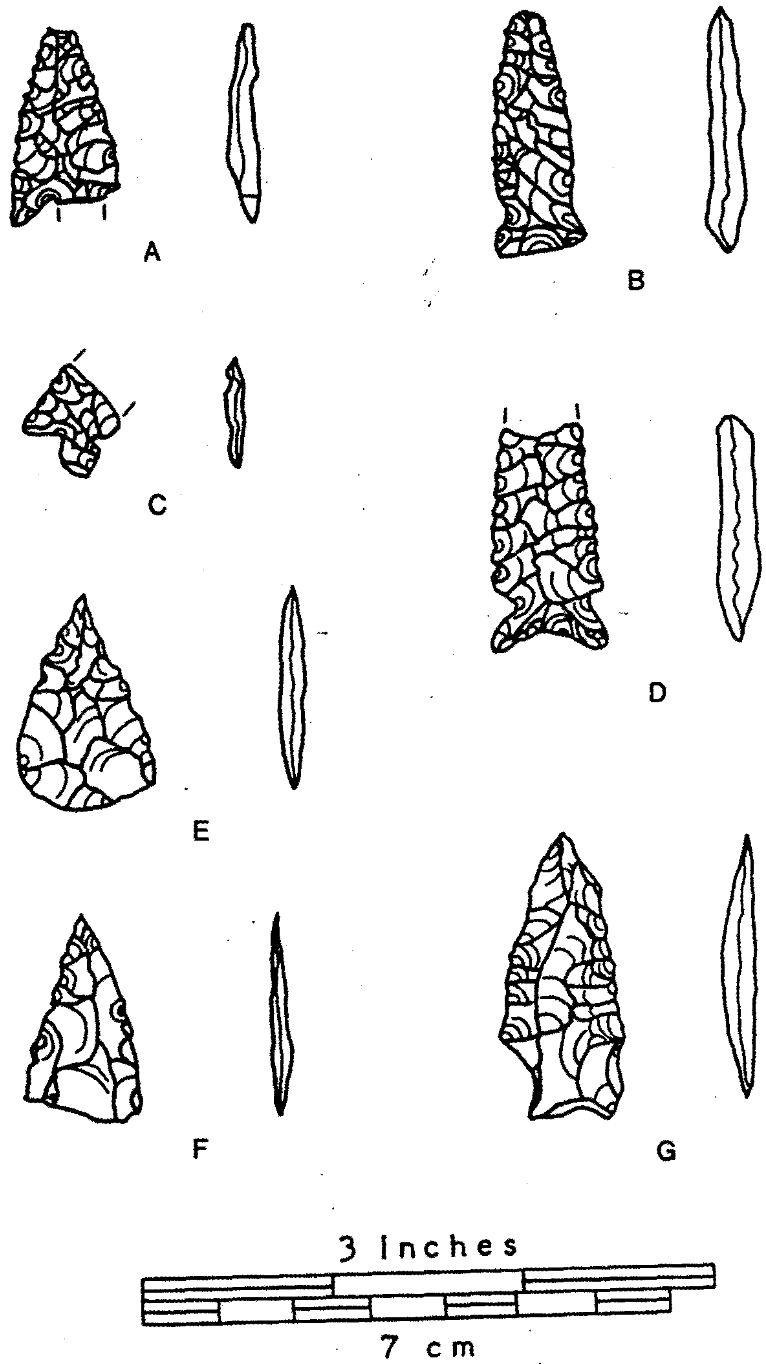
UNIFACIAL: One face; when referring to retouch it indicates that at least one-third of one surface is facially modified.

UNIFACIAL COBBLE: Similar to a bifacial cobble except that flakes have been removed only from one surface.

UNIDIRECTIONAL: Unidirectional refers to edge or marginal retouch on one surface. It is not to be confused with unifacial retouch which extends onto the face.

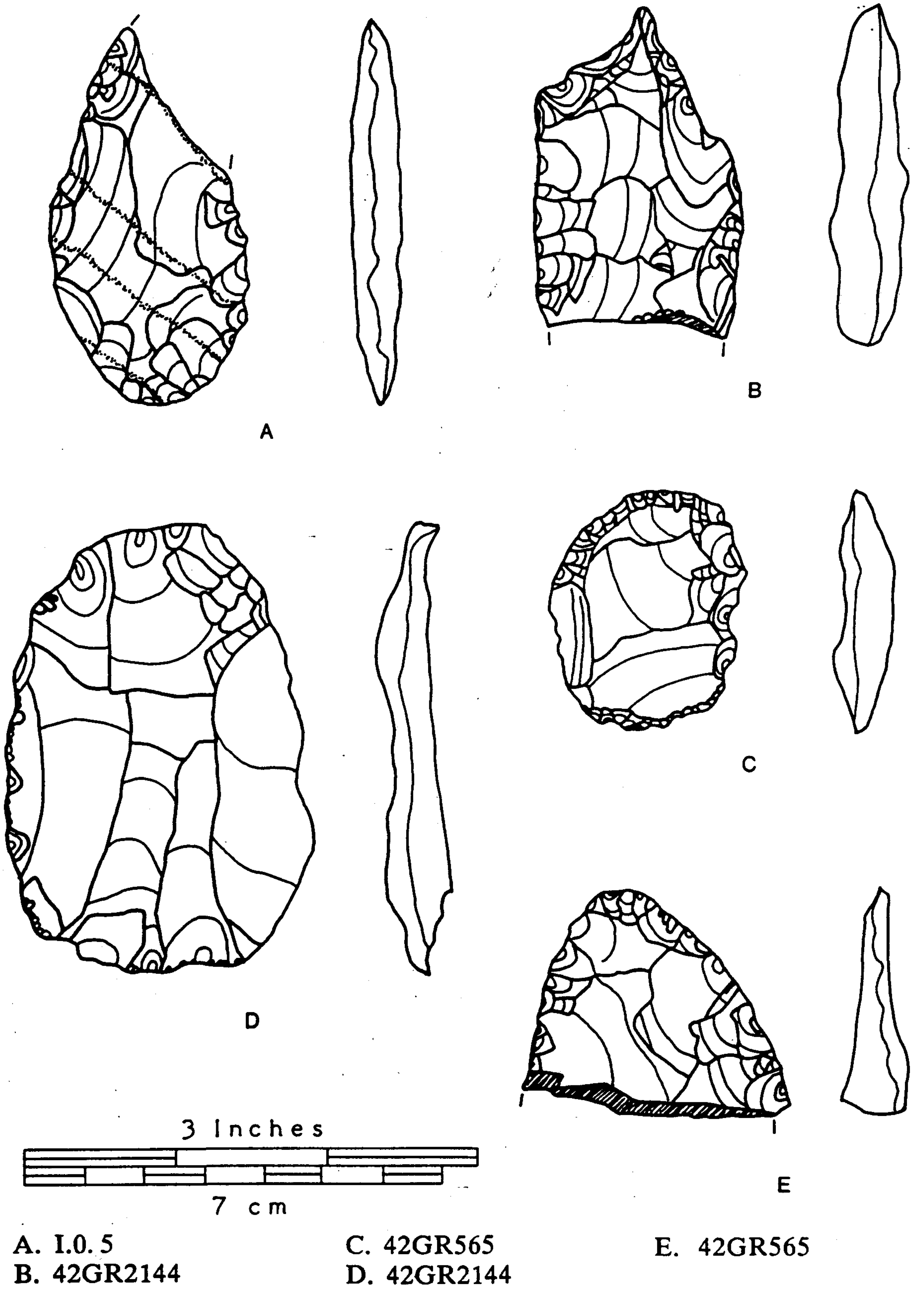
APPENDIX F

Artifact Illustrations



A. 42GR515
B. 42GR2146
C. I.O. 66
D. 42GR2147
E. 42GR539
F. 42GR539
G. 42GR565

Projectile points.



A. I.0.5
B. 42GR2144

C. 42GR565
D. 42GR2144

E. 42GR565

Bifacial tools.

APPENDIX G
Isolated Occurrences

No.	Cadastral Location	Area/ Length	Location	Artifact Type	Descriptions
1	T24S R21E, NE 1/4 of SW 1/4 of SW 1/4 of Section 7	--	sedge flat	flake	biface, white chert
2	T24S R22E, NW 1/4 of SE 1/4 of NE 1/4 of Section 8	--	ridge saddle	core	tested cobble, quartzite
3	T23S R21E, NW 1/4 of SW 1/4 of NW 1/4 of Section 21	--	slick rock slope	flake	6 interior, chalcedony, secondary dep. from UNL 2?
4	T23S R21E, NE 1/4 of SE 1/4 of SW 1/4 of Section 21	--	drainage	flake	decort., clear/white chalcedony
					4 interior, clear/white chalcedony
5	T23S R21E, NE 1/4 of SE 1/4 of SW 1/4 of Section 21	--	drainage	tool	biface
				flake	interior, chalcedony
6	T23S R21E, NE 1/4 of SE 1/4 of SW 1/4 of Section 21	10 m^2	drainage	flake	8 interior, white chalcedony
					3 biface, white chalcedony
				tool	biface, red chert
7	T23S R21E, SW 1/4 of SW 1/4 of NW 1/4 of Section 21	--	fin rim	flake	biface, white chalcedony
8	T23S R21E, SW 1/4 of NW 1/4 of NE 1/4 of Section 20	--	drainage	flake	interior, white chalcedony

No	Cadastral Location	Area/ Length	Location	Artifact Type	Descriptions
9	T23S R21E, SW 1/4 of NE 1/4 of SW 1/4 of Section 27	10 m	drainage	flake	2 interior, white chalcedony
10	T23S R21E, NE 1/4 of SW 1/4 of SW 1/4 of Section 27	--	drainage	flake	interior, white chalcedony
11	T23S R21E, SE 1/4 of NE 1/4 of NW 1/4 of Section 34	--	drainage	flake	decort., white chalcedony
12	T23S R21E, NW 1/4 of SW 1/4 of NE 1/4 of Section 34	--	drainage	flake	decort., cream chert
13	T23S R21E, NW 1/4 of NE 1/4 of SE 1/4 of Section 34	--	drainage	flake	interior, white chalcedony
14	T23S R21E, SE 1/4 of NW 1/4 of SE 1/4 of Section 34	--	drainage	flake	interior, white chalcedony
15	T23S R21E, SE 1/4 of NW 1/4 of SE 1/4 of Section 34	4 m^2	dune/ drainage	flake	3 interior, white chalcedony
16	T24S R21E, NW 1/4 of SW 1/4 of NE 1/4 of Section 2	--	drainage	flake	interior, white chalcedony
17	T24S R21E, NW 1/4 of NW 1/4 of SE 1/4 of Section 2	1 m	top of road cut	flake	2 interior, white chalcedony
18	T24S R21E, NE 1/4 of NW 1/4 of SE 1/4 of Section 2	--	top of road cut	flake	decort., white chalcedony

No	Cadastral Location	Area/ Length	Location	Artifact Type	Descriptions
19	T24S R21E, NE 1/4 of NE 1/4 of NW 1/4 of Section 11	--	ridge	core	tested cobble/ nodule, white chalcedony
20	T24S R21E, SE 1/4 of NE 1/4 of NE 1/4 of Section 11	--	drainage	flake	decort., white chalcedony
21	T24S R21E, SW 1/4 of SW 1/4 of NE 1/4 of Section 12	25 m	terrace	flake	2 interior, white chalcedony
22	T24S R21E, NW 1/4 of NE 1/4 of SE 1/4 of Section 12	2 cm	terrace	flake	decort., tan/clear chalcedony, broken in two
23	T24S R21E, NW 1/4 of SE 1/4 of NW 1/4 of Section 13	--	slope	flake	interior, white chalcedony
24	T24S R21E, NE 1/4 of SW 1/4 of SW 1/4 of Section 13	30 m	ridge	tool	biface, green altered volcanic ash
				flake	interior, quartzite
					interior, white chalcedony
25	T24S R21E, NW 1/4 of SW 1/4 of SW 1/4 of Section 13	--	ridge	tool	uniface, white chalcedony
26	T24S R21E, SW 1/4 of SW 1/4 of SW 1/4 of Section 13	1 m	slope	flake	interior, white chalcedony
					interior, green altered volcanic ash

No.	Cadastral Location	Area/ Length	Location	Artifact Type	Descriptions
27	T24S R21E, SW 1/4 of SW 1/4 of SW 1/4 of Section 13	--	slope	core	unidirec- tional, white chalcedony
28	T24S R21E, SE 1/4 of NE 1/4 of NE 1/4 of Section 23	--	ridge top	historic	horseshoe
29	T24S R21E, SE 1/4 of SE 1/4 of NE 1/4 of Section 23	10 m	ridge	flake	2 interior, white chalcedony
30	T24S R21E, SW 1/4 of SE 1/4 of NE 1/4 of Section 23	--	ridge	flake	interior, white chalcedony
31	T24S R21E, SE 1/4 of SE 1/4 of SW 1/4 of Section 23	10 m	slope	flake	2 interior, white chalcedony
32	T24S R21E, SW 1/4 of SE 1/4 of SW 1/4 of Section 23	15 m	slope	flake	2 interior, white chalcedony decort., white chalcedony
33	T24S R21E, NW 1/4 of NE 1/4 of NW 1/4 of Section 26	--	drainage	flake	decort., white chalcedony
34	T24S R21E, SW 1/4 of NE 1/4 of NW 1/4 of Section 26	--	ridge	flake	interior, white chalcedony
35	T24S R21E, SE 1/4 of NW 1/4 of NW 1/4 of Section 26	--	near drainage/ ridge(?)	flake	interior, white chalcedony
36	T24S R21E, NE 1/4 of SW 1/4 of NW 1/4 of Section 26	--	slope	flake	interior, white chalcedony

No.	Cadastral Location	Area/ Length	Location	Artifact Type	Descriptions
37	T24S R21E, NE 1/4 of NE 1/4 of SE 1/4 of Section 27	--	slope	flake	interior, white chalcedony
38	T24S R21E, NE 1/4 of NE 1/4 of SE 1/4 of Section 27	--	slope	flake	interior, white chalcedony
39	T24S R21E, NE 1/4 of SE 1/4 of SE 1/4 of Section 27	--	drainage	flake	2 biface, white chalcedony
40	T23S R21E, NE 1/4 of NE 1/4 of NE 1/4 of Section 34	25 m^2	dune	flake	2 biface, white chalcedony interior, white chalcedony angular debris, white chalcedony
41	T23S R21E, SE 1/4 of SW 1/4 of SE 1/4 of Section 27	--	dune	tool	biface
42	T23S R21E, SE 1/4 of SW 1/4 of SE 1/4 of Section 27	--	drainage	flake	biface, green altered volcanic ash
43	T24S R21E, NW 1/4 of SE 1/4 of NW 1/4 of Section 13	50 cm	dune edge	flake	biface, white chalcedony interior, white chalcedony
44	T23S R21E, NW 1/4 of NE 1/4 of NW 1/4 of Section 27	23 m	drainage dune	flake	3 interior, white chalcedony 5 biface, white chalcedony

No.	Cadastral Location	Area/ Length	Location	Artifact Type	Descriptions
45	T23S R20E, NE 1/4 of NE 1/4 of NW 1/4 of Section 26	--	drainage	flake	biface, pink chert
46	T24S R21E, SW 1/4 of NW 1/4 of SE 1/4 of Section 34	--	dune	flake	angular debris, white chalcedony
47	T25S R21E, NE 1/4 of SW 1/4 of NE 1/4 of Section 16	--	drainage	flake	interior, white chalcedony
48	T25S R21E, SW 1/4 of SW 1/4 of NE 1/4 of Section 3	--	dune	flake	biface, white chalcedony
49	T25S R21E, SW 1/4 of NE 1/4 of SW 1/4 of Section 3	15 m	dune	flake	biface, banded opaque white chalcedony
					biface, white chalcedony
					biface, white chalcedony
50	T25S R21E, NW 1/4 of NW 1/4 of NW 1/4 of Section 10	--	near drainage	tool	biface frag., white chalcedony
51	T25S R21E, NE 1/4 of NW 1/4 of SW 1/4 of Section 15	--	top of road cut	flake	interior, white chalcedony
52	T25S R21E, NE 1/4 of NW 1/4 of SW 1/4 of Section 15	--	drainage	flake	interior, pink chert, "Dewey Bridge"
53	T25S R21E, NW 1/4 of NE 1/4 of SW 1/4 of Section 15	--	road cut	flake	interior, white chalcedony

No.	Cadastral Location	Area/ Length	Location	Artifact Type	Descriptions
54	T25S R21E, SW 1/4 of SW 1/4 of SW 1/4 of Section 15	--	dune	flake	decort., white chalcedony
55	T25S R21E, SW 1/4 of SW 1/4 of SW 1/4 of Section 15	--	drainage	flake	interior, white chert, blade
56	T25S R21E, SE 1/4 of SE 1/4 of SE 1/4 of Section 16	--	dune	flake	angular debris, white chalcedony
57	T25S R21E, NW 1/4 of NE 1/4 of NE 1/4 of Section 21	--	dune	flake	biface, white chalcedony
58	T25S R21E, SE 1/4 of NW 1/4 of NE 1/4 of Section 21	25 m	road cut	flake	2 interior, white chalcedony 3 decort., white chalcedony
59	T25S R21E, SE 1/4 of NW 1/4 of NE 1/4 of Section 21	--	talus slope	flake	decort., white chalcedony
60	T25S R21E, SW 1/4 of SW 1/4 of NE 1/4 of Section 21	15 m	road cut	flake	2 interior, white chalcedony
61	T25S R21E, NE 1/4 of SE 1/4 of NW 1/4 of Section 21	--	drainage	flake	interior, white chalcedony
62	T25S R21E, NE 1/4 of SE 1/4 of NW 1/4 of Section 21	--	drainage	flake	interior, white chalcedony
63	T25S R21E, SE 1/4 of SW 1/4 of NE 1/4 of Section 20	--	talus slope	flake	decort., white chalcedony

No.	Cadastral Location	Area/ Length	Location	Artifact Type	Descriptions
64	T24S R21E, NW 1/4 of SE 1/4 of SE 1/4 of Section 23	--	dune	flake	interior, Brush Basin chalcedony
65	T24S R21E, NE 1/4 of NW 1/4 of SW 1/4 of Section 24	--	bedrock	flake	interior, dark brown/ black chert, edge retouched?
66	T24S R21E, NE 1/4 of NW 1/4 of NE 1/4 of Section 25	1 m	drainage	flake	interior, white chalcedony
				tool	hafted biface, white chalcedony
67	T24S R22E, SE 1/4 of NE 1/4 of SE 1/4 of Section 5	--	bedrock/ slick rock(?)	flake	interior, white chalcedony
68	T24S R21E, NW 1/4 of NW 1/4 of SW 1/4 of Section 30	--	drainage	flake	interior, green altered volcanic ash
69	T24S R21E, SW 1/4 of SW 1/4 of SE 1/4 of Section 24	--	dune	flake	interior, white chalcedony

APPENDIX H

Data Base Files and Codes for Files from 1987 Survey.

Fields	Codes
Bif=Bifacial Tools	1=hafted bifaces 2=unhafted bifaces
Uni=Unifacial Tools	1=extensively retouched flake 2=retouched flake 3=scraper 4=utilized flake
Core	1=multidirectional platform 2=unidirectional platform 3=tested cobble 4=bifacial core
Gs=Groundstone	1=mano 2=metate 3=unidentifiable
Other	1=bifacial cobble 2=hammerstone
Mattype=Material Type	1=Tidwell white chalcedony 2=Dewey Bridge chert 3=Brushy Basin chalcedony 4=quartzite 5=other chert/chalcedony 6=silicified wood 7=green altered volcanic ash 8=other 9=red/amber chert 10=sandstone
Comp=Completeness	1=complete 2=incomplete
Plan=Planview	0=not applicable 1=rectangular/loaf shaped 2=ovoid 3=other/unidentifiable
Usewear	1=unifacial 2=bifacial 3=unidirectional retouch 4=bidirectional retouch
Cortex	0=unknown 1=present 2=absent

Surtreat=Surface Treatment	0=not applicable 1=ground 2=pecked 3=battered

Notes:

1) Groundstone, other/unidentifiable indicated artifact is broken and use can not be determined.

2) Planview refers to surface shape of groundstones; not applicable (0) is used for all other tools.

3) Usewear for '1' and '2' refer to surface use of groundstone; '3'and '4' refer to retouch in tools. '0' is used when bifacial tools are bidirectionally retouched and unifacial tools unidirectionally retouched. However, it does (for example) occur when a uniface, for example, is retouched bidirectionally. This category is used for those instances.

4) Surface treatment refers to any composite use a tool may have incurred, a battered core, for example.

5) Technical terms are defined in Appendix C.

6) Material types are described in Project Area chapter.

Codes for DBase transect sample artifact file

Rawmaterlt= Raw material type
Decort= Decortication flake
Inter= Interior flake
Bfl= Biface flake
Angulardeb= Angular debris
Retoughflk= Retouched flake
Haftbfpp= Hafted biface
Unhaftbif= Unhafted biface
Uniface= Uniface
Extretlk= Extensively retouched flake
Modcobble= Modified cobble
FRC= Fire cracked rock
Core= Core
Metate= Metate
Tqauntdeb= Total quantity of debitage (decort, inter, bfl and angulardeb)
Pdecort= Percentage of debitage is decortication flakes
Pinter= Percentage of debitage is interior flakes
Pbfl= Percentage of debitage is biface flakes
Pangltdeb= Percentage of debitage is angular debris
Id= Temporary University of Nebraska number

Raw material types
1= Tidwell white chalcedony
2= Dewey Bridge chert
3= Brushy Basin chalcedony
4= quartzite
5= other chert/chalcedony
6= silicified wood
7= green altered volcanic ash
8= other
9= red/amber chert
10= sandstone

Site	raw material	decort	interior	bfl	angular debris	retouch flake	hafted biface	unhafted biface	uniface	extre-tlk	mod-cobble	fire cracked rock	core	metate	tquant deb	pdecort	pinter	pbfl	pangltdeb	ID #	comments
2GR0297	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	UNL 1	rock art panel, no transect
42GR2141	1	0	83	10	8	0	0	0	0	0	0	0	0	0	101	0.00	0.82	0.10	0.08	UNL 2	
42GR2141	4	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.00	1.00	0.00	0.00	UNL 2	
42GR2141	5	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.00	1.00	0.00	0.00	UNL 2	
42GR2141	6	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.00	1.00	0.00	0.00	UNL 2	
42GR2142	1	0	7	23	2	0	0	0	0	0	0	0	0	0	32	0.00	0.22	0.72	0.06	UNL 3	
42GR2143	1	0	11	1	1	0	0	0	0	0	0	0	0	0	13	0.00	0.84	0.08	0.08	UNL 4	
42GR2143	3	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.00	1.00	0.00	0.00	UNL 4	
42GR0539	1	1	46	17	3	0	0	0	0	0	1	1	0	0	67	0.01	0.69	0.25	0.04	UNL 5	
42GR0539	3	0	3	1	0	0	0	0	0	0	0	0	0	0	4	0.00	0.75	0.25	0.00	UNL 5	
42GR2144	1	0	15	2	0	0	0	0	0	0	0	0	1	0	17	0.00	0.88	0.12	0.00	UNL 6	multiplatform core
42GR2144	3	3	1	0	0	0	0	0	0	0	0	0	0	0	4	0.75	0.25	0.00	0.00	UNL 6	
42GR2145	1	2	9	0	1	0	0	0	0	0	0	0	1	0	12	0.17	0.75	0.00	0.08	UNL 7	multiplatform core, 30% cortex
42GR0565	1	3	27	1	5	0	0	0	0	0	0	0	0	0	36	0.08	0.75	0.03	0.14	UNL 8	
42GR0565	3	1	3	0	2	0	0	0	0	0	0	0	0	0	6	0.16	0.50	0.00	0.33	UNL 8	
42GR2146	1	1	8	0	0	0	0	0	0	0	0	0	0	0	9	0.11	0.89	0.00	0.00	UNL 9	
42GR2146	7	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0.00	0.00	1.00	0.00	UNL 9	green chert also observed
42GR2147	1	0	61	5	14	0	0	1	0	0	0	0	0	0	80	0.00	0.76	0.06	0.18	UNL10	
42GR2148	1	1	3	0	1	0	0	1	1	1	0	0	0	0	5	0.20	0.60	0.00	0.20	UNL11	20% cortex cover on biface
42GR2149	1	2	10	0	4	0	0	0	0	0	0	0	0	0	16	0.13	0.62	0.00	0.25	UNL12	
42GR2149	3	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0.00	1.00	0.00	0.00	UNL12	
42GR2149	5	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.00	1.00	0.00	0.00	UNL12	
42GR2150	1	0	13	8	3	0	0	0	0	0	0	0	0	0	24	0.00	0.54	0.33	0.13	UNL13	1 int therm alt. 1 int w/cortx
42GR2151	1	29	17	1	13	0	0	0	0	0	3	0	0	0	60	0.48	0.28	0.02	0.22	UNL14	
42GR2152	1	0	58	17	13	0	0	0	0	0	0	0	0	0	88	0.00	0.66	0.19	0.15	UNL15	
42GR2152	4	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0.00	1.00	0.00	0.00	UNL15	
42GR2152	5	0	5	2	0	0	0	0	0	0	0	0	0	0	7	0.00	0.71	0.29	0.00	UNL15	raw material = brown chert
42GR2152	6	0	7	1	2	0	0	0	0	0	0	0	0	0	10	0.00	0.70	0.10	0.20	UNL15	
42GR2153	1	0	13	5	5	0	0	0	0	0	0	0	0	0	23	0.00	0.56	0.22	0.22	UNL16	
42GR2154	1	0	12	3	1	0	0	0	0	0	0	0	0	0	16	0.00	0.75	0.19	0.06	UNL17	
42GR2155	1	0	9	3	1	0	0	0	0	0	0	0	0	0	13	0.00	0.69	0.23	0.08	UNL18	
42GR2156	1	0	6	3	2	0	0	0	0	0	0	0	0	0	11	0.00	0.54	0.27	0.18	UNL19	
42GR2155	4	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.00	1.00	0.00	0.00	UNL19	
42GR2155	5	0	2	1	0	0	0	0	0	0	0	0	0	0	3	0.00	0.67	0.33	0.00	UNL19	
42GR2155	7	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0.00	0.00	1.00	0.00	UNL19	raw material = volcanic ash
42GR2157	1	1	9	1	4	0	0	1	0	0	0	0	0	0	15	0.06	0.60	0.06	0.27	UNL20	
42GR2158	1	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0.00	0.00	0.00	1.00	UNL21	
42GR2159	9	0	30	0	0	0	0	0	0	0	0	0	0	0	30	0.00	1.00	0.00	0.00	UNL22	
42GR2160	1	0	33	2	4	0	0	0	0	0	0	0	0	0	39	0.00	0.85	0.05	0.10	UNL23	
42GR2160	3	1	5	1	1	0	0	0	0	0	0	0	0	0	8	0.12	0.63	0.12	0.12	UNL23	
42GR2160	4	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0.00	1.00	0.00	0.00	UNL23	
42GR2160	5	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.00	1.00	0.00	0.00	UNL23	
42GR0515	1	5	30	1	8	1	0	0	0	0	0	0	0	0	44	0.11	0.68	0.02	0.18	UNL24	
42GR0515	2	1	1	0	0	0	0	0	0	0	0	0	0	0	2	0.50	0.50	0.00	0.00	UNL24	
42GR0515	3	0	12	0	2	0	0	0	0	0	0	0	0	0	14	0.00	0.86	0.00	0.14	UNL24	
42GR0515	4	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.00	1.00	0.00	0.00	UNL24	

Appendix H (continued)

Site	raw material	decort	inter-ior	bfl	angular debris	retouch flake	hafted biface/ proj. p	unhafted biface	uniface	extret flake	modified cobble	fire cracked rock	core	metate	tquant flakes	primary decort flake	pinter	pbfl	pangular debris	ID #	comments
42GR0515	9	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0.00	0.00	0.00	1.00	UNL24	
42GR0544	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00	0.00	UNL25	historic site, no transect
42GR0290	1	0	7	8	3	0	0	0	0	0	0	0	0	0	18	0.00	0.39	0.44	0.17	UNL26	
42GR0290	2	0	1	3	1	0	0	0	0	0	0	0	0	0	5	0.00	0.20	0.60	0.20	UNL26	
42GR0290	3	0	1	3	0	0	0	0	0	0	0	0	0	0	4	0.00	0.25	0.75	0.00	UNL26	
42GR0290	4	0	1	0	1	0	0	0	0	0	0	0	0	0	2	0.00	1.00	0.00	0.00	UNL26	
42GR0290	5	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.00	1.00	0.00	0.00	UNL26	
42GR0290	8	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0.00	1.00	0.00	0.00	UNL26	rawmaterl=basalt w/cortex
42GR0290	10	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0.00	0.00	0.00	0.00	UNL26	

REPORT CERTIFICATION

I certify that "Archeological Investigations of Arches National Park, Utah", by Karen Kramer

has been reviewed against the criteria contained in 43 CFR Part 7(a)(1) and upon recommendation of the Regional Archeologist has been classified as available.

[signature]
Regional Director

3/14/91
Date

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