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# High Elevation Land-Use on the Northern Wasatch Plateau, Manti-La Sal National Forest, Utah

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*Technological analysis of 23 lithic scatters and 138 isolated finds in the Central Skyline area, Manti-La Sal National Forest, central Utah, reveals upland use patterns from 9,000 B.P. until the mid-1800s. Lithic scatter location is bimodally distributed by elevation and production activities differ at higher and lower elevations. Elevation zone use intensity changed over time. Higher elevations were used more prior to 6,000 years B.P. (Late Paleoindian and Early Archaic periods), and have more discarded tools but less evidence of tool manufacture. Lithic raw material is mainly local chert. Lower elevations were used more after A.D. 400 (Formative and Late Prehistoric periods). More non-local obsidian debitage occurs at lower elevations, but tool manufacture used local chert. Topography and low intensity of use relative to other parts of the Wasatch Plateau suggest the area was an efficient travel route between the eastern Great Basin and the northern Colorado Plateau.*

**T***his study addresses how people used the uplands of the Manti-La Sal National Forest on the Wasatch Plateau in central Utah (Figure 1) during the last 9,000 years. Specifically, surface artifacts are used to differentiate lithic activity locations and link intensity of use of the Central Skyline area (Figure 2) to the changing activities of lower elevation populations. This high elevation area of the northern Wasatch Plateau is part of the Huntington Canyon watershed, accessible from adjacent lower valleys. It is assumed to have been an integral part of the subsistence range of groups residing in those valleys (McDonald 1995), but the topography of the area suggests that it probably also served as part of a travel network connecting the northern Colorado Plateau and the eastern Great Basin.*

Archaeological sites found at higher elevations are generally considered hunting and gathering territories of prehistoric groups with residential bases at lower elevations. Explanations of spatial and temporal changes in the use of higher elevations usually relate changes in the physical environment to resource availability, subsistence mode, and occupational density at lower elevations. Lindsay and Sargent (1979:5) found evidence of a regular high-altitude seasonal round from Archaic through historical times in the Deep Creek Mountains of northwestern Utah, where groups focused on hunting deer and mountain sheep. Thomas (1983) found evidence that villages in the Toquima Range of central Nevada were first used as hunting stations in the Archaic. Following Binford (1980, 1982), he described these uplands as the edges of territories, with small logistically organized

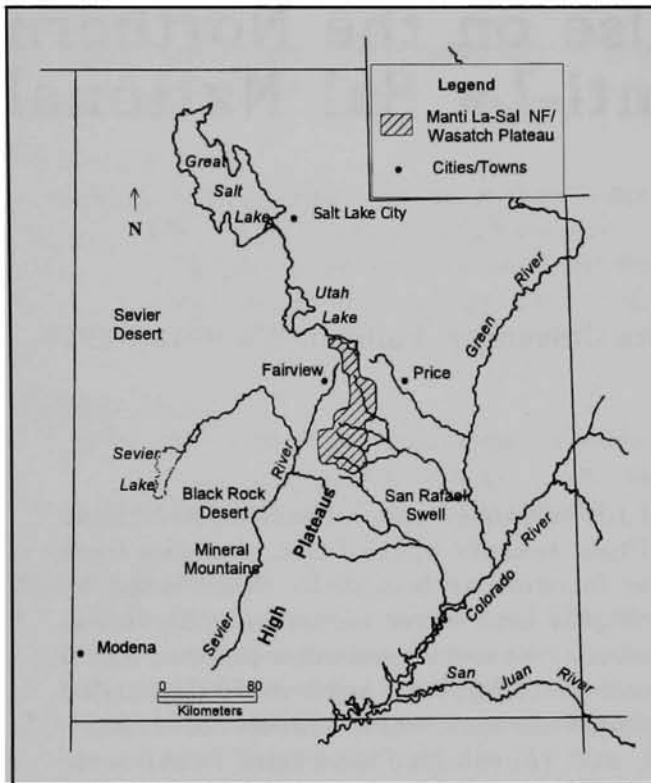


Figure 1. Utah, showing the location of the Manti-La Sal National Forest and major physiographic features mentioned in the text.

population units regrouping seasonally at lower-elevation bases (Thomas 1983:155; 1988:615). Villages in the White Mountains of California (Bettinger 1991, 1993) also served as Archaic hunting stations. During the Late Prehistoric these same locations functioned as summer residential sites in response to population growth and resource stress in the Owens Valley (Bettinger 1993:48). Benedict and Olson (1978) proposed that the Middle Archaic Mount Albion complex represented an isolated high-altitude occupation in the Front Range of the Rocky Mountains, which coincided with a decline in effective moisture between 6,000 and 5,500 years B.P. In this case, the higher elevations were a refuge for game and, by extension, people.

According to Simms (1979:12), however, the location of archaeological remains and differences in site density at high altitudes in the Fishlake National Forest may indicate good access routes as well as rich resources. Along similar lines, Benedict (1992:357) concluded

that high-altitude sites in the Front Range before 10,500 years B.P. are limited to "passes or along east-west travel routes." However, not all areas are efficient routes and the configuration of the landscape may determine frequency of use for travel. Geib (1996a, 1996c) emphasized the importance of geography in his discussion of the differential use of two lower-elevation canyons with similar resources near the Waterpocket Fold in south central Utah.

## BACKGROUND

This study is a product of modeling site location patterns for the Central Skyline area (Curewitz 1999). Small sample size and lack of dated sites required a material analysis to distinguish salient characteristics of archaeological locations that could be used to stratify the sample and improve the validity of a predictive model. Three lines of evidence are used that distinguish lithic activity areas and temporal changes in utilization of the area: distribution of point types, characteristics of the assemblage, and characteristics of the reduction trajectories. The data consist of information on lithic and ceramic artifacts recorded during surveys conducted from 1989 through 1994. The surveys yielded a sample of lithic scatters ( $n = 23$ ) and isolated finds ( $n = 138$ ) reported at varying degrees of precision using the Intermountain Antiquities Computer System (IMACS) reporting form for administrative, environmental and site data. In addition to size and lack of chronometric dates, the data are limited by an inconsistently applied definition of "site" versus "isolated find," measurement at nominal and ordinal rather than ratio levels, and estimated artifact counts. For example, tool type and flaking stage are recorded, but size and weight of artifacts are not. Some temporal control is provided by 30 projectile points which can be assigned to wide and often overlapping categories ranging from Late Paleoindian to Late Prehistoric (Holmer 1986), and an even smaller sample of five ceramic sherds.

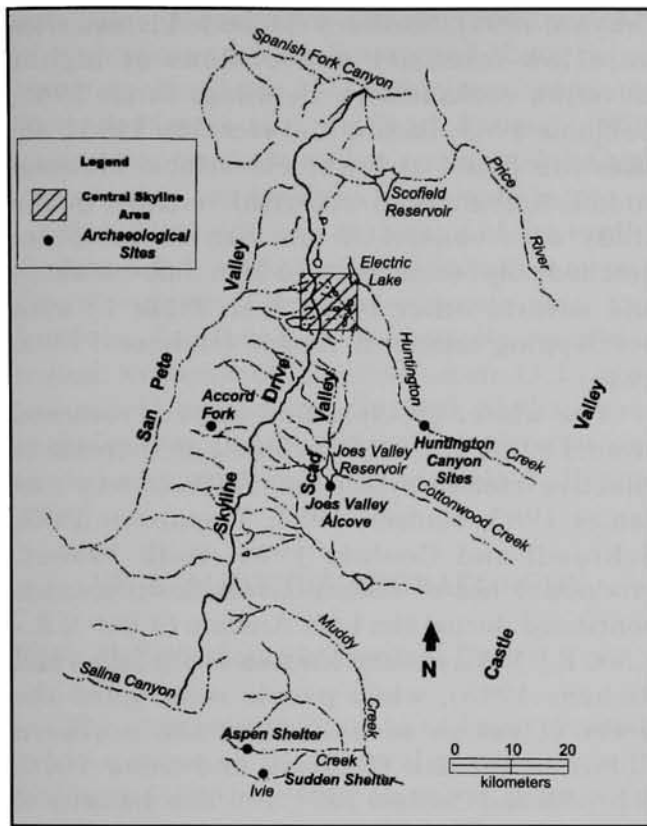


Figure 2. The Wasatch Plateau, showing the location of the Central Skyline area and archaeological sites mentioned in the text (adapted from Larson 1996).

### The Study Area

The Central Skyline area is located on the northern part of the Wasatch Plateau (see Figure 2) at an elevation ranging from 2,500 m. to 3,300 m. above sea level. The area (Figure 3) is named for Skyline Drive, a dirt road constructed by the Civilian Conservation Corps in the 1930s (Geary 1992), which follows the physiographic divide between the Basin and Range and Colorado Plateau provinces. Skyline Drive forms the western boundary of the study area at a maximum elevation of 3,193 m.; the Left Fork of Huntington Creek defines the eastern boundary. The Scad Valley between them is bordered by a classic scalloped upland or biscuit-board topography (Bloom 1991:422) on its western edge, sculpted by late Pleistocene canyon glaciers (Larson 1996).

Present forest vegetation consists of

subalpine forest containing Engelmann spruce (*Picea engelmannii*), alpine fir (*Abies lasiocarpa*), and quaking aspen (*Populus tremuloides*). Some limber pine (*Pinus flexilis*) occurs in rock crevices on very steep slopes. Open spaces contain sagebrush (*Artemisia* spp.), rabbitbrush (*Chrysothamnus* spp.), and various grasses. To date, there are no detailed paleoenvironmental studies to determine temporal changes in local vegetation patterns.

### Environmental and Cultural History

The Wasatch is the northernmost of the High Plateaus of Utah (see Figure 1), and forms a climatic and biogeographic boundary between the eastern Great Basin and the northern Colorado Plateau (Zaveloff and Collett 1988; Grayson 1993). Effective moisture on either side of the High Plateaus varies with the strength and degree of penetration of winter and summer precipitation. Topographic effects on orographic

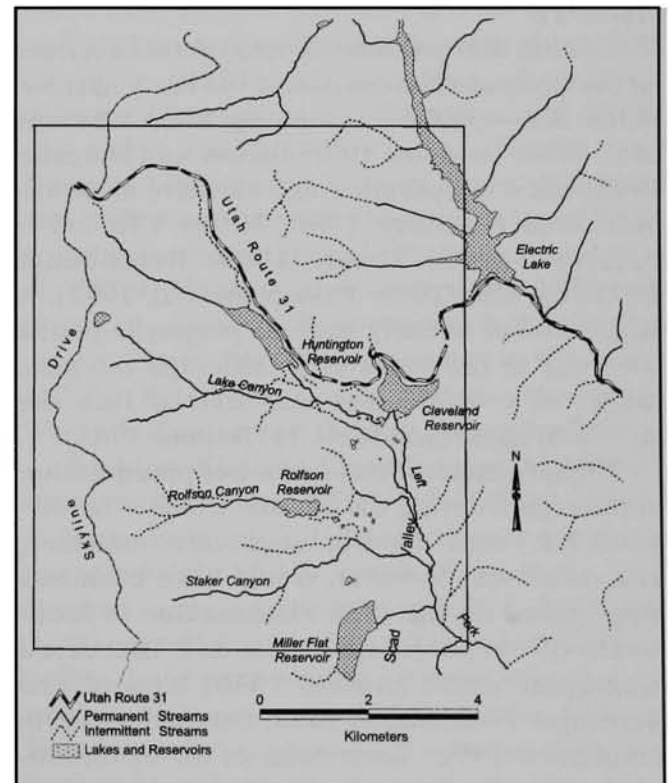


Figure 3. The northern section of the Huntington Canyon watershed, showing the boundaries of the Central Skyline area.

rainfall and air temperature, plus soil type, determine the types and quantities of local plant and animal resources (Madsen and Currey 1979; Wigand and Mehringer 1985; Petersen 1988; Shafer 1989; Betancourt 1990).

Paleoclimatic studies conducted in the region outline general patterns of climate change from the last full glacial to the present. A strong winter precipitation pattern characterized by westward-moving cool maritime air masses from the north Pacific prevailed until the end of the glacial period. Between 13,000 and 10,000 years ago, the influence of the summer monsoon from the Gulf of Mexico became stronger. An increase in effective moisture on the northern Colorado Plateau from 12,000 to 7,000 years ago extended into the eastern Great Basin (Elias 1991; Thompson et al. 1993; Oviatt 1997).

No evidence of Early Paleoindian occupation (before 10,000 B.P.) has been found in the study area. Late Paleoindian (10,000 B.P. - 8,000 B.P.) projectile points resemble types found on the northern Colorado Plateau and in the Rockies (Table 1).

Intense occupations occurred at rockshelters on the Colorado Plateau during the Early Archaic (8,000 B.P. - 6,000 B.P.) (Jennings 1980; Jennings et al. 1980; DeBloois 1983; Barlow and Metcalfe 1993) when temperature and effective moisture increased (Lindsay 1980; Miller 1987:179; Petersen 1988; Shafer 1989; Betancourt 1990:285; Elias 1991; Thompson et al. 1993). A large number of Early Archaic projectile points occurred in the study area, although the time ranges of several types may extend into the Middle Archaic (see Table 1) (Holmer 1986).

Higher temperatures and lower precipitation in the region during the Middle Archaic (6,000 - 4,000 B.P.) caused a drop in effective moisture. The reduction, however, would have been less pronounced on the High Plateaus due to lower levels of evapotranspiration and increased orographic uplift (Antevs 1948; Wigand and Mehringer 1985; Shafer 1989; Betancourt 1990; Thompson 1992; Thompson et al. 1993:490-491). Eastern Great Basin sites occurred in pinyon-juniper uplands with access to higher and lower elevation ecotones (Madsen 1982:215;

Grayson 1993). Northern Colorado Plateau sites were low-intensity occupations at higher elevation rockshelters (Jennings et al. 1980; DeBloois 1983; Barlow and Metcalfe 1993). No sites are found at lower elevations. Minimal Middle Archaic archaeological remains in the study area consist of one San Rafael Side-notched point (similar to Sudden Side-notched) and several other types (see Table 1) with overlapping temporal ranges (Holmer 1980a, 1986).

The winter precipitation pattern returned around 5,000 years B.P., bringing an increase in effective moisture (Antevs 1948; Currey and James 1982; Madsen 1982; Thompson 1992; Schroedl and Coulam 1994; Geib 1996c). Productive use of eastern Great Basin uplands continued during the Late Archaic (4,000 B.P. - 1,500 B.P.) (Aikens and Madsen 1986; Talbot and Richens 1993), while people reoccupied the lower elevation cave sites on the northern Colorado Plateau (Lindsay and Lund 1976; Schroedl and Coulam 1994:20). The majority of projectile points at Late Archaic sites such as Cowboy Cave and Sudden Shelter (see Figure 2; Holmer 1980b) are Gypsum points; however, only one Gypsum point was recovered in the study area.

Maize cultivation spread into the region during the Late Archaic (Winter and Wylie 1974; Wilde and Newman 1989; Geib 1996d:55) but hunting and gathering remained important. Although corn became a significant cultigen in the Fremont period (A.D. 400 - 1350), the Fremont probably maintained a flexible subsistence strategy, shifting between sedentary farming and mobile foraging (Simms 1986). The use of upland shelters continued and may have intensified. Occupations occur at both Aspen Shelter (see Figure 2; Janetski et al. 1991; Crosland 1993) and Joes Valley Alcove (see Figure 2; Barlow and Metcalfe 1993). Two seasonal, semi-sedentary Fremont sites in Huntington Canyon (see Figure 2) were extensively occupied for short periods from 680±50 B.P. through 1,165±60 B.P. These sites contain Fremont points, Late Prehistoric points and evidence of hunting, gathering, and

cultivation (Montgomery and Montgomery 1993). The presence of Rose Spring and Uinta points and grayware (Table 1) at high elevations on the Wasatch Plateau contrasts with Simms' (1979) finding that horticulturalists rarely used the high elevations in the Fishlake National Forest.

Drought conditions at the end of the twelfth century A.D. brought maize cultivation to an end. Two Cottonwood Triangular points may date from the Fremont-Late Prehistoric transition period. Evidence of Late Prehistoric (A.D. 1350 - contact) use of the Central Skyline area includes one Desert Side-notched point and three brownware sherds (see Table 1; Holmer 1986).

## HIGH ALTITUDE ARCHAEOLOGY

### High Altitude Sites in Central Utah

The archaeological sites in and near the study area conform to the general pattern seen by DeBloois (1983) for high elevation areas of the national forests in central Utah. His summary of 336 high-elevation sites indicates a general decrease in site numbers with increasing elevation. Eighty-six percent of the sites are lithic scatters, most of which (94%) have no subsurface component. Only 7% of the sites contain ground stone. Despite reports by collectors, he found no evidence of early Paleoindian points.

Simms (1979:1) used data from eleven small parcels above 1,830 m. in the Fishlake National Forest to address "aboriginal use of high altitude areas." He departed from the notion that high altitude occupations indicate separate high-altitude cultures, instead viewing them as part of an optimal foraging strategy practiced by groups based at lower elevations. He concluded that the timing and frequency of travel in such a context might be important in explaining the density of sites and isolated finds in high elevation areas (1979:12).

According to Winter (1983), upland use patterns in the study area would have included both seasonal high-altitude residential camps and logistical use for specialized purposes

(Binford 1980). Edible species ripen after low elevation varieties. Grasses persist later into the season due to increased moisture, and animals ascend to graze and browse as the lowlands desiccate. The shorter growing season, however, limits the potential for horticulture and the seasonal availability of wild foods.

While there is no archaeological evidence of plant-gathering at these elevations, ethnographic data (Janetski 1994) suggest it was likely. Ellison (1954:104) noted that native people probably gathered tobacco root (*Valeriana edulis*) in the subalpine zone of the Wasatch Plateau for medicinal purposes, and Janetski (1986:149) mentioned that this plant occurs in the Utah Valley. Stan McDonald (personal communication, 1999) reported that "biscuitroot," (probably species of *Lomatium*), occurs at high elevations south of the study area.

### Archaeology of the Wasatch Plateau

Three rockshelters in or near Salina Canyon (see Figure 2), provided the basis for developing and testing a regional projectile point chronology (Holmer 1980a), examination of mobility patterns (Janetski et al. 1991; Crosland 1993), and lithic technology studies (Barlow and Metcalfe 1993). Salina Canyon is a natural travel and trade route between the eastern Great Basin and the northern Colorado Plateau (Jennings et al. 1980; Hughes and Bennyhoff 1986). It provided access to resources such as obsidian quarries in western Utah, marshes in the Sevier and San Pete Valleys, and chert quarries on the Wasatch Plateau and the San Rafael Swell.

Sudden Shelter (Jennings et al. 1980), occupied between 7,900±190 B.P. and 3,360±85 B.P., is located 2,100 m. above sea level approximately 85 km. south of the study area. Distinct occupation peaks at 6,400, 4,600 and 3,700 years B.P. coincide with increases in *Pinus* pollen, indicating annual and seasonal changes in precipitation, or a slightly cooler climate. Trends in subsistence strategies during each peak probably relate to changes in the local environment (Lindsay 1980).

Aspen Shelter (Janetski et al. 1991), located

8 km. north at 2,500 m. above sea level (see Figure 2), was occupied periodically between  $4,570 \pm 110$  and  $1,070 \pm 60$  B.P., from the end of the Middle Archaic into the Fremont Period. It was used most intensively during the Middle to Late Archaic (Janetski et al. 1991:39). Although the lithic assemblage supports the use of the shelter as a residential base camp in a logistical system (Binford 1980), the faunal data suggest use as a field camp in both Archaic and Fremont periods (Crosland 1993). Only the latest Archaic occupations (400 B.C. - A.D. 70 and A.D. 130 - A.D. 430), containing house pits, features, and grinding implements, fit the criteria for a residential base in a mobile foraging system.

Fifty kilometers to the north, short-term field camps at Joes Valley Alcove (see Figure 2) were occupied seasonally and sporadically by hunting parties. Early occupation occurred from the Early Archaic to the end of the Middle Archaic ( $8,940 \pm 180$  B.P. to  $3,920 \pm 80$  B.P.), with a hiatus between  $3,920 \pm 80$  B.P. and  $2,460 \pm 120$  B.P. The shelter was reoccupied in the Late Archaic and use continued through the Fremont period, with the latest radiocarbon date at  $930 \pm 100$  B.P. (DeBloois 1983; Barlow and Metcalfe 1993).

### Archaeology of the Central Skyline Area

Environmental and archaeological surveys in the Central Skyline area (see Figure 3) before 1989 were limited to smaller projects such as watershed restoration and a cultural resource inventory of several reservoirs. Two environmental impact surveys (Hauck 1979; Reed and Chandler 1984), carried out on coal and timber leases that abut the study area on the east, identified no prehistoric sites.

The Central Skyline survey began in 1989 after the 1986 and 1988 discoveries of extinct Pleistocene megafauna remains at elevations over 2,700 m. above sea level (Miller 1987; Gillette and Madsen 1993). Mastodon remains dated to between 6,900 years B.P. and 7,700 years B.P. (Miller 1987) and Columbian mammoth remains dated to  $11,220 \pm 110$  years B.P. (Meltzer and Mead 1985; Gillette and Madsen 1993). Paleoenvironmental research by Haynes

(1991) suggested that the area might have served as a refuge for large game animals during a drought at the end of the Pleistocene (Haley 1994). Analysis of the mammoth bones showed possible butchering marks (Gillette and Madsen 1993:677), but the fossils could not be directly associated with prehistoric artifacts.

Weekend volunteers from the Utah State Archaeological Society collected basic archaeological information beginning in 1989. Survey continued through 1994, sponsored and funded by the United States Forest Service, Red Deer College, and Earthwatch. The survey covered approximately 21 km.<sup>2</sup>, and added 19 sites and 159 isolated finds to the existing database (Curewitz 1999). Limited test excavations in 1993 and 1994 uncovered little or no subsurface material.

Artifacts recovered during the Central Skyline survey include ceramic sherds ( $n = 5$ ) and diagnostic projectile points ( $n = 30$ ), which indicate occupation from the Late Paleoindian through Late Prehistoric periods (see Table 1). Neither survey nor excavation revealed evidence of Early Paleoindian hunters.

### DISTRIBUTION OF DIAGNOSTIC ARTIFACTS

Differential distributions of diagnostic artifacts over time can be observed between the higher and lower elevation zones in the study area. A lower zone in the Scad Valley (2,400 to 2,800 m.) and a higher zone along the ridge and the Skyline (2,800 to 3,200 m.) were defined using the strongly bimodal distribution of archaeological sites (Figure 4). The overall distribution of elevation values (Figure 5) is also bimodal but not nearly as strong. A two-sample Kolmogorov-Smirnov test, comparing the cumulative distribution of archaeological sites with a random sample of non-site locations by elevation, indicates that a difference in distributions is extremely likely ( $KS = .149559$ ;  $p = .0001$ ).

The sample of projectile points and sherds was reclassified into Early (Pre-ceramic) and Late (Ceramic) periods to reduce the number of

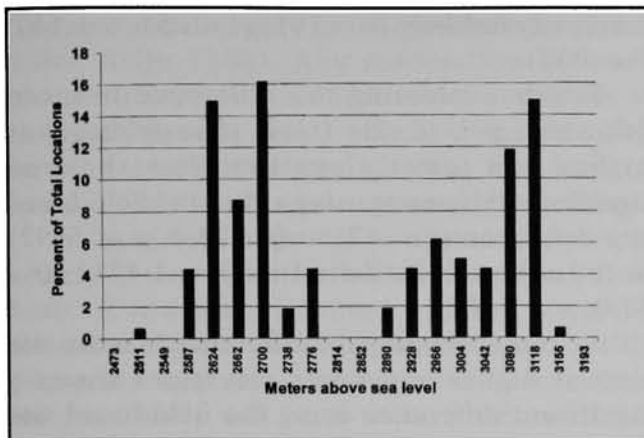


Figure 4. Distribution of sites and isolated finds by elevation in the surveyed area.

categories with small counts. The Early period consists of artifacts classified as Late Paleoindian and Archaic. Seven Elko points and three “Archaic” points not included in Table 1 are classified as Early (Table 2a). The Late period consists of Fremont and Late Prehistoric artifacts. A chi-square test of association shows a significant and moderately strong relationship between elevation zones and the distribution of 35 temporally diagnostic artifacts ( $\chi^2 = 5.106$ ;  $p = .024$ ;  $V = .382$ ).

Early period artifacts occur more frequently at higher elevations and less frequently at lower elevations; the opposite is true for Late period artifacts. Seventy percent of the projectile points attributable to the Early period (9,000 to 6,000 years B.P.) occur in the higher elevation zone. In contrast, 75% of the artifacts attributed to the Late period (1,550 years B.P. to contact) occur in the lower elevation zone. However, the association of Late period artifacts with the lower elevations is due solely to the differential distribution of Late Prehistoric artifacts (Table 2b). While Rose Spring points and Fremont ceramics are evenly distributed between higher and lower elevation zones, all projectile points assigned to the Late Prehistoric period are in the lower elevation zone. Despite the small sample, the absence of any Late Prehistoric artifacts at higher elevations is unusual, particularly since DeBlois (1983:76) cites historic records indicating that Southern Paiute groups wintered at high elevations on the Markagunt and Fishlake Plateaus to the south.

## CHARACTERISTICS OF THE ASSEMBLAGE

The analysis of diagnostic artifact distribution provides limited temporal information. Quantifying associations between different attributes of the assemblage supplies information about mobility, access to raw material, and spatial differences in activities. Inferences made about each of these additional lines of evidence strengthen inferences about land use. In order to infer subsistence and settlement patterns from lithic assemblages, contextual information is required. Distance from raw material sources, quality and abundance of raw material (Andrefsky 1994), the need to conserve and recycle material (Bamforth 1986), transport costs (Barlow and Metcalfe 1993), and the intended product of the reduction event (Tomka 1989) each affect the characteristics of tool and debitage assemblages.

The small sample size limits which characteristics of the assemblage can be analyzed by elevation zone. For instance, associations between tool type and material source, diagnostic artifacts and location type (whether a location is a “site” or an “isolated find”), and diagnostic artifacts and material source can only be analyzed for the area as a whole. The absence of significant associations (Table 3a) indicates no preference in material for specific tool types at any time, and no

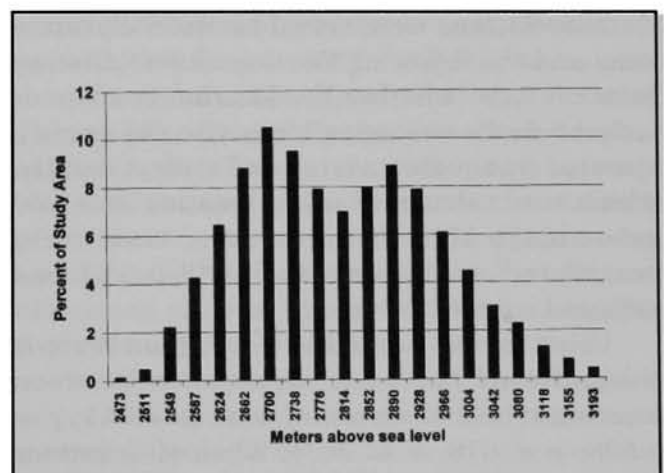


Figure 5. Distribution of elevation values in the surveyed area.



difference in the occurrence of diagnostic artifacts by location type.

### Characteristics of Locations by Elevation Zone

McDonald (1995:7) defined sites "as cultural phenomena consisting of 10 or more artifacts within a 50 m diameter area." Concentrations not meeting this definition are isolated finds. Specific location data, environmental data, and detailed artifact descriptions were collected only for sites. The implication is that a site represents a longer duration of occupation and/or repeated use, while an isolated find represents a shorter duration and/or single occupation (but see Camilli 1988). The distinction between them, however, was not consistently applied in the field. One site consists of only five artifacts, while seventeen isolated finds have artifact counts greater than or equal to five. Two isolated finds contain more than 10 items. Haley (1994:22) questions whether one high-elevation site is a single site or a series of isolated finds in close proximity. Two sites now separated by an erosion gully were probably originally one site (Haley 1994:28). Twenty-three sites, 17 at lower elevations and six at higher elevations, were identified using the field-based site definition. An adjusted site definition, that included any location with more than five artifacts, increased the sample to 40 sites, 19 at lower elevations and 21 at higher elevations.

Associations were tested between elevation zone and the following location characteristics: location type (whether the location is a site or isolated find); site assemblage size (by count); site area (in square meters); and artifact density, which was calculated using location size and assemblage size. In each case, tests were conducted using both the field-based and adjusted site definitions.

Using the field-based site definition there is a significant but weak association between location type and elevation zone ( $n = 161$ ;  $\chi^2 = 6.628$ ;  $p = .010$ ;  $V = .203$ ). When all locations with five or more items are reclassified as sites (the adjusted definition), any association between elevation and location type becomes

extremely unlikely ( $n = 161$ ;  $\chi^2 = .251$ ;  $p = .617$ ;  $V = .039$ ).

*T*-tests evaluating the difference in mean lithic assemblage size (tools plus debitage) at higher and lower elevation sites show no significant difference using either the field-based site definition ( $t = .6716$ ;  $df = 21.0$ ;  $p = .5092$ ) or the adjusted site definition ( $t = -1.4673$ ;  $df = 37.0$ ;  $p = .1507$ ).

A *t*-test evaluating the difference in mean site area at higher and lower elevations shows a significant difference using the field-based site definition ( $t = 2.5473$ ;  $df = 21.0$ ;  $p = .0188$ ). Using the adjusted site definition, with the maximum area of an isolated find set at 1,963 m.<sup>2</sup>, any significant difference between the sample means becomes fairly unlikely ( $t = 1.1033$ ;  $df = 37.0$ ;  $p = .2770$ ).

Artifact density is calculated using assemblage size and site area. The range of densities for all sites is .001 to .200 artifacts/m.<sup>2</sup>. All sites with artifact densities greater than .05 artifacts/m.<sup>2</sup> occur in the lower elevation zone. A *t*-test indicates that a significant difference between artifact densities at higher and lower elevations is extremely likely when the field-based site definition is used ( $t = -3.2632$ ;  $df = 18.5$ ;  $p = .0042$ ). Using the adjusted site definition, with artifact densities for isolated finds calculated using the maximum area of an isolated find (1,963m.<sup>2</sup>), a significant difference is still extremely likely ( $t = -3.3723$ ;  $df = 20.6$ ;  $p = .0029$ ). This is the only significant association relating location characteristics and elevation zone and indicates a difference in intensity and possibly in the type of activity.

### Assemblage Characteristics and Elevation Zone

#### Uniform Assemblage Characteristics

No significant associations occur between elevation zone and tool type, tool completeness, or extent of curation<sup>1</sup> (Table 3b). The uniformity of these assemblage characteristics provides information about mobility and the quality and abundance of raw material.

High residential mobility often tends to limit

the size and diversity of tool inventories (Shott 1986; Kelly 1988). Any association between elevation zone and occurrence of tool types in the study area is very unlikely (see Table 3b), but the small numbers of tools and limited numbers of tool classes suggests high mobility.

If local raw material is abundant, people generally use it for both formal and informal tools. If raw material quality is low, however, formal tools will be made from higher quality imported material where available, while informal tools will tend to be produced from lower quality, local material (Bamforth 1986; Andrefsky 1994). Recycling, particularly of the local raw material, probably occurs less frequently in areas of relative raw material abundance (Bamforth 1986; Camilli and Ebert 1992; Andrefsky 1994); therefore unbroken tools will be found in larger proportions than if recycling of tool stone is essential.

Based on these predictions, the large number of unbroken tools (53.2%) and the predominance of formal tools made of local raw materials (90.8%) found in both elevation zones of the Central Skyline area indicate that toolmakers considered both the quantity and quality of local material high. No association exists between tool completeness and elevation zone, or between formal versus informal tools and elevation zone (see Table 3b). Changes in the relative proportion of tool materials and the ratio of broken to unbroken tools over time could indicate changing access to sources of lithic material, but the sample could not be temporally stratified due to the absence of stratigraphic or chronometric dates.

### Differences between Elevation Zones

Where the sample is large enough, tests of association show that characteristics of the lithic assemblage do differ significantly above and below 2,800 m. in elevation, indicating differences in the nature and intensity of production activities that took place in each zone. Attributes used to characterize the assemblage include the types of raw material used for all tools and debitage, and the ratio of

tools to debitage.

Local lithic raw material consists primarily of chert, quartzite and chalcedony, with very small quantities of jasper and agate (Barlow and Metcalfe 1993). Castle Dale chert occurs 26 km. east of Joes Valley Alcove and at Accord Fork, along the Skyline Drive between Joes Valley Alcove and the study area (see Figure 2). These lithic sources provide the majority of the raw material found at Joes Alcove (Barlow and Metcalfe 1993) and in the Central Skyline area (McDonald 1995).

Obsidian is the primary non-local raw material. Nelson (1992) analyzed twelve obsidian artifacts from the study area. Ten originated in Wild Horse Canyon in the Mineral Mountains (see Figure 1), about 180 km. from the study area. Two, from a single high elevation site, come from the Modena area on the border between Iron County, Utah, and Lincoln County, Nevada (see Figure 1), about 320 km. from the study area. Obsidian from the Black Rock Desert (see Figure 1), 140 km. to the southwest, is found at Joes Valley Alcove (see Figure 2) as well as at sites in the Castle Valley to the east (Nelson and Holmes 1979; Black and Metcalf 1986; Barlow and Metcalfe 1993). The variety of obsidian sources indicates that people using the study area had access to high-quality tool stone, probably through a combination of mobility and trade with people in the eastern Great Basin.

An association between elevation zone and source of tool raw material is somewhat likely ( $n = 77$ ; Fisher's  $p = .096$ ). Obsidian tools occur more frequently than expected at lower elevation sites and less frequently than expected at higher elevation sites, while the difference between observed and expected frequencies of tools made of local raw material is small. Obsidian makes up only 4.2% of all tools found at higher elevations, whereas at lower elevations, obsidian tools account for 17.2% of the total.

Prehistoric people searching for recyclable or reusable material were more likely to collect discarded tools or cores. Modern collectors are more interested in tools as well. Past and recent collecting activities are unlikely to impact debitage frequency, therefore debitage may

provide a more accurate picture of the distribution of raw material used in tool production.

Debitage frequency is reported as a range on the IMACS form for each site. Raw material types are identified in the field and the percentage estimated. The raw material type at isolated finds is often specified. To arrive at ratio-level counts of debitage material, estimated percentages of raw material types were applied to the midpoint of each site's frequency range and added the exact numbers given for each isolated find were added.

A significant and moderately strong association exists between debitage raw material and elevation zone ( $n = 1260$ ;  $\chi^2 = 100.5$ ;  $p = .001$ ;  $V = -.28$ ). Local chert accounts for 98.7% of all debitage found at higher elevations, a figure much larger than expected. At lower elevations, 21.5% of all debitage is from obsidian, also much greater than expected.

The number of tools relative to debitage is another measure of raw material abundance (Bamforth 1986). Fewer tools relative to debitage implies more on-site recycling and tool maintenance, as well as more on-site production. According to Binford (1979), few tools in relation to debitage implies that tools were transported into and out of a site, and were partially processed on-site at special purpose locations.

The tool-to-debitage ratios at locations in the study area were ranked as follows: none (no tools, only debitage); low (ratio between 0 and .18); medium (ratio between .18 and .39); high (ratio between .39 and .70). A significant association between elevation zone and the occurrence of tools in relation to quantity of debitage exists using both the field-based site definition ( $n = 23$ ; Fisher's  $p = .022$ ) and the adjusted site definition ( $n = 40$ ; Fisher's  $p = .017$ ). At higher elevation sites, fewer low ratios of tools occur than expected while medium and high ratios are greater than expected. The opposite is true at lower elevations: more low ratios and fewer medium and high ratios of tools occur than expected. This distinction relates to differences in tool and debitage material reported above. Obsidian debitage occurs more frequently

at lower elevations, where the tool-to-debitage ratio is lower, while at higher elevations both tools and debitage are made from abundant local chert and tools occur in greater proportions relative to debitage. This implies that obsidian was scarcer and more highly curated in both zones.

In sum, bivariate analyses indicate that people generally made similar use of most locations in the study area. Specifically, the differences are that at higher elevations early artifacts occur more often and the number of tools found relative to the frequency of debitage is greater. At lower elevations artifact concentrations are denser and the occurrence of obsidian tools and debitage is greater.

#### FUNCTIONAL DIFFERENCES BETWEEN SITES

The frequency of debitage types at sites can be used to infer different reduction strategies (Sullivan and Rozen 1985; Mauldin and Amick 1989; Tomka 1989). The IMACS form requests information on the frequency of five flaking stages defined in the *IMACS User's Guide* (1988: Section 445, p. 1): core, decortication flakes (primary), secondary flakes, tertiary flakes (primary thinning or interior), and shatter. The *User's Guide* (1988) defines primary and secondary flakes by size and percentage of cortex. Experimental studies, however, show that the percent of cortex on a flake may vary with the amount of cortex initially present on the core, and that the goal of the reduction may also affect the number of flakes with cortex (Sullivan and Rozen 1985:756; Mauldin and Amick 1989:67; Tomka 1989:139). The *User's Guide* (1988: Section 445, p. 1) defines tertiary flakes by size and number of dorsal flake scars, but according to Mauldin and Amick (1989) and Tomka (1989) dorsal scar count is not significant in establishing the signature for a reduction sequence. The number of tertiary flakes produced during reduction is also dependent on the initial size and shape of the core (Tomka 1989:142).

Only those locations originally designated as

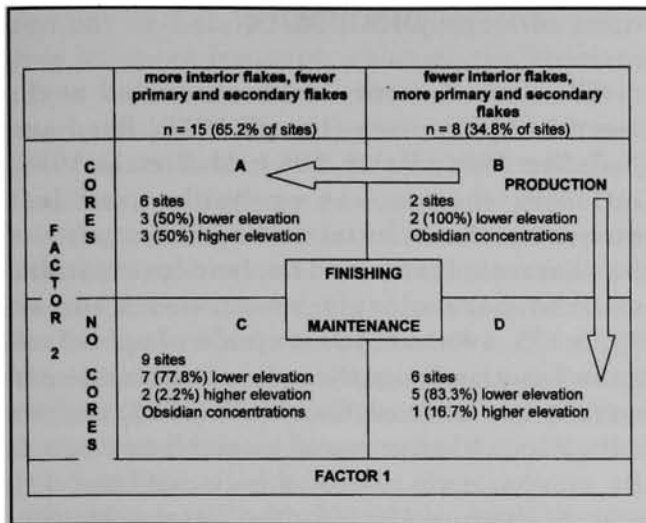


Figure 6. Summary of characteristics of site groupings based on factor score.

sites in the field ( $n = 23$ ) have data measured at levels necessary for multivariate analysis. The relative abundance of each debitage type was estimated in the field and coded as follows on the IMACS form: zero percent = none; one through nine percent = rare; 10-50% = common; 51-100% = dominant (IMACS 1990). The rankings were used to compute Spearman correlation coefficients and were converted to percentages for other statistical analyses<sup>2</sup>.

The results of Kolmogorov-Smirnov tests (Table 4) indicate no significant associations between elevation and debitage stage. A possible exception is interior flakes, which may be more likely to dominate assemblages at higher elevations. The Spearman correlation, a distribution-free test that examines the relationship between ordinal-level variables, was used to assess the relationship between the manufacturing stages, with elevation added as a partial variable to control for its effect. The results (Table 5) show a significant negative association between secondary flakes and interior flakes, and a significant positive association between primary and secondary flakes. Cores and primary flakes are positively associated and primary flakes and interior flakes are negatively associated, but the associations are not very significant.

A principal components analysis was

conducted on ratio-level versions of the ranked nominal debitage categories to reduce the number of variables. This allowed "trends or groupings within the data" (Shennan 1997:267) to be visually interpreted using a scatter plot. The number of variables was reduced to two factors (Table 6) explaining 76.8% of the variation and supporting the results of the Spearman correlation (see Table 5). All sites were plotted based on factor scores and general trends for each quadrant of the plot were determined (Figure 6).

Factor 1 explains 50.7% of the variation and has a high positive score for secondary flakes, a moderately high score for primary flakes, and a high negative score for interior flakes. Cores score very close to zero. Sites with positive values for Factor 1 have assemblages with no cores, moderate quantities of primary flakes, large quantities of secondary flakes and few interior flakes. Sites with negative values for Factor 1 also have no cores but are dominated by interior flakes, with primary and secondary flakes rare or absent.

Factor 2 explains an additional 28.1% of the variation and has a very high positive score for cores, a moderately high positive score for primary flakes, and a moderately low negative score for secondary flakes. Interior flakes score close to zero. Site assemblages with positive values for Factor 2 on a scatter plot contain cores. Some assemblages have primary flakes. All have moderate quantities of secondary flakes and low quantities of interior flakes. Sites with negative values for Factor 2 have no cores and most have no primary flakes. Quantities of secondary flakes range from none to moderate, while quantities of interior flakes range from moderate to large.

A plot based on site factor scores defines four groups with different debitage characteristics (see Figure 6). When Factor 1 is negative and Factor 2 is positive (A), all six sites (26.1% of the total) contain chert cores. Three sites occur at higher elevations, which is the largest proportion of higher elevation sites found in any of the factor-defined groupings. Two of these contain the entire manufacturing sequence, and

both have Late Paleoindian and Early Archaic period diagnostic artifacts. No significant quantities of obsidian were found at these sites.

When both Factor 1 and Factor 2 are positive (B) the entire manufacturing sequence is present, indicating probable tool production from cores. Only two sites (8.7% of the total), both in the lower elevation zone, score positive on both Factor 1 and Factor 2. Half the debitage at each site is obsidian, but no obsidian cores are present.

When both Factor 1 and Factor 2 are negative (C), no cores or primary flakes are present. Interior flakes make up the majority of debitage; only small quantities of secondary flakes occur. The nine sites (39.1% of the total) with these characteristics represent tool finishing and maintenance activities. The differing amount of secondary flakes may distinguish finishing and maintenance, depending on the initial amount of cortex present. Tool and debitage material at these sites is predominantly chert; however, the debitage at two lower elevation sites consists of 50% obsidian. These two plus two nearby sites appear to represent a cluster of obsidian tool maintenance locations in the lower elevation zone.

The six sites with Factor 1 positive and Factor 2 negative (D) (26.1% of the total) contain no cores; half contain primary flakes. Secondary and interior flakes are nearly equal in quantity. These sites most likely represent a combination of tool maintenance and finishing locations; production is from cores with little cortex or flake blanks. Five are at lower elevations. Debitage is primarily chert; however, at one lower elevation site it consists of 50% obsidian.

Results of the principal components analysis indicate that finishing and maintenance are primary activities at all sites. The principal activity at the 17 lower-elevation sites is finishing and maintenance of obsidian tools with some production of chert tools, while the main activity at the six higher-elevation sites is the maintenance of chert tools, with production occurring at proportionally fewer locations.

## DISCUSSION

The limited survey work conducted in the Central Skyline area (Hauck 1979; Reed and Chandler 1984; Haley 1994; McDonald 1995) indicates that it was probably used less intensively than central and southern parts of the Wasatch Plateau. The land use pattern inferred here closely resembles Thomas' (1983:155, 1988:615) description of upland use in the Toquima Range, Nevada, where residential mobility was minimal. Crosland's (1993) analysis of the Aspen Shelter faunal assemblage supports the emphasis on use of a logistical mobility strategy (Binford 1980) for the Wasatch Plateau. In the Central Skyline area, small populations maintained lower elevation base camps and divided and regrouped seasonally. The transient use of both higher and lower zones is supported by the absence of ground stone, structures, faunal remains, hearth features, and by the limited tool diversity.

Higher and lower location assemblages show significant differences. At higher elevations, assemblages are less densely concentrated but contain relatively more discarded tools (62.3% of all tools) and a higher tool-to-debitage ratio. Local chert comprises 95.8% of tools and 98.7% of debitage. The small sample of obsidian from the Modena area of southwest Utah (see Figure 1; Nelson 1992) indicates long-distance travel, or trade with people who quarried this source. The predominance of later-stage debitage indicates that the focus of lithic technology was tool finishing and maintenance rather than production, although the lower density of debitage points to maintenance rather than finishing. The lower density may also indicate less activity during shorter stays. Projectile point types generally date to the Late Paleoindian and Early Archaic. The higher rate of tool discard relative to debitage is a sign of good access to tool stone and indicates a high level of mobility and/or interaction.

At lower elevations, the density of artifacts is much higher. The lower frequency of discarded tools indicates that tool material was more highly curated, although curation is not high overall.

Fremont or Late Prehistoric projectile point types are more frequent, although the Fremont appear to have used both the higher and lower zones similarly. The proportion of local raw material is lower (82.8%) than at higher elevations, indicating a preference for obsidian. Over thirteen times as many flakes found at sites in the lower elevation zone are made of obsidian from the Mineral Mountains of west-central Utah. The lack of obsidian cores and early stage debitage indicates an emphasis on the finishing and maintenance of obsidian tools rather than production. Production activities that did take place used the abundant local cherts.

Locations in both elevation zones fit the definition of a field camp or "temporary operational center for a task group" (Binford 1980:10) in a logistical mobility pattern. The lower zone could be more suitable for the "high country base camps" (Thomas 1983:154) required for logistic use of the summit area, but this function was probably served by caves and shelters at even lower elevations, like those in Huntington Canyon (see Figure 2; Montgomery and Montgomery 1993).

Based on the frequency of point types found at higher versus lower elevations of the Central Skyline area, Haley (1994:35) concluded that the upper elevations were used more during the Late Paleoindian and Early Archaic periods, associated with warming temperatures and high effective moisture. The lower elevations were used more after the Archaic. That conclusion is supported here.

In the mid-Holocene, when the lower elevations presumably became warmer and drier, use of the Central Skyline area appears to decrease rather than increase. Middle Archaic occupations occur at Sudden Shelter, Aspen Shelter and Joes Valley Alcove (see Figure 2). These rockshelters provided flexible base camp locations with access to higher and lower elevation resource areas. The need to remain close to reliable supplies of water and food, however, reduced mobility. Although residential mobility along watercourses on the Colorado Plateau in the Middle Archaic intensified (Geib 1996b, 1996c), people at the higher elevations

probably employed a more logistical strategy that resulted in fewer archaeological remains at task-specific locations. This may be one explanation for the lack of Middle Archaic projectile points in the study area. Use of Aspen Shelter, for instance, began in the Middle Archaic, and the mobility strategy there has been identified as more logistical than residential (Crosland 1993). Only Middle Archaic groups based within a narrow radius would have used the Central Skyline.

The rarity of Late Archaic projectile points is unexpected. Increases in occupational intensity during the Late Archaic at the nearby high-elevation rock shelters correspond with regional climatic improvements. In the study area, however, there is no evidence of increased use. Unfortunately, the lack of faunal material and local paleoenvironmental studies precludes an explanation of the role local resource variety and abundance played in the area's appeal. One possible explanation for the small number of Late Archaic tools is more extensive curation and recycling.

Changes in artifact density over time may indicate how often the area was used as a travel route rather than simply the degree of hunting and foraging use. The transient nature of archaeological sites may indicate that the Central Skyline, located along the boundary between two physiographic provinces, had importance as a travel route between resource areas and populations. The locations of sites and isolated finds can be seen as brief stops on the way to other places, not simply final destinations at the periphery of a group's territory (Simms 1979:12). People continue to travel through areas with fewer resources. High-elevation archaeological remains in the Central Skyline are concentrated on the highest and flattest ridges and tablelands that require less energy to traverse. The high visibility is advantageous for locating game (Curewitz 1999:114-115, 120-121, Figure 16). Like Salina Canyon, the Central Skyline area is accessible from either side of the Wasatch Plateau. The Skyline provides a north-south route (see Figure 2) with access to canyons leading east to the Castle Valley and the San

Rafael Swell, and west to the San Pete and Sevier Valleys. These destinations encompass riverine habitats, marsh and lacustrine areas, and lithic resources. The more southerly destinations include lithic resources in Accord Fork and Joes Valley, rockshelters in and near Salina Canyon, and obsidian trade routes illustrated in Nelson and Holmes (1979:Fig. 5).

In sum, using limited, low-precision data from surface surveys, significant associations between landscape and assemblage attributes in the uplands of the northern Wasatch Plateau are shown. Behavior inferred from these characteristics relates to raw material use, reduction strategies, frequency and intensity of activity, and the distribution of temporally diagnostic artifacts. The density of artifacts is significantly higher at lower elevations. Finishing and maintenance of obsidian tools is the main activity at lower elevation sites, while maintenance and finishing of chert tools characterizes higher elevation sites. Tools produced from chert cores occur more frequently at lower than at higher elevations, while there is little evidence that obsidian tool production from cores occurs anywhere. The preponderance of formal tools and the high rate of unbroken tools made of local raw material provide evidence that tool material was both abundant and high-quality in the Central Skyline area. The absence of discarded obsidian cores or early-stage obsidian debitage, and the scarcity of obsidian tools at both higher and lower elevations indicate that this non-local raw material was carefully curated over all periods, and that access to it through trade or long-distance travel was limited. The differential distribution of diagnostic artifacts over time indicates that earlier, more mobile groups used the higher elevations more frequently during the Late Paleoindian and Early Archaic periods. While the limited quantities of Middle and Late Archaic artifacts suggests decreased use, this may instead indicate a change to a more logistical strategy and higher degree of raw material curation overall, resulting in fewer archaeological remains.

#### NOTES

1. Tool curation is a set of tool production

behaviors which includes production in anticipation of future needs, production of multi-purpose tools, transport, maintenance, and recycling. These may occur in combination (Binford 1979; Bamforth 1986).

2. Percentages of debitage types are calculated from ranked percentage ranges as follows: types coded "rare" were set equal to 9 percent; any type coded "dominant" was assumed to equal at least 51 percent; the total of rare and dominant types was subtracted from 100 percent; the percentage for types coded "common" was then calculated based on the remainder. For example, if no primary flakes or cores occur, and all other categories are ranked common, the percentages for the secondary flakes, interior flakes and shatter were set equal to 33.3, 33.3, and 33.4 percent. If no shatter occurred and cores, primary flakes, and secondary flakes were rare, each of these was given a value of 9 percent and the dominant type, interior flakes, was assigned a value of 73 percent.

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**Table 1**  
**SUMMARY OF DIAGNOSTIC ARTIFACTS FOR THE CENTRAL SKYLINE SURVEY**

Period	Total for Period	Number and Type
Late Prehistoric [A. D. 1350 - contact]	6	1 Desert Side-notched 3 Brownware sherds 2 Cottonwood Triangular <sup>a</sup>
Formative (Fremont) [A. D. 400 - A. D. 1350]	6	3 Rose Spring 1 Uinta Side-notched 2 Grayware sherds
Late Archaic [4,000 B. P. - 1, 500 B. P. (A. D. 400)]	1	1 Gypsum <sup>b</sup>
Middle Archaic [6,000 B. P. - 4,000 B. P.]	1	1 San Rafael Side-notched
Early Archaic [8,000 B. P. - 6,000 B. P.]	7	1 Rocker Side-notched <sup>b</sup> 2 Humboldt <sup>b</sup> 1 lanceolate <sup>b</sup> 2 Pinto 1 Lookingbill
Late Paleoindian [> 8,000 B.P.]	4	1 Pryor Stemmed 1 Yankee 1 Medicine Lodge 1 "Eden-Scottsbluff"

Note: 7 Elko points are considered pre-A.D. 400 but non-diagnostic (Holmer 1986), as are 3 "Archaic" points.

<sup>a</sup> possible temporal overlap with Formative (Holmer 1986).

<sup>b</sup> possible temporal overlap with Middle Archaic (Holmer 1986).

**Table 2****(A) OBSERVED AND EXPECTED FREQUENCIES OF DIAGNOSTIC ARTIFACTS BY ELEVATION ZONES WITH TYPES RECLASSIFIED INTO EARLY (PRECERAMIC) AND LATE (CERAMIC)**

Elevation Zone		Early	Late	Total
High	Observed	15	3	18
	Expected	11.83	6.17	
Low	Observed	8	9	17
	Expected	11.17	5.83	
Total		23	12	35
%		65.71	34.29	100.00

**(B) OBSERVED AND EXPECTED FREQUENCIES OF DIAGNOSTIC ARTIFACTS BY ELEVATION ZONES USING ORIGINAL TYPE DESIGNATIONS**

Elevation Zone		Paleo-indian	Early Archaic	Archaic	Fremont	Late Pre-historic	Total
High	Observed	3	4	8	3	0	18
	Expected	2.06	3.09	6.69	3.09	3.09	
Low	Observed	1	2	5	3	6	17
	Expected	1.94	2.91	6.34	2.91	2.91	
Total		4	6	13	6	6	35
		11.42	17.14	37.14	17.14	17.14	100.00

**Table 3**  
**(A) SUMMARY OF *p*-VALUES FOR FISHER'S EXACT TESTS WHERE NO SIGNIFICANT ASSOCIATION WAS FOUND (*k* = NUMBER OF CATEGORIES)**

<b>Relationship</b>	<b><i>n</i></b>	<b>Fisher's <i>p</i></b>
Tool types ( <i>k</i> = 3) by material source ( <i>k</i> = 2)	76	.591
Material source of dated tools ( <i>k</i> = 2) and period ( <i>k</i> = 2)	28	.191
Location type of dated tools ( <i>k</i> = 2) and period ( <i>k</i> = 2)	35	.721
Tool completeness ( <i>k</i> = 2) by period ( <i>k</i> = 5)	31	.931
Tool completeness ( <i>k</i> = 2) by material source ( <i>k</i> = 2)	79	.438

**(B) SUMMARY OF *p*-VALUES FOR CONTINGENCY TABLES WHERE NO SIGNIFICANT ASSOCIATION WAS FOUND WITH ELEVATION (*k* = NUMBER OF CATEGORIES)**

<b>Relationship</b>	<b><i>n</i></b>	<b><math>\chi^2</math></b>	<b><i>p</i></b>	<b>Fisher's <i>p</i></b>
Tool type ( <i>k</i> = 4) by elevation zone ( <i>k</i> = 2)	89			.338
Tool completeness ( <i>k</i> = 2) and elevation zone ( <i>k</i> = 2)	79	1.368	.242	
Curation ( <i>k</i> = 2) and elevation zone ( <i>k</i> = 2)	98			1.000

**Table 4**  
**ASSOCIATIONS BETWEEN DEBITAGE TYPES AND ELEVATION ZONES AT 23 SITES  
 (HIGHER SITES = 6, LOWER SITES = 17)**

<b>Debitage Type</b>	<b><i>n</i><sup>a</sup></b>	<b>Cumulative Percent</b>		<b><i>p</i> (Kolmogorov- Smirnov)</b>
		<b>Higher Elevation</b>	<b>Lower Elevation</b>	
Cores	7	5.0	2.9	.9918
Primary	7	8.3	7.2	1.0000
Secondary	19	25.0	22.8	.9527
Interior	23	80.0	74.0	.2798
Shatter	18	100.0	100.0	.8376

<sup>a</sup> *n* = number of sites with this debitage type

**Table 5**  
**ASSOCIATIONS BETWEEN DIFFERENT STAGES OF THE MANUFACTURING PROCESS,**  
**ARRANGED IN ASCENDING ORDER OF  $p$  -VALUE.**

Association	Fisher's $p$	Spearman Correlation Coefficient and $p$ -value	
		without height	partial correlation with height
Secondary flakes with interior flakes <sup>a</sup>	.017	-.5759 .0040	-.6315 .0016
Primary flakes with secondary flakes <sup>a</sup>	.080	.5255 .0100	.5198 .0131
Primary flakes with interior flakes <sup>b</sup>	.124	-.3574 .0940	-.3472 .1133
Cores with primary flakes <sup>b</sup>	.146	.3700 .0822	.3789 .0820
Cores with secondary flakes	.401	.0458 .8352	.0502 .8241
Cores with interior flakes	.657	-.1121 .6105	-.1639 .4660

<sup>a</sup> significant

<sup>b</sup> possibly significant

**Table 6**  
**STANDARDIZED SCORING COEFFICIENTS.**

Debitage Type	FACTOR 1	FACTOR 2
Core	-.0910	.8273
Primary	.3173	.3298
Secondary	.4694	-.2721
Interior	-.4311	-.0166



