High-Altitude Archaeology in the Uncompahgre Wilderness

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High-Altitude Archaeology in the Uncompahgre Wilderness: Archaeological Investigations During 2010 at the Uncompahgre Cirque Site, Hinsdale County, Colorado

by

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Abstract

In 2010, Paleocultural Research Group and the Grand Mesa, Uncompahgre, and Gunnison National Forests jointly carried out an archaeological assessment of the Uncompahgre Cirque site (5HN1098), an extensive quarry workshop located high on the east flank of Uncompahgre Peak. Funding for the project was provided by the Forest Service and History Colorado's State Historical Fund.

The site, located at an elevation of 3,840 m, consists of a dense scatter of flaking debris and chipped stone tools covering 1.15 ha (2.8 ac). Artifacts are scattered throughout this area but are visible primarily in four concentrations. The 2010 effort focused on the largest and densest of the four, designated Locus 1. Archaeological fieldwork in Locus 1 included small-scale hand excavation, intensive surface mapping, and targeted surface collection. The research team also surveyed a small portion of the valley adjacent to Uncompahgre Cirque. Subsequent laboratory analyses of recovered artifacts included minimum analytical nodule analysis of surface-collected debris aggregates; individual flake analysis and mass analysis of excavated flaking debris; technological analysis of stone tools; and compositional and hydration analysis of obsidian artifacts.

Multiple lines of evidence together indicate that the site was occupied briefly between about 5900 and 5700 calendar years ago. All four radiocarbon dates from the site are statistically equivalent, yielding a weighted mean age of 5038±19 ^{14}C yr B.P. This mean age spans at two standard deviations the period from 3944 cal B.C. to 3776 cal B.C., or a total of 168 calendar years. Obsidian artifact hydration rim thickness distributions point to a brief occupation or short series of brief occupations within this period. Stratigraphic data bolster the inference that the occupation at Uncompahgre Cirque was brief. Artifacts primarily occur in a single zone near the base of a prominent paleosol. The presence of well-defined chipped stone features primarily representing the reduction of individual raw material nodules testifies to the remarkable integrity of the site's cultural deposits.

The principal activity at Uncompahgre Cirque was reduction of chert nodules quarried on the high, narrow ridge immediately north of the site. Blanks prepared for off-site transport and use include large flakes, multi-directional cores, and both early- and late-stage bifaces. Flint knappers at Uncompahgre Cirque also manufactured a variety of tools for on-site use in hide processing, woodworking, animal butchery, or other tasks. These include expedient flake tools as well as patterned end scrapers and bifaces. Some of the tools produced from local stone for on-site use were made from heat-treated flakes or nodules.

A notable feature of the workshop is the presence of cores, tools, and flaking debris made from imported raw materials, including obsidian from northern New Mexico and quartzite, chert, and possibly other materials likely from the Gunnison basin and central Colorado. The diversity of imported raw materials suggests that multiple groups from different regions came together to use the chert quarry at Uncompahgre Cirque. Imported stone arrived as both finished tools and as cores, and was used at Uncompahgre Cirque in much the same way as the local chert. Initial core reduction of imported stone is indicated by the presence of large, unused flakes bearing cortex. Exhausted cores of obsidian, rhyolite, and chalcedony also occur in the collection, as do smaller flakes of imported stone indicative of tool manufacturing or maintenance. These latter items include thinning flakes produced during the late stages of biface manufacture as well as flakes produced by soft-hammer percussion and pressure flaking during tool rejuvenation.

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Acknowledgements

This project presented special logistical challenges that were met by a dedicated cadre of volunteers and professionals. Leigh Ann Hunt, Heritage Program Manager for the Grand Mesa, Uncompahgre, and Gunnison National Forests, immediately recognized the importance of the Uncompahgre Cirque site for understanding the native use of alpine landscapes in the Southern Rockies and worked hard to build the partnerships necessary to accomplish this project. Gunnison National Forest Archaeologist Justin Lawrence provided critical logistical support for the field effort. R. G. Severson expertly managed the pack string required to transport bulky excavation and camp gear. Chris Johnston, PCRG Lab Supervisor, demonstrated his outstanding project management skills, both at the site and in camp. The team accomplished all the project's major goals, thanks to the fortitude and camaraderie of an exceptional field crew comprised of PCRG and Forest Service Passport In Time volunteers, including Stephanie Anderson, Alex Goetz, Travis Hill, John Johnson, Calvin Loving, Erika Sessions, Jennifer Murdock, Paul Smith, Don Sullivan, Greg Sustad, and Mike Wilson.

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Introduction and Context

This report presents the results of an archaeological assessment of the Uncompahgre Cirque site (5HN1098), jointly undertaken in 2010 by the U.S. Forest Service (Grand Mesa, Uncompahgre, and Gunnison National Forests [GMUG]), and Paleocultural Research Group (PCRG), a member-supported, non-profit organization dedicated to scientific research, student training, and public education in archaeology. The site is located within the boundaries of the Uncompahgre Wilderness, which is managed by the GMUG. Funding for the project was provided by a Challenge Cost Share Agreement between PCRG and the GMUG (No. 09-CS-11020400-047) and by an archaeological assessment grant awarded to PCRG by History Colorado's State Historical Fund (No. 2010-AS-005).

The major objectives of the project are to document the site's extent, content, age, and current condition. The field investigation incorporated four data collection strategies: small-scale hand excavation, intensive surface mapping, targeted surface collection, and pedestrian survey. Subsequent laboratory investigations included minimum analytical nodule analysis of surface-collected debris aggregates, individual flake analysis and mass analysis of excavated flaking debris, technological analysis of stone tools, and compositional and hydration analysis of obsidian artifacts. The results of the field and lab investigations are combined in this report with existing data on other sites located above timberline in the San Juan Mountains to offer a benchmark context to guide future work in the region.

This chapter introduces the site, gives an overview of the 2010 field effort, and presents contextual environmental and archaeological data for the San Juan Mountains region. A detailed account of the archaeological field investigation is presented in chapter 2. Chapter 3 describes and analyzes the stone tools and flaking debris recovered from surface and subsurface contexts. Chapter 4 summarizes data from other high-elevation sites in the San Juans. The final chapter summarizes the project's major findings and makes recommendations for future work at the site and in the region.

Prior Documentation

The Uncompahgre Cirque site is a dense scatter of flaking debris and stone tools located on a turf-banked bedrock terrace at 3,840 m on the east flank of Uncompahgre Peak, the highest peak in the San Juan Mountains, and one of just 54 above 4,265 m in Colorado (figures 1.1 and 1.2). Adjacent to the site is a snowmelt- and groundwater-fed pond and fen, a wetland containing peat. The pond appears to be permanent, judging by historic photographs and other evidence discussed in chapter 2. This feature no doubt drew both animals and people to the area in the past. An extensive source of moderate- to high-quality chert, another key resource for American Indian peoples in the past, is located on the narrow ridge north of the site, at roughly 3,950 m.

The Forest Service archaeologists who first documented the site in 2007 described it as a series of three artifact concentrations together containing more

Figure 1.1. Uncompahgre Peak and the upper Nellie Creek valley.

Figure 1.2. Overview of the Uncompahgre Cirque site.

than 3,000 flakes and chipped stone tools, spread over roughly 1.18 ha (2.9 ac) (Bennett et al. 2007). The survey crew also observed approximately 75 artifacts made from obsidian mingled with items made from local stone. The only temporally diagnostic artifact they tallied was a quartzite stemmed to weakly corner-notched dart point fragment, suggesting Archaic-era use of the site. (A second chert projectile point was noted but not described.) Artifacts at the site are entrained in a loess deposit roughly 30 cm thick that overlies glacial till. The survey crew did not observe buried cultural features, but their photographs of the eroding sediment cap show pockets of what may be charcoal-stained sediment.

Given the site's high artifact density and the diversity of the raw materials present, including numerous items made from obsidian and other imported materials that may yield information about trade and interaction, the Forest Service recommended that the site be considered eligible for inclusion on the National Register of Historic Places. Observed prior impacts to the site include casual surface collection and livestock grazing. The trail to the summit of Uncompahgre Peak passes near the site and the Forest Service crew noted that recreational users have been seen picking up artifacts. They also note the presence of numerous animal trails likely produced by twentieth-century sheep grazing.

Overview of the Field Effort

The research team carried out field investigations at Uncompahgre Cirque and in adjacent portions of the upper Nellie Creek valley during an eight-day period from July 13 to July 20, 2010. Seventeen people devoted a total of 99 person-days (792 person-hours) to the field effort, just over 70 person-days of which were donated. Dr. Mark Mitchell, PCRG Research Director, and Leigh Ann Hunt, GMUG Heritage Program Manager, served as field supervisors. PCRG Lab Supervisor Chris Johnston, and Gunnison National Forest archaeologists Justin Lawrence and Jessica LeCasse served as assistant field supervisors. The field crew consisted of PCRG and Passport-In-Time volunteers, including Stephanie Anderson, Travis Hill, John Johnson, Calvin Loving, Paul Smith, Greg Sustad, and Mike Wilson. A team led by Dr. Don Sullivan from the University of Denver (DU) concurrently collected geological and other data in the Nellie Creek valley. Sullivan was assisted by Alex Goetz and DU students Erika Sessions and Jennifer Murdock. R. G. Severson managed the GMUG pack string that was used to transport excavation gear to the site.

Intensive fieldwork at Uncompahgre Cirque focused on Locus 1, the largest and densest of four artifact concentrations defined in 2010. The research team opened up a total of six test units: five 50 x 50-cm units in the loess turf bank and one 1 x 1-m unit in an adjacent eroded area. Roughly 544 liters of sediment were excavated and screened from these units, producing an artifact assemblage comprising 108 stone tools and 1,003 pieces of flaking debris. Another 1,178 flakes and 78 tools were collected from the surface of Locus 1.

The crew systematically surveyed approximately 21 ha (52 ac) west of the Uncompahgre Cirque site, recording three sites and two isolated finds. A third isolated find was recorded adjacent to the Uncompahgre Peak trail.

Archaeological Context

The San Juan Mountains fall into three different river-basin context regions. The northern and western sections of the San Juans mark the southern boundary of the Northern Colorado River region discussed by Reed and Metcalf (1999). The eastern San Juans are part of the Rio Grande basin, the archaeology of which is synthesized by Martorano and others (1999). Limited portions of the southern flank of the San Juans, including the La Plata Mountains, fall into the Southern Colorado River region that are summarized by Lipe and others (1999). Table 1.1 lists the broad chronological divisions used to organize archaeological data in these three context regions.

Paleoindian Period

Only limited data are available on the Paleoindian occupation of the San Juan Mountains and adjacent regions. Early Paleoindian artifacts (including Clovis, Folsom, Goshen/Plainview, and Agate Basin points) are rare in southwest Colorado (Pitblado 1998) and in the Northern Colorado Basin (Reed and Metcalf 1999). By comparison, Folsom artifacts and sites are relatively common in the Rio Grande basin, where 43 localities are known and excavation data are available for four sites (Jodry1999a). Folsom sites occur in a wide variety of ecological settings. Camps on the San Luis Valley floor are associated with bison kill and butchery localities; bison population density likely peaked there during Folsom times (Jodry 1999b). Data from the Stewart's Cattle Guard site adjacent to Great Sand Dunes National Park and Preserve reveal the spatial organization of Folsom kill-camp localities, with the bison kill area segregated from contemporaneous residential and work areas. The residential area exhibits at least five discrete, hearth-centered activity loci, each likely representing the refuse produced by a single household group. The kill area, located southeast of the camp, contains the remains of at least 49 bison. Initial butchery took place in the kill area. A separate work area southwest of the camp produced evidence of intensive hide processing.

The most important Folsom sites within or adjacent to the San Juans are the Black Mountain site in the eastern San Juans and the Mountaineer site in the Gunnison River basin. At 3,097 m, the Black Mountain site is the highest excavated Folsom campsite (Jodry 1999a). Located in a forest-edge setting along an upper tributary of the Rio Grande, the site consists of two concentrations of flaking debris and stone tools. The diversity of the assemblage, which includes Folsom point preforms, channel flakes, early-stage bifaces, scrapers, and gravers, is indicative of a multi-function camp, where hunters refurbished equipment for the next kill. At the Mountaineer site, located at 2,630 m on an isolated mesa overlooking the Gunnison River valley, a Folsom band built a roughly circular structure of daub-covered poles (Stiger 2006). Activities associated with the structure include projectile point manufacture and animal butchery. Spatial patterning is apparent in the distributions of artifacts, hearths, and cleared work areas. Both Black Mountain and Mountaineer point to a generalized, rather than focal, use of high country settings by Folsom people.

Late Paleoindian lanceolate point types dating to between 9000 and 7500 B.P. are more common than early Paleoindian types in an around the San Juans (Jodry 1999a; Pitblado 1998; Reed and Metcalf 1999). Though morphologically variable, most exhibit a parallel-oblique flaking pattern, a slightly to strongly concave base, and ground lateral margins. Projectiles

Table 1.1. Chronology of major culture-historical divisions in three Colorado river basins. To simplify comparison, all ages are presented in uncalibrated radiocarbon years before present (B.P.).

Period, Era, or Stage	Southern Colorado Basin (Lipe et al. 1999)	Northern Colorado Basin (Reed and Metcalf 1999)	Rio Grande Basin (Martorano et al. 1999)
Paleoindian	>11,500 – 7500	11,500 – 6400	11,200 - 7450
Archaic	7500 – 2950	8350 – 1950	7450 – 1450
Puebloan/Formative/Late Prehistoric	2950 – 650	2350 – 650	1450 – 350
Post-Puebloan/Protohistoric	650 – 110	650 – 69	350 – 69

exhibiting these attributes generally are typed as Angostura, James Allen, or Frederick. A subset of points assigned to the contemporaneous Foothills-Mountain complex also includes weakly stemmed forms (Frison 1992; Kornfeld et al. 2010). Some Foothills-Mountain specimens exhibit a parallel-transverse to collateral, rather than parallel-oblique, flaking pattern. Many Late Paleoindian flint knappers preferred quartzites or other brittle materials for making projectile points (Bradley 2010; Pitblado 2003; Reed and Metcalf 1999). Late Paleoindian groups in the mountains pursued a broad-spectrum subsistence strategy, in contrast to their bison-focused contemporaries in the Plains (Frison 1992; Reed and Metcalf 1999:68). Jodry (1999a:102) speculates that Foothill-Mountain groups may have exploited mid-elevation wetland resources in conjunction with large and small artidactyls available in nearby alpine settings.

Archaic Period

The size of the Archaic dataset varies greatly by region. The Northern Colorado basin record is the most extensive. Data from sites in the Gunnison basin, immediately north of the San Juan Mountains, are especially abundant. Much less is known about Archaic sites south of the San Juans, though some data are available for northwest New Mexico. Only a few Archaic stage sites have been investigated in the Rio Grande basin.

Researchers working in the Northern Colorado River basin generally accept the view that hunter-gatherer groups there practiced a local, year-round, upland- or mountain-focused settlement and subsistence system distinct from that of groups living in adjacent regions (Black 1991). Most researchers also recognize long-term adaptive continuity in the region, beginning as early as the Late Paleoindian period. Debate continues on whether this also reflects cultural continuity (Stiger 2001), as well as on the specific attributes defining a mountain adaptation (Reed and Metcalf 1999).

Reed and Metcalf (1999) partition the Northern Colorado River basin Archaic into four periods. The earliest, dubbed the Pioneer period (8350-6450 B.P.), marks the initial settlement of the region by full-time residents practicing a seasonal settlement system. During the subsequent Settled period (6450-4450 B.P.), local bands practiced a central-place settlement strategy that featured a combination of logistical moves around strategic habitation areas in the winter and residential mobility in the summer. This basic pattern continued into the Transitional period (4450-2950 B.P.), but was accompanied during this later period by increasing material culture variation, more restricted use of higher-elevation life zones, and possibly decreased sedentism. The final Archaic period, the Terminal (2950-1950 B.P.), was a period of subsistence stress that prompted various forms of economic intensification as well as technological change.

Stiger (2001) offers a model of settlement and subsistence change developed specifically for the Gunnison basin. People took up full-time residence in the basin after 8000 B.P. Their central-place foraging system featured large and small mammal hunting combined with bulk processing and storage of plant resources. This basic pattern continued, apart from a brief interruption between 5000 and 4500 B.P., until about 3000 B.P., when central-place residences were replaced by seasonal, special-use sites occupied by groups wintering outside the basin. This shift coincided with the local extirpation of pinon groves.

Comparably detailed sequences are not available for the Southern Colorado or Rio Grande basins. Archaic sites south of the San Juans commonly are organized according to the phases of the Oshara tradition (Irwin-Williams 1973). South of the San Juan River, in northwestern New Mexico, San Jose phase and Armijo phase groups (corresponding roughly to the Middle Archaic or Transitional periods north of the mountains) practiced a similar dual-phase subsistence round based on logistical organization centered on aggregated camps in the winter and small-band residential mobility in the summer (Lipe and Pitblado 1999:108-114).

The most extensive dataset for southwest Colorado comes from the open grassland-shrubland zone south of Ute Mountain. Sites dating to the San Jose and Armijo phases, which are more numerous than either earlier or later Archaic sites in this area, represent procurement localities occupied by logistically organized groups tethered to residential bases located in adjacent regions. This pattern shifted during the succeeding En Medio phase (Late Archaic), with hunter-gatherers establishing residential base camps in the region. The roughly concurrent initiation of maize horticulture may explain this change (Lipe and Pitblado 1999:123).

The small number of excavated Archaic-stage sites in the Rio Grande basin has limited the development of a region-specific chronology or settlement model (Hoefer 1999). The few radiocarbon-dated components all span the Late Archaic-Late Prehistoric transition. One of these, a multi-function camp located on the floor of the San Luis Valley, produced a diverse flaked and ground stone tool assemblage associated with a large archaeofauna composed of fish, bird, and mammal remains. Many Archaic sites on the western flank of the Sangre de Cristo Mountains consist of massive concentrations of burned rock and ground stone tools, indicative of intensive processing of plant resources, especially Indian ricegrass. Andrews and others

(2004) argue that the Late Archaic-Late Prehistoric transition witnessed a shift from logistical to small-group residential use of upland settings during the late summer or early fall. They suggest that this shift was prompted by the spread of pinon pines in the region. Residential exploitation of upland resources was embedded in a larger system focused on exploitation of lacustrine resources on the valley floor.

Across the San Luis Valley, in the eastern San Juans, Archaic sites consist primarily of small lithic scatters, likely representing a combination of special-use localities and short-term camps. How these sites fit within a larger settlement system is not known.

Architectural features are important elements of the Archaic record. Winter-occupied habitation structures appeared in the Gunnison basin as early as the Pioneer period and are well attested through the Transitional period (Reed and Metcalf 1999; Shields 1998; Stiger 2001). Most were semi-subterranean, with shallow, saucer-shaped floors. Superstructures were diverse, incorporating upright poles, cribbed logs, and lighter materials in a variety of configurations Many incorporated adobe daub. Other Archaic-period structure types include wickiups (timbered lodges) and masonry surface structures (Black 1990). Hoefer (1999) attributes some stone enclosures in the Rio Grande basin to Archaic occupation of the region, but no radiocarbon dates are available to confirm this. Middle Archaic pithouses occur in northwest New Mexico, south of the San Juan River (Lipe and Pitblado 1999). In southwest Colorado, basin houses with upright-pole superstructures, but lacking adobe packing, first appeared in the Late Archaic or Basketmaker II periods (Billman et al. 1997; Lipe and Pitblado 1999).

One hallmark of regional Archaic assemblages is the diversity of associated projectile point types (Mullen 2009; Reed and Metcalf 1999). Many Archaic point styles were produced over long periods of time and many well-dated components incorporate multiple styles. As Reed and Metcalf (1999:86) observe, “broad series show some patterning, but the rule is for diversity within sites and temporal periods.” For the San Juan Mountains, this problem is compounded by the routine application of style names linked to sequences originally developed for sites in adjacent regions, including the northern Southwest, the Great Basin, and the Plains. In view of the chaotic diversity of Archaic point types in the Southern Rockies, it is likely that projectile point morphology there provides little or no information on inter-regional cultural connections (Stiger 2001).

Post-3000 B.P. Period

Diversity characterizes the Late Archaic and Late Prehistoric archaeology of the San Juan Mountains region. Much of what is known about this period comes from habitation sites located in the lower foothills and major stream valleys surrounding the mountains. To the south, the introduction of maize horticulture between 2950 B.P. and 2450 B.P. prompted increasing sedentism, though the degree to which Basketmaker II groups relied on maize is debated (Lipe 1999). Architectural features south of the mountains varied, ranging from simple basin houses to somewhat more formal cut-and-fill structures. These sites represent the beginnings of the complex ancestral Puebloan sequence that has been the primary focus of archaeological research carried out in southwest Colorado since the late nineteenth century. Within the sequence, the most intensive use of the lower foothills of the San Juans occurred during the Pueblo I period, especially during the late A.D. 700s and early A.D. 800s (Potter 2010; Wilshusen 1999).

Reed and Metcalf (1999) partition the Formative era in the Northern Colorado River basin into a set of cultural traditions, including the Fremont, Gateway, Anasazi, and Aspen traditions. All share use of the bow and arrow. With the exception of the Aspen tradition, all of the Northern Colorado basin’s Formative groups relied on maize horticulture to some extent, though it played a lesser role north of the mountains than it did to the south. Architectural features in the north varied in design and construction technology, both within and between traditions. Manufacture and use of ceramic containers varied, with some groups producing high-quality vessels but others making only limited use of pottery. Settlement systems varied: Formative-era people in some areas continued to follow Archaic-era settlement and subsistence patterns but in other areas people were tethered to long-term habitation sites near maize fields. Formative-era projectile point diversity diminished relative to that of the Archaic.

As is true of the Archaic, relatively little is known about the Late Prehistoric, or Ceramic, stage in the Rio Grande basin (Martorano 1999a). Maize horticulture was probably not possible in the Colorado portion of the basin. The available data suggest that the San Luis Valley and adjacent foothills and mountains were used both by indigenous hunter-gatherers and by groups who maintained long-term residences farther south along the Rio Grande or to the east in the Arkansas River basin. Logistical use of the region by numerous outside groups is suggested by the notable diversity of both rock art motifs and ceramic styles. The largest concentration of Late Prehistoric sites occurs on the floor of the San Luis Valley, especially along San Luis and Saguache creeks. Most of these sites are central-place foraging camps. A number exhibit evidence of repeated re-occupation. Architectural features, consisting of circular stone enclosures, occur primarily, though not exclusively, on the west side of the valley, especially along Saguache Creek (Bevilacqua et al. 2007; Mitchell 2012).

Aggregate population rose dramatically both north and south of the mountains during the Late Prehistoric. In the Northern Colorado basin, population peaked at about A.D. 1000 then began declining slowly. To the south, ancestral Puebloan population waxed and waned locally, but likely reached a regional peak in the late A.D. 1100s to mid-A.D. 1200s, immediately prior to a sharp decline in the late A.D. 1200s (Lipe and Varien 1999).

Post-A.D. 1300 Period

Ute bands were the primary occupants of the San Juan Mountains region after A.D. 1300. Utes, or related Numic-speaking peoples, first appeared in the region around A.D. 1100 (Reed 1994), though debate continues both on the timing of their arrival and on their relationships, if any, to earlier Formative or Late Prehistoric groups (Reed and Metcalf 1999). By the late 1600s or early 1700s the Utes were the dominant cultural group in the San Juans. Shoshonean groups, who also speak a Numic language and used a similar suite of material goods (apart from their distinctive pottery style), occupied areas north of the Yampa River. Athapaskan-speaking peoples lived on the San Juans' southern flank beginning in the mid-1500s or possibly earlier, and may have traveled through or periodically visited areas to the north. One of the most important Navajo sacred sites is a peak in the La Plata Mountains (Wilshusen and Towner 1999). Various groups visited the San Luis Valley and the eastern flank of the San Juans after A.D. 1300, including ancestral Puebloans, multiple Apachean groups, Utes, Comanches, Navajos, and possibly other peoples (Cole 2008; Martorano 1999b; Mitchell 2012; White 2005).

Post-A.D. 1300 projectile point styles include triangular side-notched and unnotched arrowpoints. Documented architectural features include conical timber lodges, brush wickiups, forked-stick hogans, and possibly circular stone enclosures (Martorano 1999b; Reed and Metcalf 1999; Wilshusen and Towner 1999). A variety of ceramic types are associated with post-A.D. 1300 sites, including Uncompahgre Brown ware (commonly associated with Ute occupations); Intermountain ware (Shoshonean); Navajo Gray, Dinetah Gray, and Gobernador Polychrome (Navajo); Biscuit B (Rio Grande Pueblo); and numerous micaceous types (Apachean and Rio Grande Pueblo) (Brunswig et al., eds. 1995; Crosser et al. 2008; Eiselt and Darling 2012).

Environmental Context

Elevation is the single most important factor affecting ecological patterning in the San Juan Mountains region. Mean annual temperature decreases and precipitation increases as elevation increases, though cold-air drainage patterns, slope aspect, and prevailing winds also affect species distributions (table 1.2). Elevation-dependent temperature and precipitation values together produce a regular sequence of ecological zones ringing the mountains. Lower-elevation areas support grassland, shrubland, and pinyon-juniper woodland biotic communities (Adams and Peterson 1999). Above 2,000 m, the San Juan foothills support a ponderosa pine-Douglas-fir forest. The lower sections of this ecozone also feature fruit-bearing shrubs and a variety of grasses, while the upper sections feature large mammal species that hunter-gatherers commonly targeted. A spruce-fir forest occurs between about 2,500 m and 3,500 m. Many of the plant and animal species found at lower elevations also occur in this ecozone, but at this higher altitude the forest often is denser and less productive. The highest-elevation life zone in the San Juans, the alpine tundra, occurs above 3,500 m. Economically important plants grow at this altitude, but often in small, low-density patches. Important animal species found in the tundra zone include deer, elk, and bighorn sheep. Table 1.3 lists animal species currently present for all or part of the year in Hinsdale County, in the north-central portion of the San Juans. Table 1.4 lists faunal remains recovered from archaeological sites in the Gunnison River basin, north of the San Juans.

The surface geology of the western San Juan Mountains is complex (Kelley 1957). Precambrian rocks are exposed in the highest peaks. To the west, north, and south, the mountains are ringed by Paleozoic and Mesozoic sedimentary formations that are intruded by Cenozoic igneous formations. Mesozoic Morrison formation rocks west and south of the mountains contain orthoquartzites and cherts. Chert also occurs in the Paleozoic Leadville Limestone; a notable source of this material is the Mosca Creek quarry on the upper tributaries of the Piedra River (Jodry 1999a). Orthoquartzite sources are abundant in the Gunnison River basin (Black 2000). Exposed bedrock in the eastern San Juans consists largely of Cenozoic (Oligocene) ash-flow tuffs and rhyolites. Secondary cherts and chalcedonies occur in these formations, including at the quarry adjacent to Uncompahgre Cirque. Similar chert outcrops occur on the west side of the San Luis Valley in the La Garita Mountains, in the Saguache Creek Valley, and the Cochetopa Hills (Black 2000; Mitchell 2012).

Table 1.2. Climate records for five weather stations within and adjacent to the San Juan Mountains (Western Regional Climate Center 2012).

	Weather Station				
Variable	Durango	Ridgeway	Lake City	Silverton	Wolf Creek Pass
Period of Record	1894-1991	1982-2012	1905-2010	1899-2012	1957-2001
Elevation (m)	1,988	2,103	2,640	2,837	3,312
Average Max. Temperature (F)	62.6	60.3	55.3	52.2	45.9
Average Min. Temperature (F)	30.1	25.5	22.7	18.4	21.5
Average Total Precipitation (in.)	18.98	17.13	14.24	24.49	45.39
Average Total Snow Fall (in.)	68.7	84.9	83.5	156.1	435.6

Table 1.3. Mammal species currently present in Hinsdale County (Natural Diversity Information Source 2012).

Common Name	Scientific Name	Abundance
American Badger	*Taxidea taxus*	Uncommon
American Beaver	*Castor canadensis*	Fairly Common
American Elk	*Cervus elaphus*	Abundant
American Marten	*Martes americana*	Uncommon
American Pika	*Ochotona princeps*	Common
Big Brown Bat	*Eptesicus fuscus*	Unknown
Bighorn Sheep	*Ovis canadensis*	Fairly Common
Black Bear	*Ursus americanus*	Fairly Common
Bobcat	*Lynx rufus*	Uncommon
Bushy-tailed Woodrat	*Neotoma cinerea*	Fairly Common
Colorado Chipmunk	*Tamias quadrivittatus*	Fairly Common
Common Muskrat	*Ondatra zibethicus*	Common
Common Porcupine	*Erethizon dorsatum*	Uncommon
Coyote	*Canis latrans*	Common
Deer Mouse	*Peromyscus maniculatus*	Abundant
Ermine	*Mustela erminea*	Uncommon
Golden-mantled Ground Squirrel	*Spermophilus lateralis*	Fairly Common
Gunnison’s Prairie Dog	*Cynomys gunnisoni*	Fairly Common
Hoary Bat	*Lasiurus cinereus*	Unknown
House Mouse	*Mus musculus*	Abundant
Least Chipmunk	*Tamias minimus*	Common
Little Brown Myotis	*Myotis lucifugus*	Abundant
Long-eared Myotis	*Myotis evotis*	Unknown
Long-legged Myotis	*Myotis volans*	Unknown
Long-tailed Vole	*Microtus longicaudus*	Fairly Common
Long-tailed Weasel	*Mustela frenata*	Uncommon
Lynx	*Lynx canadensis*	Very Rare
Masked Shrew	*Sorex cinereus*	Fairly Common
Mink	*Mustela vison*	Uncommon
Montane Shrew	*Sorex monticolus*	Common
Montane Vole	*Microtus montanus*	Common
Moose	*Alces alces*	Rare
Mountain Cottontail	*Sylvilagus nuttallii*	Fairly Common
Mountain Goat	*Oreamnos americanus*	Casual/Accidental
Mountain Lion	*Felis concolor*	Uncommon
Mule Deer	*Odocoileus hemionus*	Abundant
Northern Pocket Gopher	*Thomomys talpoides*	Common
Northern River Otter	*Lutra canadensis*	Very Rare

Table 1.3. Mammal species currently present in Hinsdale County (continued).

Common Name	Scientific Name	Abundance
Pine Squirrel	*Tamiasciurus hudsonicus*	Fairly Common
Raccoon	*Procyon lotor*	Fairly Common
Red Fox	*Vulpes vulpes*	Fairly Common
Ringtail	*Bassariscus astutus*	Unknown
Silver-haired Bat	*Lasionycteris noctivagans*	Common
Snowshoe Hare	*Lepus americanus*	Fairly Common
Southern Red-backed Vole	*Clethrionomys gapperi*	Fairly Common
Striped Skunk	*Mephitis mephitis*	Fairly Common
Water Shrew	*Sorex palustris*	Uncommon
Western Jumping Mouse	*Zapus princeps*	Fairly Common
Western Small-footed Myotis	*Myotis ciliolabrum*	Unknown
White-tailed Jackrabbit	*Lepus townsendii*	Common
Wolverine	*Gulo gulo*	Extirpated
Yellow-bellied Marmot	*Marmota flaviventris*	Unknown

Table 1.4. Mammal species recovered from archaeological contexts in the Gunnison River basin (data from Rood and Stiger 2001:Table 4.1).

Common Species Name	Taxon
Cottontail	*Sylvilagus* sp.
Jackrabbit or hare	*Lepus* sp.
Chipmunk	*Neotamias* sp.
Marmot	*Marmota* sp.
Ground Squirrel	*Spermophilus* sp.
Prairie Dog	*Cynomys* sp.
Pocket Gopher	*Thomomys* sp.
American Beaver	*Castor canadensis*
Mouse	*Peromyscus* sp.
Woodrat	*Neotoma* sp.
Vole	*Microtus* sp.
Canid	*Canis* sp.
Bear	*Ursus* sp.
American Badger	*Taxidea taxus*
Elk	*Cervus canadensis*
Mule Deer	*Odocoileus hemionus*
Pronghorn	*Antilocapra americana*
American Bison	*Bison bison*
Bighorn Sheep	*Ovis canadensis*

Paleoenvironment

Paleoenvironmental reconstructions derived from a variety of proxy data, including tree rings and sediment cores from lakes and fens, are available for a number of locations within and adjacent to the San Juan Mountains (Adams and Peterson 1999; Carrara 2011; Jodry 1999b; Reed and Metcalf 1999).

Pinedale (Wisconsinin) glaciers began retreating from the San Juans about 16,000 B.P. and had disappeared entirely by about 10,500 B.P. (Carrara 2011). Holocene climate in western Colorado is strongly influenced by the position of the Southwest monsoon boundary; south and east of the boundary more than half of total annual precipitation falls during the warm season (a summer-dominant regime), while north and west less than half does (winter-dominant) (Mitchell 1976). The position of this boundary, well north of the San Juans, has been relatively stable throughout the Holocene (Feiler et al. 1997). From roughly 8000 B.P. to 4000 B.P., the climate of the San Juan Mountains region was warmer and wetter than at present (Adams and Peterson 1999; Carrara 2011). By comparison, conditions were warmer and drier in northern Colorado, and in the Central Plains to the east, after 7300 B.P. (Reed and Metcalf 1999). Late Holocene reconstructions for the north are variable and, in some cases, conflicting. Some records point to cooler and drier conditions between 4600 B.P. and 2000 B.P., while others suggest higher effective moisture. In the south, conditions were cooler and drier after 4000 B.P. Climate change in the last 2,000 years has affected the extent of the dry-farming belt south of the mountains, but generally was smaller in scale than earlier shifts (Adams and Peterson 1999).

Climate change affected the upper limits of the San Juans' subalpine forest. In the early to mid-Holocene, from about 9200 B.P. until 5800 B.P., timberline and upper treeline in the San Juans was at least 80 m, and possibly as much as 140 m, higher than at present (Carrara 2011). Treeline likely was near its present position between 5400 B.P. and 3500 B.P. Treeline may have declined below its modern elevation after 3500 B.P. Peterson (1988) describes a sequence of small-scale fluctuations in treeline in the La Plata Mountains after 2800 B.P.

2

Archaeological Field Investigation

The 2010 fieldwork incorporated two major activities: intensive investigation of a portion of the Uncompahgre Cirque site and pedestrian inventory of a section of the upper Nellie Creek valley west of Uncompahgre Cirque.

Uncompahgre Cirque Site Investigations

The Uncompahgre Cirque site is located on a sloping bedrock bench that descends gradually from a narrow ridge projecting eastward from Uncompahgre Peak toward the center of the Nellie Creek valley (figure 2.1). At one time, both glacial and post-glacial deposits entirely mantled this bench. Currently, bedrock is exposed on the bench's southern end and only discontinuous patches of the original tundra-clad loess deposit or turf bank remain intact (figure 2.2). Much of the current site surface consists of a lag formed in a thin till deposit. A groundwater-fed spring drains the swale west of the bench, leaving the elevated site area comparatively dry. A rock glacier spills into the upper end of the swale, suggesting that the channel is ancient (figure 2.3). Cobbles in the spring channel are stained on all surfaces by minerals dissolved in the groundwater, likely including both iron and manganese. *In situ* pebbles and cobbles in the till beneath the site are stained only on their lower surfaces.

As recorded in 2010, the site covers 1.15 ha (2.8 ac), an area slightly smaller than was first estimated in 2007. Artifacts are scattered throughout this area but are visible primarily in four concentrations or loci (figure 2.4). Locus 1 is an oblong area 50 m long (northeast-southwest) and 25 m wide (northwest-southeast), or roughly 980 sq. m. The research team did not attempt to inventory the artifacts visible on the surface in Locus 1, which easily number in the thousands. Items present include flaking debris, cores, and tools. Chert from the ridge-top quarry located to the north dominates the assemblage but a wide variety of imported raw materials also is present, including obsidian, basalt, quartzite, rhyolite, and non-local cherts.

Locus 2 is approximately 40 m northeast of Locus 1, and slightly higher on the bedrock bench. This small artifact concentration is scattered over an eroded area

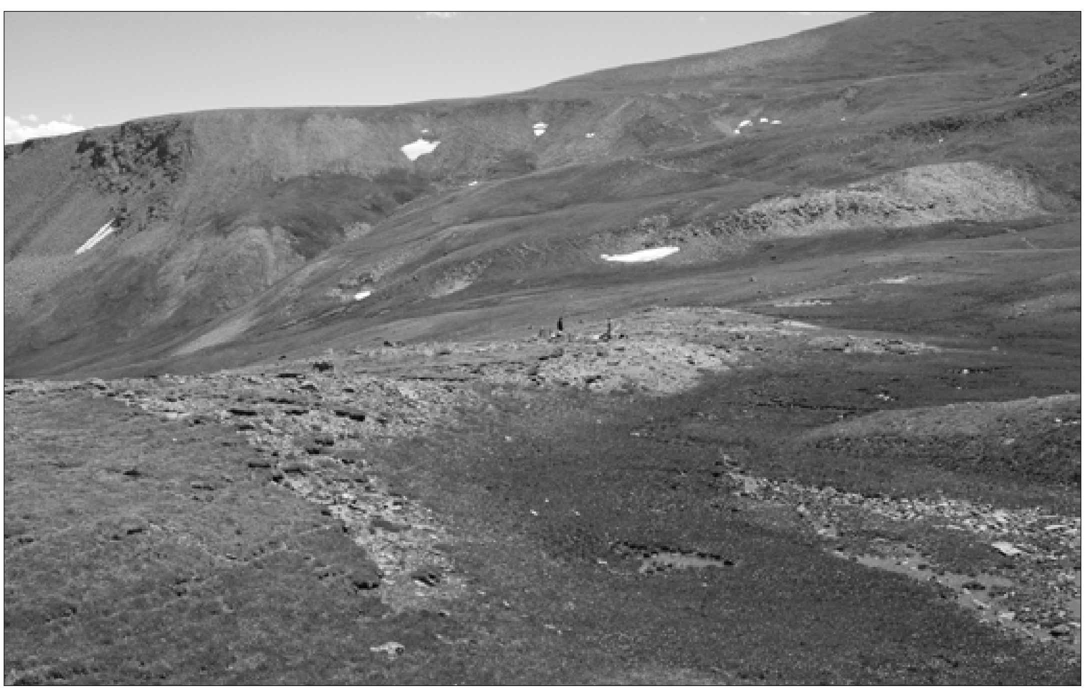

Figure 2.1. Overview of the Uncompahgre Cirque site, looking south.

Figure 2.2. Remnant turf bank at the Uncompahgre Cirque site.

Figure 2.3. The rock glacier spilling into the swale west of the Uncompahgre Cirque site.

roughly 10 m in diameter and includes a yellow chert scraping tool and a black chert biface. Locus 3 consists of about a dozen artifacts located below a low knoll immediately west of the bedrock bench. A yellow, mottled chert scraping tool was collected from Locus 3 (CN1238). Locus 4, on the northeast end of the site, consists of roughly 100 black chert flakes in an eroded area about 5 m in diameter.

A light- to moderate-density scatter of artifacts occurs outside these defined concentrations, on and adjacent to the bedrock bench. Additional unrecorded artifact concentrations are located higher on the bench, northeast of the mapped site boundary, as well as on a second bench, down valley to the southeast.

The four loci comprising the site are conterminous with major breaks in the turf bank and few artifacts occur on the upper surface of the loess blanket where it is visible in minor gaps in the tundra. This pattern indicates that the most recent occupation of the site largely or wholly pre-dates the most recent episode of sediment deposition. A similar pattern can be seen at a larger scale throughout the upper Nellie Creek valley: artifacts are visible on surfaces composed of deflated till or bedrock, but not in areas where the loess deposit is largely intact.

Mapping and Surface Collection

The research team selected Locus 1, the largest and densest artifact concentration, for intensive study. Three methods were used to document its extent and content: intensive surface mapping, controlled surface collection, and limited subsurface testing. Horizontal and vertical control for these tasks were provided by a metric grid system oriented to true north, which at the time of the fieldwork was 10 degrees, 2 minutes west of magnetic north. The principal datum, consisting of an aluminum-capped, 2-foot steel rod, was set on the southwest edge of Locus 1; its coordinates are arbitrarily designated 300NE100, Z100.000. A backsight, also consisting of a steel rod with an aluminum cap, was placed at 287.536NE93.071, Z99.658 (HzA 209°4’15”); this backsight position is a mean value derived from seven measurements. Positions within the grid were measured with a Nikon DTM-A10 total station. Owing to technical difficulties with the total station’s datalogger, measured coordinates were recorded by

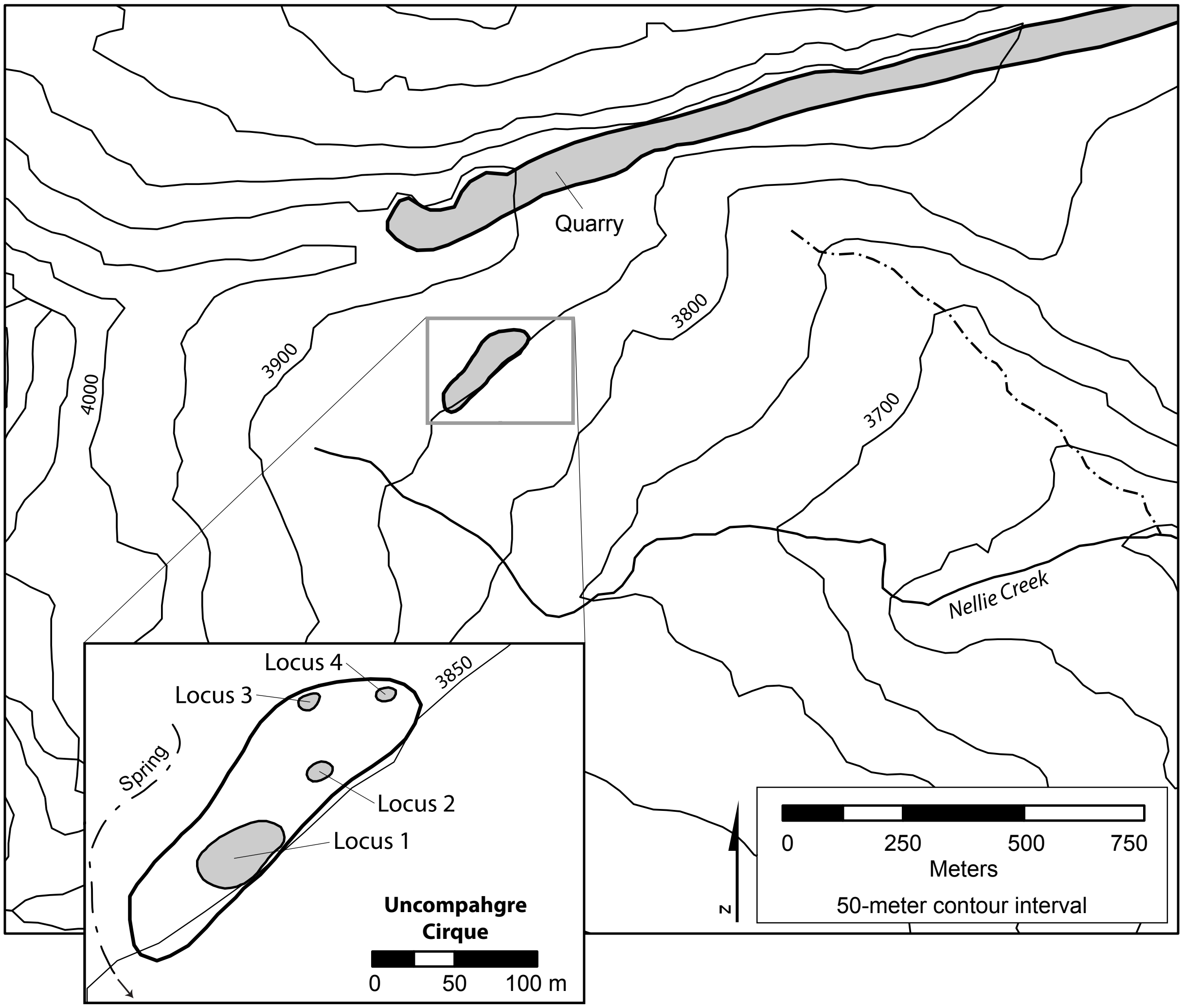

Figure 2.4. Map of the upper Nellie Creek valley showing the location of the Uncompahgre Cirque site.

hand in a surveyor's notebook, then entered into an Excel spreadsheet following the conclusion of the fieldwork.

The topographic map of Locus 1 is derived from 159 measured positions (figure 2.5). These positions include scattered topographic shots, points taken along the Locus 1 boundary, piece-plotted surface artifact locations, and the center points of features exposed on the surface. Positions were taken along the perimeters of the two remnant turf patches in Locus 1 and on the corners of the six excavation units but these points were not used in the topographic map.

Two remnant patches of tundra-clad loess occur in Locus 1. The north turf bank covers roughly one-third of the locus. The south turf bank is just one-tenth as large. Surface artifacts are particularly abundant around the south turf bank. However, artifact density varies greatly across Locus 1, ranging from about 5 to 10 artifacts per sq. m up to roughly 100 per sq. m. Artifact density is markedly lower on the slopes bounding the bedrock bench to the northwest and southeast.

Surface Collection

The Locus 1 surface assemblage includes individually plotted specimens, an unprovenienced grab sample, and artifact lots from three flaked stone concentrations. An intensive survey was carried out in 2010 to identify temporally diagnostic specimens and items made from imported raw materials, especially obsidian. These artifacts were plotted and collected under individual catalog numbers. In a few cases, two to four closely spaced obsidian artifacts were collected under a single catalog number. The unprovenienced grab sample consists of 19 specimens picked up in 2007 when the site was first documented, in addition to a single projectile

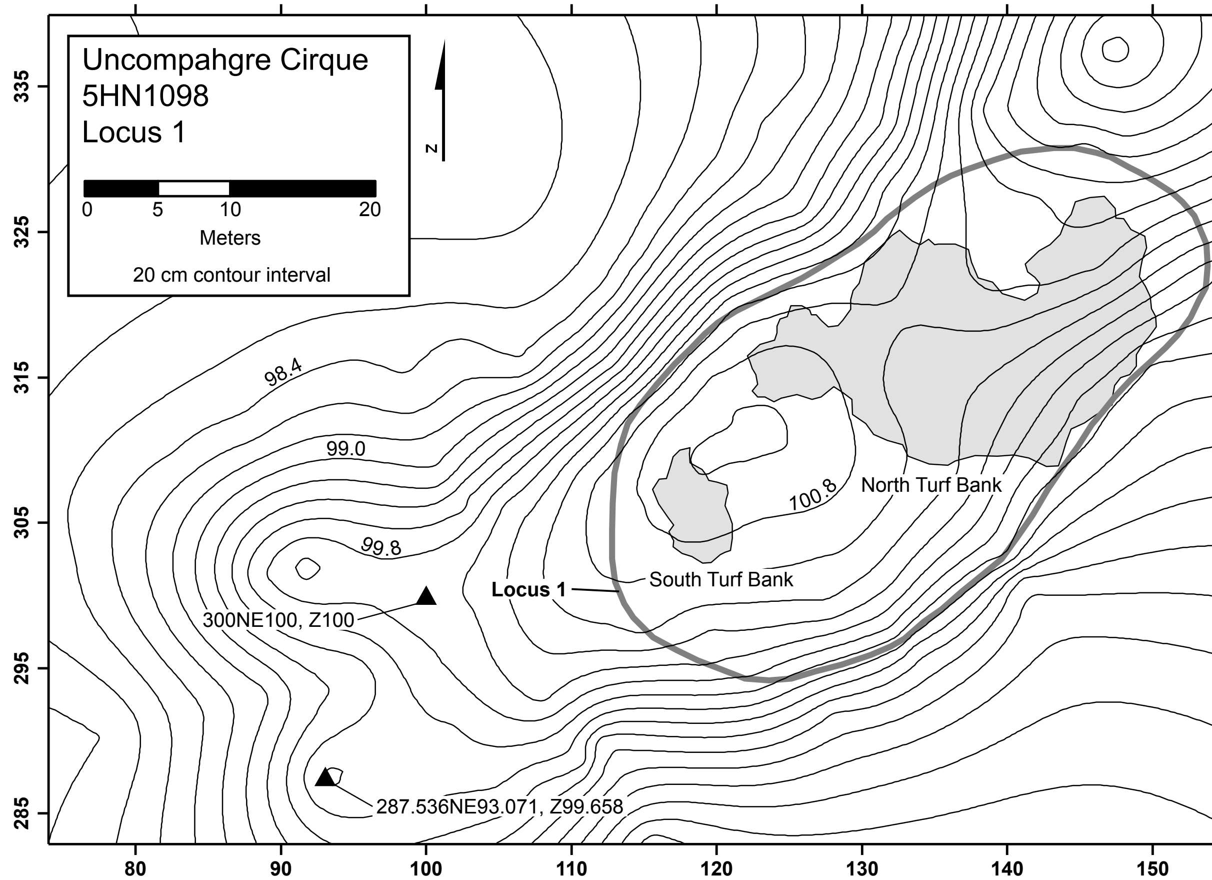

Figure 2.5. Topographic map of Locus 1.

point picked up in 2010. Summary data on individually plotted and unprovenienced specimens are presented in table 2.1. Few patterned tools occur in the surface collection. This may be due to casual collecting; the well-used trail to Uncompahgre Peak is roughly 75 m south of the site's southwest boundary and a connector spur to the Big Blue Creek trail traverses the site.

Surface Features

The crew identified three notably dense, compact clusters of flaking debris and tools (figure 2.6). All artifacts visible on the surface within these features were collected by hand. Unconsolidated surface sediment was carefully searched to maximize artifact recovery but was not screened. Table 2.2 summarizes data on these three chipped stone features.

The three surface artifact concentrations share a number of properties. Their boundaries are well marked; a small number of artifacts occur outside them, but each feature was easily defined and mapped in the field. Each concentration exhibits a central zone in which most of the flakes and tools occur. The compactness of these features suggests that erosion of the turf bank was due

Table 2.1. Counts of plotted and unprovenienced artifacts in the Locus 1 surface collection.

	Plotted Specimens		Grab Sample (CN1236 and CN1239)	
Raw Material Group	Stone Tools	Flaking Debris	Stone Tools	Flaking Debris
Obsidian	14[a]	50		
Other imported material	12	5	2	6
Local chert	3		4	8
Total	29	55	6	14

[a] One obsidian tool exhibits two technological cases.

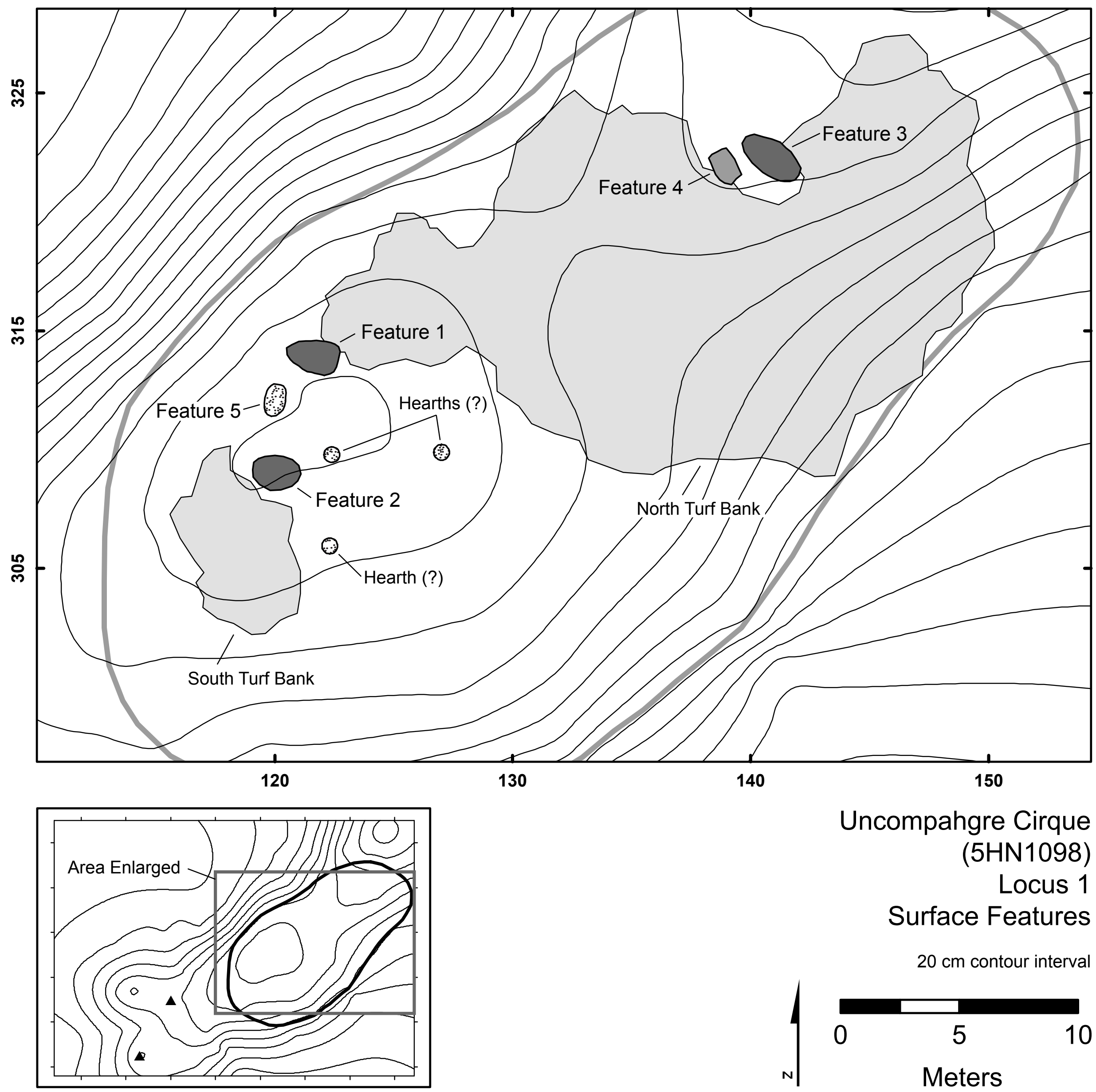

Figure 2.6. Topographic map of Locus 1 showing the locations of surface features.

Table 2.2. Summary data on three chipped stone surface features.

Feature	Catalog Number	Area (sq. m)	Flaking debris		Stone Tools	
			Count	Weight (g)	Count	Weight (g)
1	1066	3.3	476	1145.5	13[a]	113.7
2	1098	2.7	293	813.7	1	3.2
3	1151	3.1	340	776.2	28[b]	551.6

[a] Two of the 13 tools exhibit two technological cases.
[b] Two of the 28 tools exhibit two technological cases.

mainly to aeolian deflation rather than sheet wash. Recent activities, including recreation and grazing, may also have affected the loess deposit, but lateral movement of artifacts appears to have been minimal. The compactness of these three features further suggests that they represent either isolated reduction events or individual dumps of waste flakes and exhausted tools. Small portions of two concentrations (Feature 1 and Feature 3) remain entrained in the lower part of the turf bank, indicating a similar stratigraphic origin and perhaps age for both. The primary difference among the feature assemblages is the predominant color of the chert used to produce them.

Feature 1 consists of 489 artifacts mostly made from dark gray to black chert. The feature is located on the west edge of the northern turf patch and covers roughly 3.3 sq. m, measuring 250 cm east-west and 170 cm north-south (figures 2.7 and 2.8). The majority of the specimens were recovered from a central concentration covering 1.1 sq. m. An unknown, but likely small, number of artifacts still remain in the turf cap on the feature's northeast side.

Feature 2 is located roughly 5 m south-southwest of Feature 1, on the north edge of the southern turf bank (figure 2.9). It consists of 294 specimens recovered from an area measuring roughly 165 cm north-south and 205 cm east-west (2.7 sq. m). The artifacts comprising Feature 2 are made mostly from tan- to olive-colored chert. The full extent of Feature 2 is exposed on the eroded surface.

Feature 3 consists of 368 artifacts concentrated in 3.1 sq. m on the north side of the north turf bank (figure 2.10). The edges of Feature 3 are somewhat less well defined than those of Feature 1 or Feature 2, but its central concentration is equally dense. Raw material diversity is greater in Feature 3, though the majority of the recovered artifacts were made from yellow chert.

Five other surface features were also documented in Locus 1 (figure 2.6). A cairn is located immediately west of Feature 3 (figure 2.10). Designated **Feature 4**, the cairn measures approximately 120 cm east-west and 100 cm north-south and is made from five stacked rocks set against a bedrock boulder. The largest placed stone measures 53 cm wide, 47 cm high, and 18 cm thick, and exhibits mineral staining on the upper surface, indicating that it was overturned (figure 2.11). The four other rocks making up the cairn measure 30 to 35 cm across and are wedged between the bedrock boulder and the large, placed upright. The cairn's age is unknown, but the extent of lichen growth on the placed stones indicates that it was not constructed recently.

Remnants of one definite and three possible hearth features were observed on the lag surface between the

Figure 2.8. The central concentration of flaking debris in Feature 1.

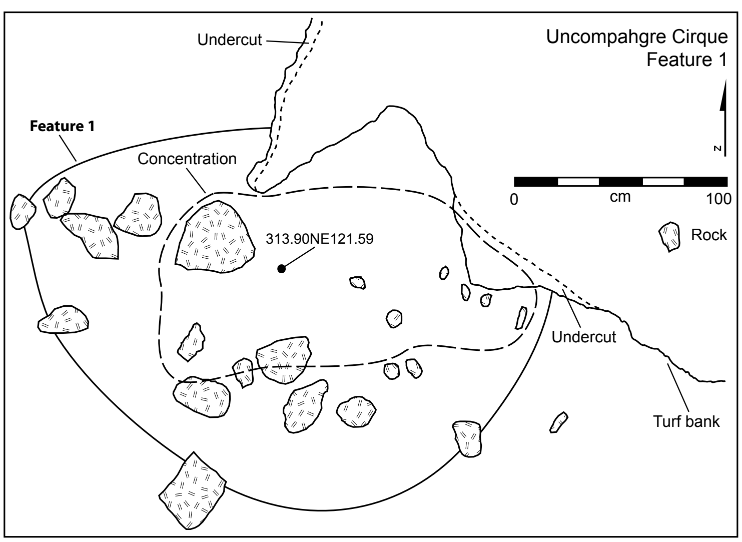

Figure 2.7. Plan map of Feature 1.

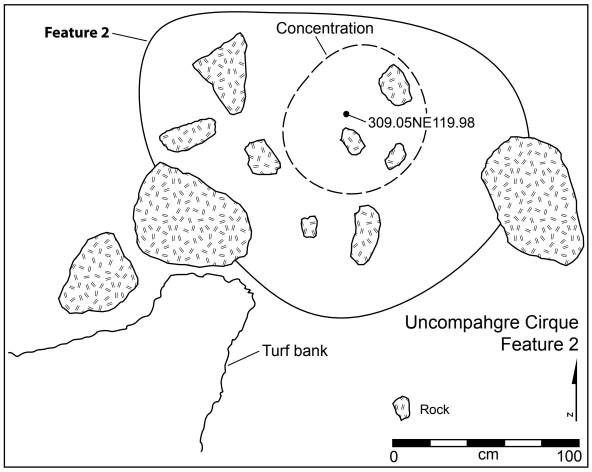

Figure 2.9. Plan map of Feature 2.

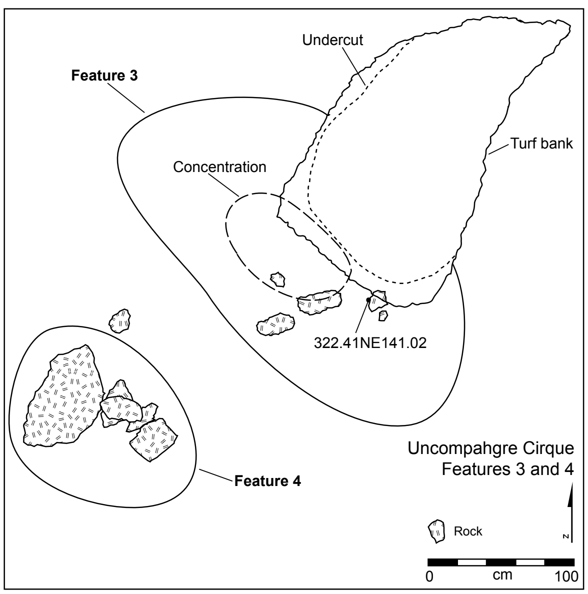

Figure 2.10. Plan map of Feature 3.

Figure 2.11. The Feature 4 cairn.

northern and southern turf banks. **Feature 5** is the lower part of a basin hearth. The remaining portion measures roughly 125 cm across and is marked by charcoal-stained sediment and a scatter of fire-reddened stones. The hearth's stratigraphic origin is not preserved, but the data suggest that it likely was constructed from the lower section of the loess deposit. If so, Feature 5 would originally have been about 15 cm deep.

Three other possible hearth remnants, each between 60 and 100 cm in diameter, were documented on the lag surface east of the Feature 2 chipped stone concentration. The southernmost of these, located just east of the southern turf bank, is associated with several burned flakes and till cobbles. Only a few burned stones and no burned flakes occur within the other two, which are slightly smaller.

Test Excavations

The crew opened up a total of six test units: two in the small southern turf bank, three in the larger northern turf bank, and one in the eroded area between them (figure 2.12). Five of the six units measured 50 x 50 cm; the sixth measured 1 x 1 m. The smaller size was chosen to minimize post-excavation erosion of the remnant tundra (figure 2.13). Table 2.3 summarizes data on each of the six test units.

With the exception of EU5, the main factors used to select the location for each test unit were the composition, density, and distribution of nearby surface artifacts. Eroded sections of the turf bank adjacent to each test unit were also examined for evidence of charcoal, burned rocks, or unusual stratigraphy. The position of EU5 was chosen to capture data on the remnants of the Feature 5 hearth (figure 2.14).

With the exception of EU2, local vertical control for each excavation square was provided by a large spike located in the unit's southwest corner and driven flush with the ground surface. Vertical control for EU2 was tied to a spike in the southeast corner. Excavation depths were measured from a string tied to the top of each spike, which was designated as that unit's "surface datum" (identified as SD in the excavation unit descriptions that follow). Horizontal positions were measured within each excavation unit and so were not tied directly to the site-wide grid system in the field. However, coordinate data were collected on each unit's local datum and grid positions of plotted artifacts from subsurface contexts were calculated during the analysis.

PCRG excavation methods distinguish between "general" excavation levels (designated GL in the excavation unit descriptions), which include all materials recovered from each excavation increment within a test unit, and "feature" levels (FL), which only

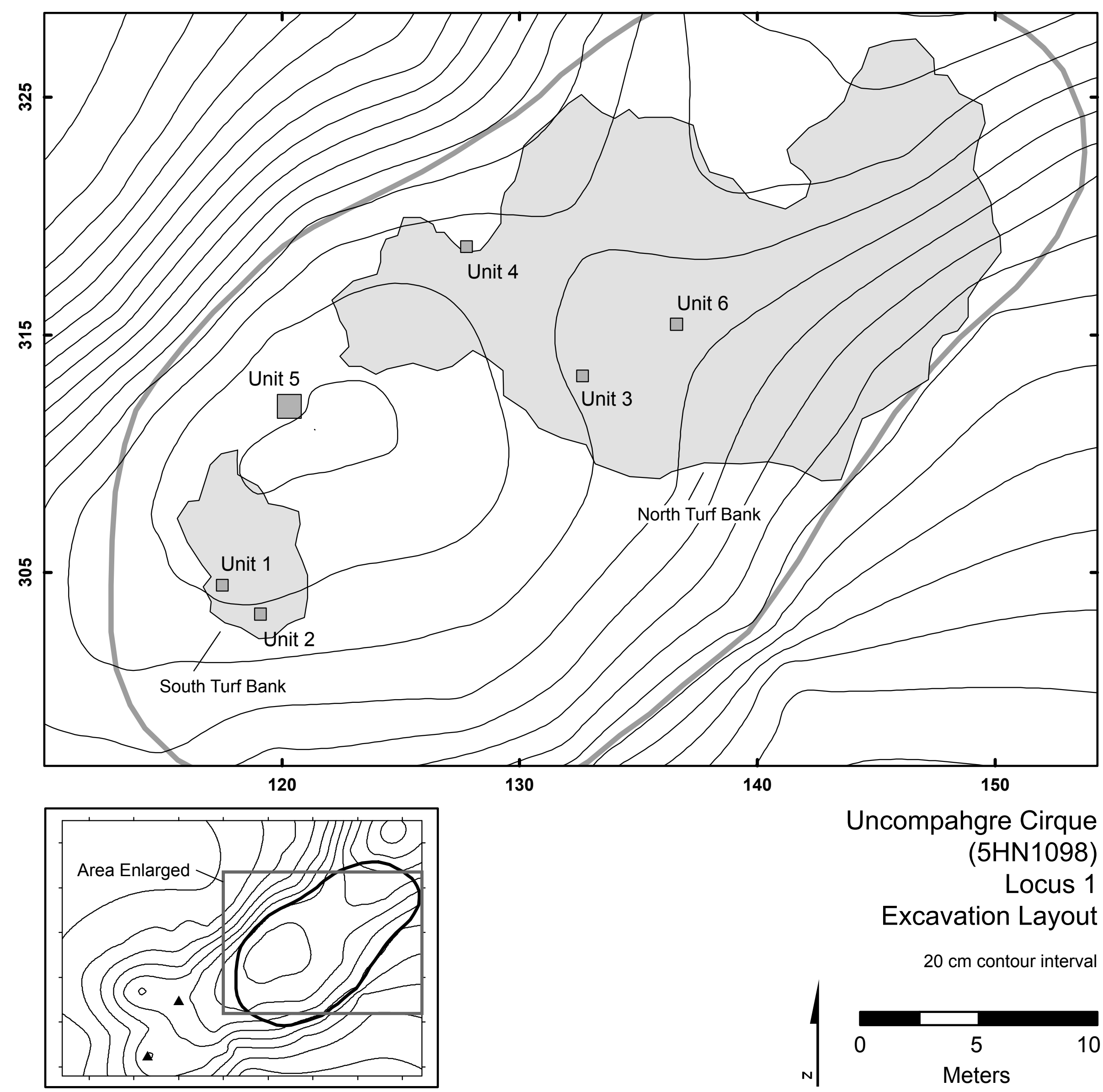

Figure 2.12. Topographic map of Locus 1 showing the locations of excavation units.

Table 2.3. Provenience and other data on six test excavation units in Locus 1.

EU No.	Unit Size (cm)	SW Corner Coordinate	Local Surface Datum Location	Local Surface Datum Elevation	Number of General Levels	Excavated Volume (liters)
1	50x50	304.22NE117.25	SW	101.071	6	87.5
2	50x50	303.01NE118.86	SE	101.011	8	130.6
3	50x50	313.02NE132.41	SW	100.724	5	72.5
4	50x50	318.46NE127.52	SW	100.853	6	73.6
5	100x100	311.48NE119.81	SW	101.080	3	132.0
6	50x50	315.18NE136.35	SW	100.510	3	47.5
Total						543.7

Figure 2.13. Work in progress in EU3.

include material from a defined and numbered cultural feature. The fill of the single excavated feature, Feature 5, was too disturbed to excavate separately and so all levels in all test units are defined as general levels, or GL. Excavation levels varied in thickness. The first level of each excavation unit, except EU5, was 10 cm thick, owing mainly to the difficulty of cutting through the alpine tundra and to the hummocky, uneven character of the modern surface. All subsequent levels were 5 cm thick, except for the deepest levels in EU1, EU2, and EU4, which penetrated the culturally sterile glacial till underlying the turf bank and were 10 cm thick. All levels in EU5 were 5 cm thick.

Excavation was carried out entirely with trowels, brushes, and other small hand tools. Excavated sediment was transferred to 5-gallon plastic buckets and transported to a central screening station. All excavated sediment was passed through ¼-inch hardware cloth.

Figure 2.14. John Johnson and Stephanie Anderson working in EU5.

Sediment passing through the screen was collected on black plastic tarps and used later for backfilling.

Excavation data were recorded on pre-printed level forms. In addition to basic provenience data, the forms include spaces for the excavators to write short narratives describing the sediment and artifacts observed and to discuss problems or unusual situations encountered during the work. Excavators drew a plan map of the base of each level and digital photographs were taken of representative levels. The project field supervisor drew at least three profiles of each excavation unit. Digital photographs also were taken of the work in progress. An on-site, provenience- and recovery-based field catalog was maintained. Catalog numbers were assigned to each arbitrary level when excavation began and all of the objects recovered during screening were grouped under that number. Individual catalog numbers were also assigned to each piece-plotted artifact.

On the project's final day each of the excavation units was lined with black plastic, backfilled with screened sediment, and armored with large stones to minimize erosion.

Excavation Unit 1

EU1 is located on the west edge of the south turf bank. A dense scatter of artifacts occurs on the deflated till surface to the west. Prior to excavation, roughly two-thirds of the ground surface within the unit was covered with a dense tundra mat. The sediment below the root mat consists of dark brown silt with few artifacts (figure 2.15). A small number of pea-sized pebbles is present. The tops of several cobbles roughly 5 cm in diameter were observed at the base of GL1, 10 cm below the modern ground surface.

Artifact density increases in GL2 (10-15 cm SD) but sediment color and texture is similar. Near the top of GL3, at about 15 to 17 cm below the modern surface, the sediment becomes lighter and slightly redder. Artifact density is also higher. The number of cobbles increases, as does their size. In GL4 (20-25 cm SD) and GL5 (25-30 cm SD) the number of artifacts drops off significantly and the number of larger blocks increases. A filled marmot burrow covers the northern third of the unit below 25 cm SD. The upper surface of the till, which consists of lighter sediment with higher proportions of both sand and clay, undulates slightly and occurs between 30 and 38 cm SD. The contact between the loess cap and the till is partly obscured by the marmot burrow.

No artifacts were recovered from GL6 (30-40 cm SD). Numerous pebbles and cobbles of various sizes occur at this depth, along with pockets of sand and clayey silt.

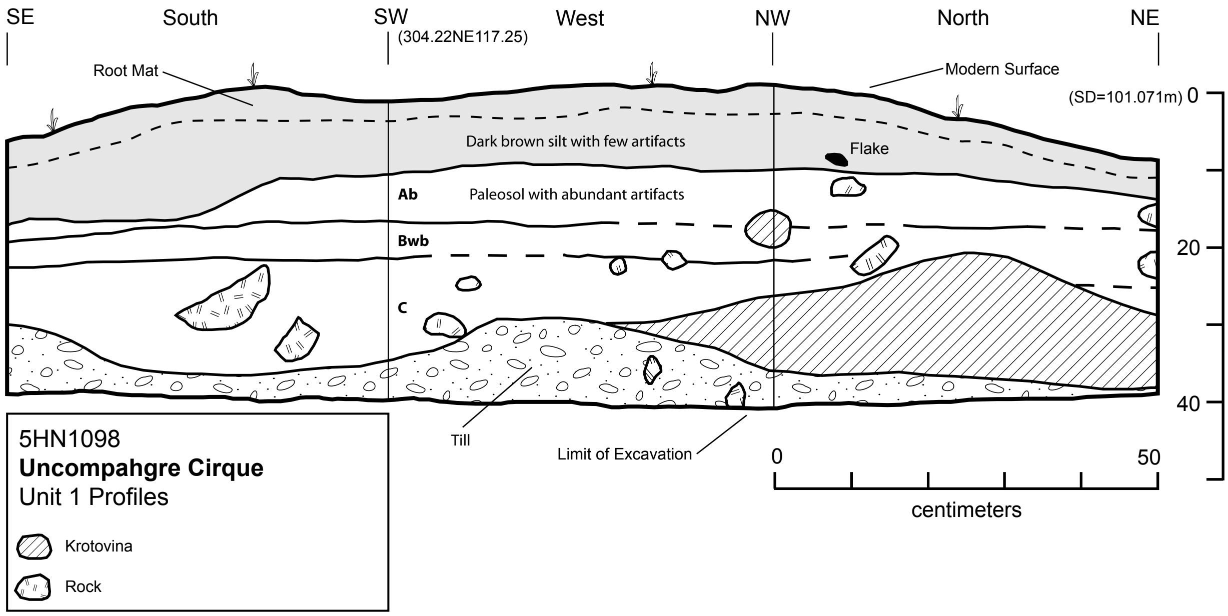

Figure 2.15. Excavation Unit 1 profiles.

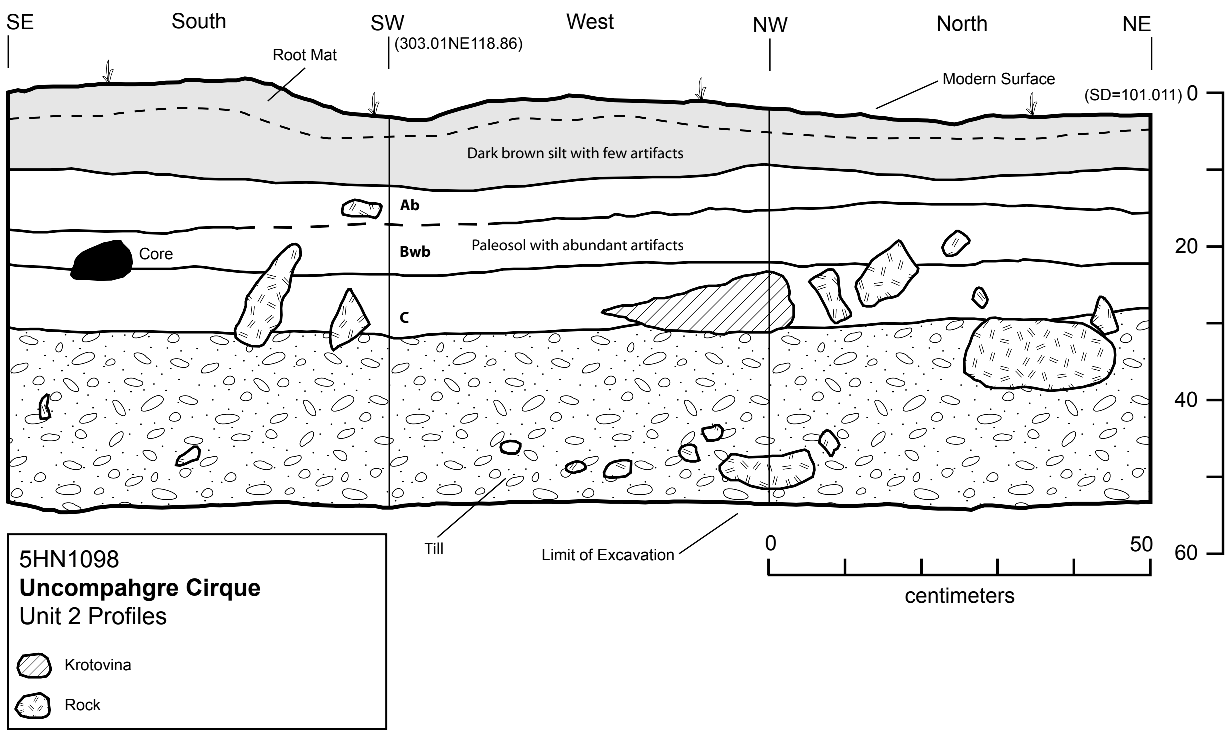

Figure 2.16. Excavation Unit 2 profiles.

Excavation Unit 2

EU2 is located about 2 m southeast of EU1. Artifacts occur abundantly on the eroded till surface to the west, east, and south. Eighty percent of the ground surface inside the unit was covered with tundra before excavation began. The sediment encountered in GL1 (0-10 cm SD) is similar to that seen in EU1; however, artifact density is higher and the number of larger rocks is lower in EU2 (figure 2.16). In GL3 (15-20 cm SD) the artifact density decreases and the number of small and large pebbles increases. The frequency of large cobbles further increases in GL4 (20-25 cm SD).

Excavators encountered a clear stratigraphic break separating the upper loess cap from the underlying till deposit at about 28 cm SD, in GL5. The till contains more sand and clay and more small and large pebbles and cobbles. Subrounded blocks up to 20 cm long also occur in the till. Excavation continued into the till to a depth of to 55 cm SD. No further stratigraphic changes were observed and no artifacts were recovered from GL6, GL7, or GL8.

Excavation Unit 3

EU3 sampled the north turf bank, about 15 m northeast of EU1 and EU2. Like the excavation units in the south turf bank, the ground surface inside EU3 was nearly covered with a dense tundra mat prior to excavation. An eroded pocket in the tundra just north of EU3 contains abundant flaking debris.

The texture and content of the sediment encountered in GL1 (0-10 cm SD) are similar to the uppermost levels in EU1 and EU2: a few artifacts are present, along with a few pea-sized pebbles, in a dark brown silt matrix (figure 2.17). GL2 (10-15 cm SD) contains a few more artifacts than GL1 and GL3 (15-20 cm SD) contains many more. Several 5- to 10-cm-long cobbles also occur in GL3.

Artifacts are very abundant in GL4 (20-25 cm SD) and GL5 (25-30 cm SD). Below about 22 cm SD the silt matrix is slightly lighter. The number of larger, angular cobbles also increases below this depth. Many of these rocks are stacked or partly overlapping (figure 2.18). Artifacts occur abundantly on and around these larger stones, as do flecks and small chunks of charcoal. Charcoal was not seen in equivalent strata in EU1 or EU2.

The contact between the loess cap and the underlying till was encountered on the south side of EU3 at about 28 cm SD. The contact dips slightly to the north. Excavation stopped at the base of GL5 (25-30 cm SD). Only a few small krotovina were observed in EU3.

Excavation Unit 4

EU4 is 7 m northwest of EU3, on the eroded north edge of the north turf bank. This location was selected for excavation because a burned rock was observed in the west profile and several other burned stones are present nearby on the partly eroded loess surface, along with a few flecks of charcoal.

The strata exposed in EU4 are similar to those encountered in EU1 and EU2 (figures 2.19 and 2.20). GL1 (0-10 cm SD) contains a moderate number of artifacts in a gray silt matrix. The majority of the artifacts recovered from EU4 occurred in GL2 (10-15 cm SD) and GL3 (15-20 cm SD). The number of rocks increased significantly in GL3. Several of these exhibit evidence of burning, but an intact hearth feature was not encountered. In both GL2 and GL3 artifacts occur mostly on the east side of the unit, while rocks occur mostly on the west. Two filled marmot burrows are present, one in the southeast corner of the unit between 10 and 20 cm SD and the other in the northwest corner and west wall below 20 cm SD.

Just two artifacts were recovered below 20 cm SD and none below 30 cm SD (GL4 and GL5). The contact between the loess cap and the till was observed at roughly 30 cm SD.

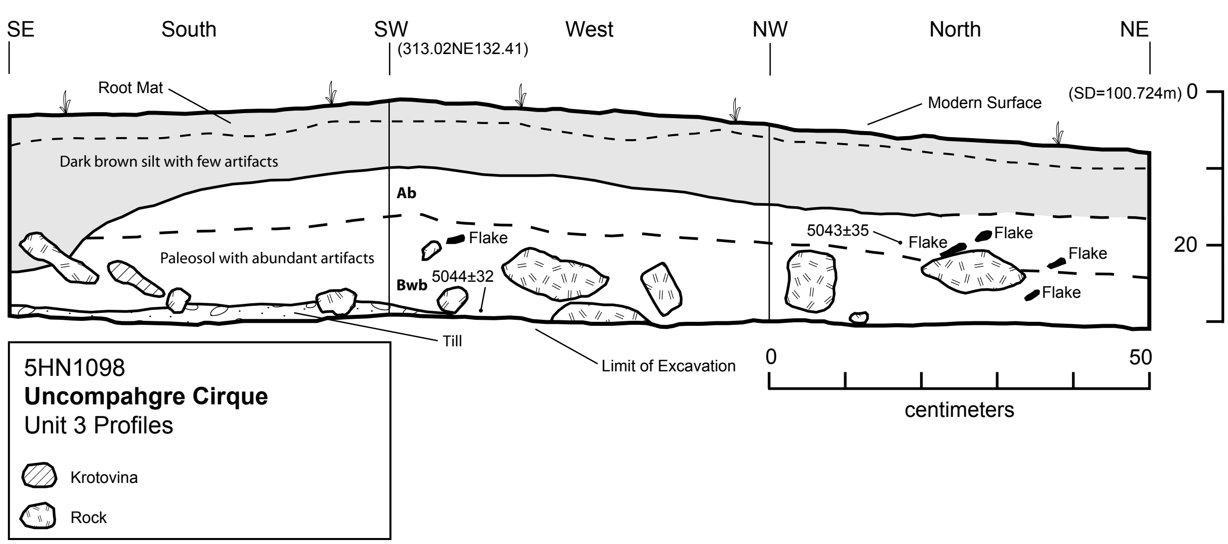

Figure 2.17. Excavation Unit 3 profiles.

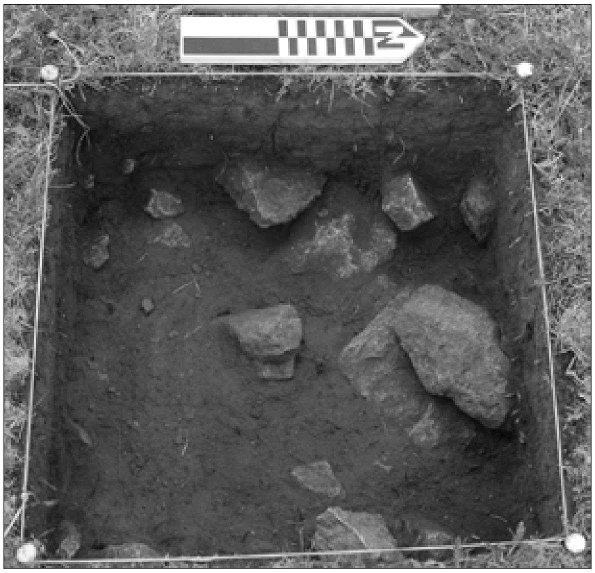

Figure 2.18. Larger cobbles at the base of GL5 in EU3.

Excavation Unit 5

EU5 is a 1 x 1-m unit located in the eroded area between the north and south turf banks. The unit was positioned to investigate the east half of a deflated hearth designated Feature 5. Vegetation within the unit prior to excavation consisted of sparse bunch grasses and forbs.

The remnants of the hearth consist of a dense cluster of heated and burned stones (indicated by their conspicuous red color and angular shapes) surrounded by dark gray silt containing abundant flecks and small chunks of charcoal. This gray silt matrix rests directly on both till and on the base of the loess cap (figure 2.21). Some of the rocks in contact with feature fill are broken and friable, while others are simply charcoal-stained on their upper surfaces. The hearth's perimeter could not be defined on the modern ground surface but was mapped at the base of GL2 (5-10 cm SD) (figures 2.22 and 2.23). Judging by the distribution of burned stones and charcoal-stained sediment, the hearth's center was originally located in the northwest corner of EU5, at approximately 312.40NE119.80.

More than half of the artifacts recovered from EU5

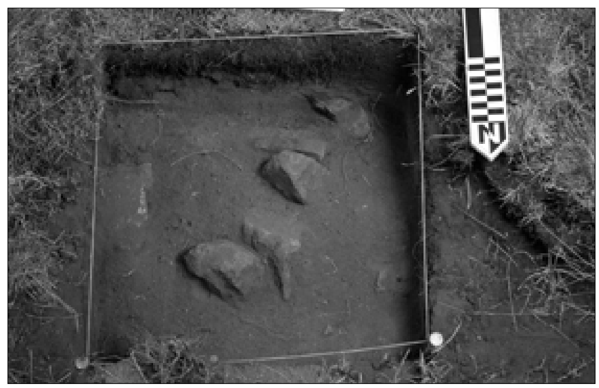

Figure 2.20. Cobbles at the base of GL4 in EU4.

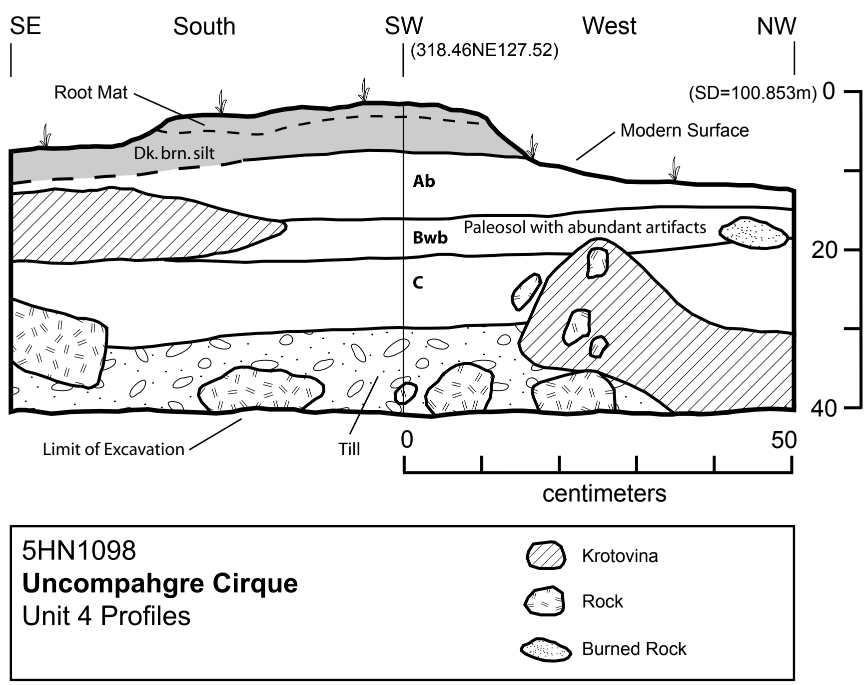

Figure 2.19. Excavation Unit 4 profiles.

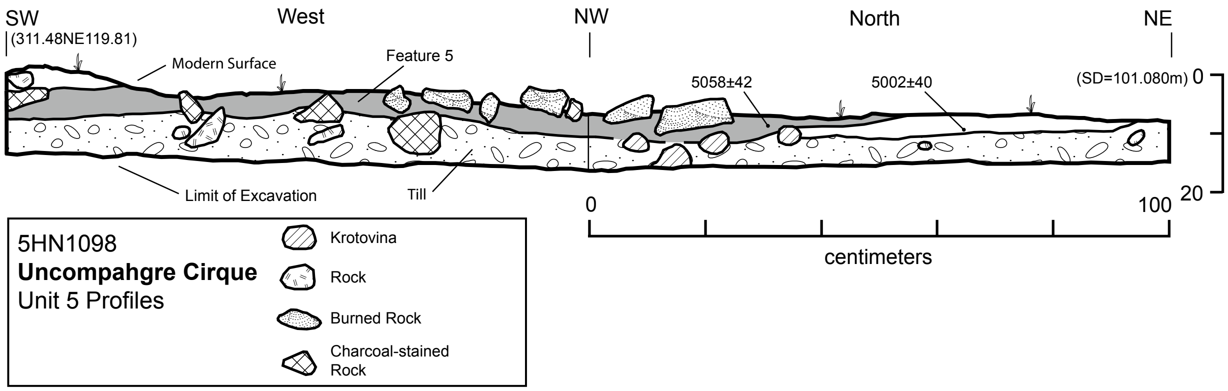

Figure 2.21. Excavation Unit 5 profiles.

Figure 2.22. The remnant of Feature 5 at the base of GL2 in EU5.

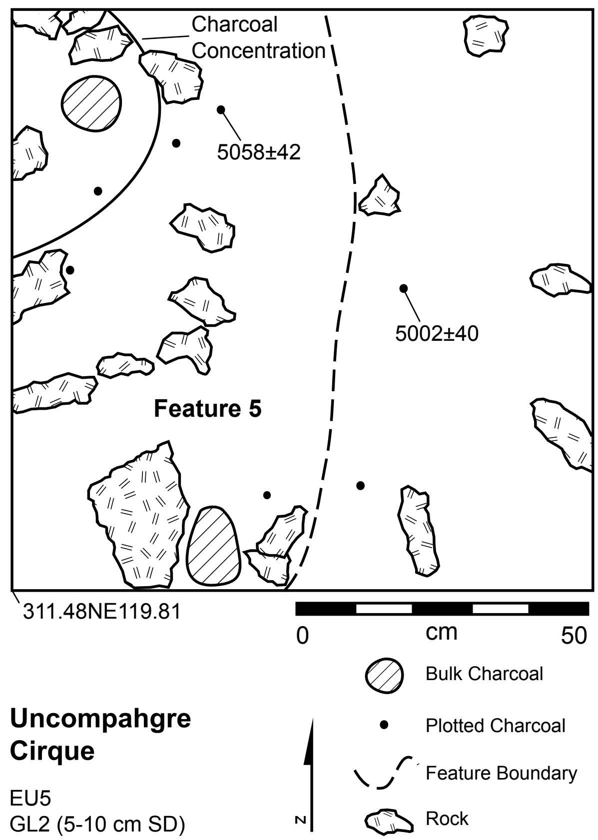

Figure 2.23. Plan map of the base of GL2 in EU5.

occur in GL1 (0-5 cm SD). Only a few are burned. A few small krotovina are present on the features's northeast edge.

Excavation Unit 6

EU6 is near the center of the north turf bank, 4 m northwest of EU3 and 10 m southeast of EU4. An exceptionally dense tundra mat covered the unit prior to excavation. The texture and content of GL1 (0-10 cm SD) are similar to those seen in the first levels of EU1, EU2, and EU3. Roughly one-fifth of the artifacts recovered from EU6 come from GL1, and most of those come from the lower third of the level. The majority come from GL2 (10-15 cm SD) and are especially dense between 14 cm SD and 17 cm SD.

A minor stratigraphic change occurs at about 8 cm SD (figure 2.24). No other breaks were observed and excavation did not reach the upper surface of the till. The tops of several subrounded blocks up to 20 cm across were encountered at 17 to 18 cm SD. Charcoal flecks and chunks occur in the lowest exposed stratum.

Stratigraphic Summary

Both pedogenic horizons and lithostratigraphic units occur in the deposits investigated in 2010. Three strata, partitioned into five horizons, are present (table 2.4). These strata and horizons are best expressed in EU2, but also occur in EU1 and EU4 (figure 2.25). The strata and horizons encountered in EU3 and EU6 differ somewhat from those encountered in the other three tundra units.

The uppermost stratum consists of very dark gray to dark brown silt capped by dense alpine vegetation. The tundra's dense root mat is 2 to 5 cm thick. The root mat was screened, but very few artifacts were recovered. The upper stratum is commonly 10 cm thick but is up to 20 cm thick in the southeast corner of EU3, due either to ancient burrowing or to erosion of the underlying stratum. Artifact density within this stratum varies from roughly 0.36 flakes/liter to 2.38 flakes/liter. This upper stratum may represent organic-rich silt deflated from melting snowbanks.

Beneath this stratum is a paleosol formed in minimally re-worked loess. The upper surface of the loess undulates slightly and the modern ground surface generally follows these undulations. The paleosol's Ab horizon is black to very dark brown and contains a few small cobbles. Artifact density ranges from 2.4 flakes/liter to 10.8 flakes/liter. The boundary between this Ab and the underlying Bwb is clear in EU1, EU2, and EU4 but gradual in EU3. The Ab-Bwb contact was not observed in EU6. Artifact density is highly variable in the Bwb horizon, ranging from less than 1 flake/liter in EU2 to more than 15 flakes/liter in EU3. Flecks and small pieces of charcoal are present above and below this contact in EU3 and EU4 but not in EU1 or EU2.

Grayish brown to dark grayish brown C-horizon silt occurs in EU1, EU2, and EU4, where it varies from 8 to 15 cm thick. It is not present in EU3. Variation in the thickness of the C horizon is due to undulations in the upper surface of the underlying till and to the extent of local pedogenesis. Few artifacts occur in C horizon sediment: estimated density values range from 0.08 flakes/liter to 0.32 flakes/liter.

This paleosol rests on a pale brown to yellowish brown till deposit. The till is poorly sorted and includes subrounded blocks up to 20 cm across along with lenses of coarse sand and clayey silt. The lower surfaces of larger clasts in the till are uniformly stained with manganese or iron. Artifacts occur close to the upper surface of the till in EU3 (in the Bwb horizon), but no artifacts were observed within the till itself.

The origin of the cobbles present in the lower portion of the loess deposit is not clear. Some cobbles rest directly on or in the underlying till, suggesting a period of deflation following the retreat of the valley glacier but prior to the initiation of loess deposition. However, others are entirely contained within the loess. Some of these may have been displaced from the till when the site's occupants excavated basin hearths or other features.

The overall thickness of the loess cap, including the modern A horizon, is relatively uniform, ranging from 25 cm in EU3, to 28 cm in EU4, to 33 cm in EU1 and EU2. Marmots currently are active on the site and filled marmot burrows were observed in EU1 and EU4. However, smaller krotovina are rare and no evidence of recent activity by small burrowing animals was observed. Pocket gophers are very active near timberline, but do not appear to have impacted the loess deposit at Uncompahgre Cirque.

Stratigraphic Distribution and Orientation of Artifacts

Figure 2.26 illustrates the vertical distribution of artifacts within the five tundra units. The upper panel shows the count proportions of each unit's stone tool and flaking debris assemblage by excavation level. The dotted lines indicate the approximate depth of the Ab-Bwb contact in EUs 1 through 4. The dashed lines indicate the maximum depth of excavation in EU3 and EU6. No artifacts were recovered below 30 cm SD in EU1, EU2, or EU4. The middle panel shows the mean weight of flakes from each excavation level. The bottom panel shows the density of flakes in each of the horizons comprising the loess cap. Density data are only approximate because the position and thickness of the excavation levels were chosen arbitrarily. Data from excavation levels straddling two horizons are omitted.

The majority of the flaking debris and stone tools come from the paleosol. More than half of the EU1 assemblage was recovered from immediately above and below the Ab-Bwb contact, as was more than two-thirds of the EU4 assemblage. Seventy percent of the EU3 assemblage comes from the paleosol's Bwb horizon. The proportions recovered from the modern A horizon range from 1.3 percent in EU3 to 47.9 percent in EU2.

Flakes recovered from the paleosol, particularly those from the lower part of the Ab horizon and the upper part of the Bwb horizon, are heavier on average than those in the modern A horizon (figure 2.26, middle panel). Because periglacial processes tend to move larger artifacts upward through the profile, this distribution suggests that only limited post-occupation translocation has occurred (Benedict 1978). It also suggests that the influence of periglacial processes is muted at Uncompahgre Cirque compared to many alpine settings, likely owing to the limited amount of groundwater flowing though the turf bank and the underlying till.

The greatest number of flakes per liter of excavated matrix occurs in the Ab and Bwb horizons, further indicating that the primary occupation zone is positioned in the middle of the turf bank. Together, these data suggest that the occupation took place while the loess deposit was forming and that the surface represented by the top of the Ab horizon stabilized only later. Thus, the development of soil horizons within the paleosol postdates the period of occupation. This interpretation

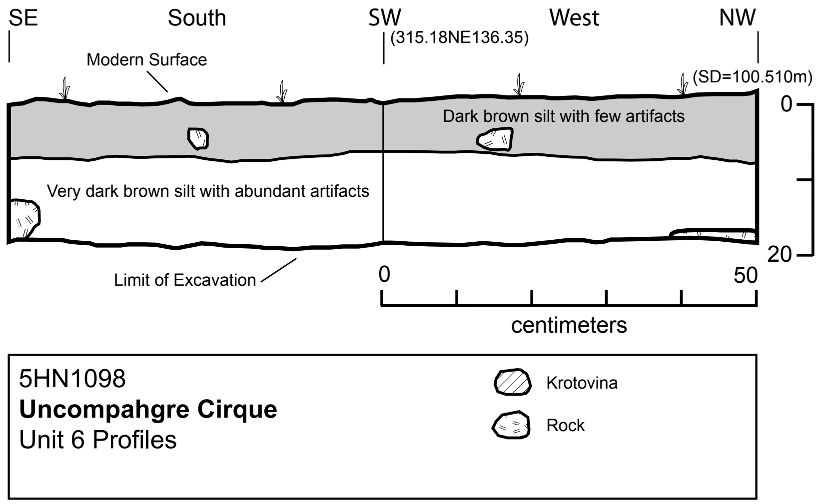

Figure 2.24. Excavation Unit 6 profiles.

Table 2.4. Summary data on strata and horizons.

Stratum	Soil Horizon	Thickness (cm)	Color	Description
1	A	6-20	10YR 3/1—10YR 3/3	Silt loam with sparse fine to medium gravel and a few small cobbles; common fine and medium roots; smooth, abrupt boundary; low to moderate artifact density
2	Ab	4-8	10YR 2/1—10YR 2/2	Silt with a few small cobbles; common fine roots and few medium roots; smooth, clear to gradual boundary; high to very high artifact density
	Bwb	5-10	10YR 3/2—7.5YR 3/2	Silt with larger cobbles; few fine roots; smooth, clear boundary; moderate to very high artifact density
	C	0-15	10YR 4/2—10YR 5/2	Compact silt with larger cobbles; few fine roots; smooth to undulating, very abrupt boundary; low artifact density
3	--	>25	10YR 6/3—10YR 5/4	Glacial till; no artifacts

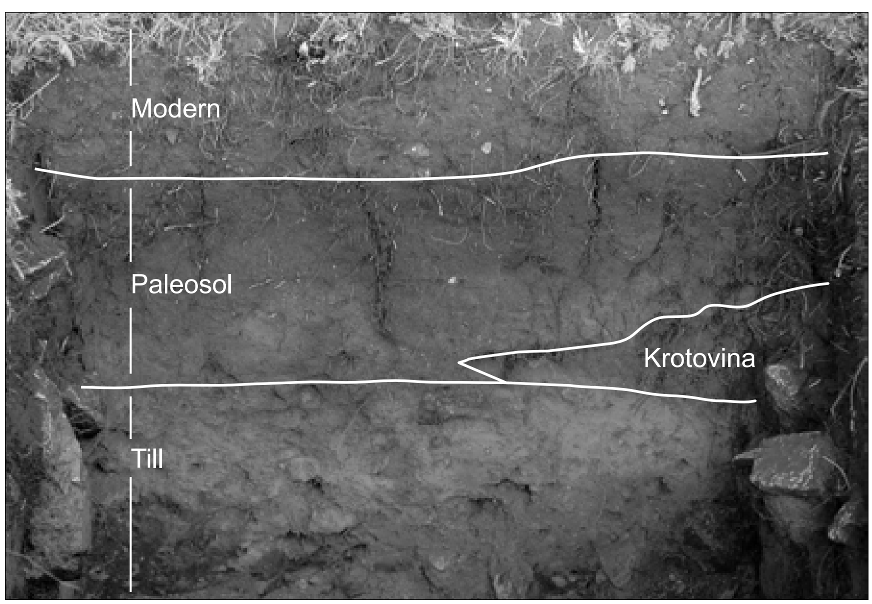

Figure 2.25. The west profile of EU2, showing strata and horizons.

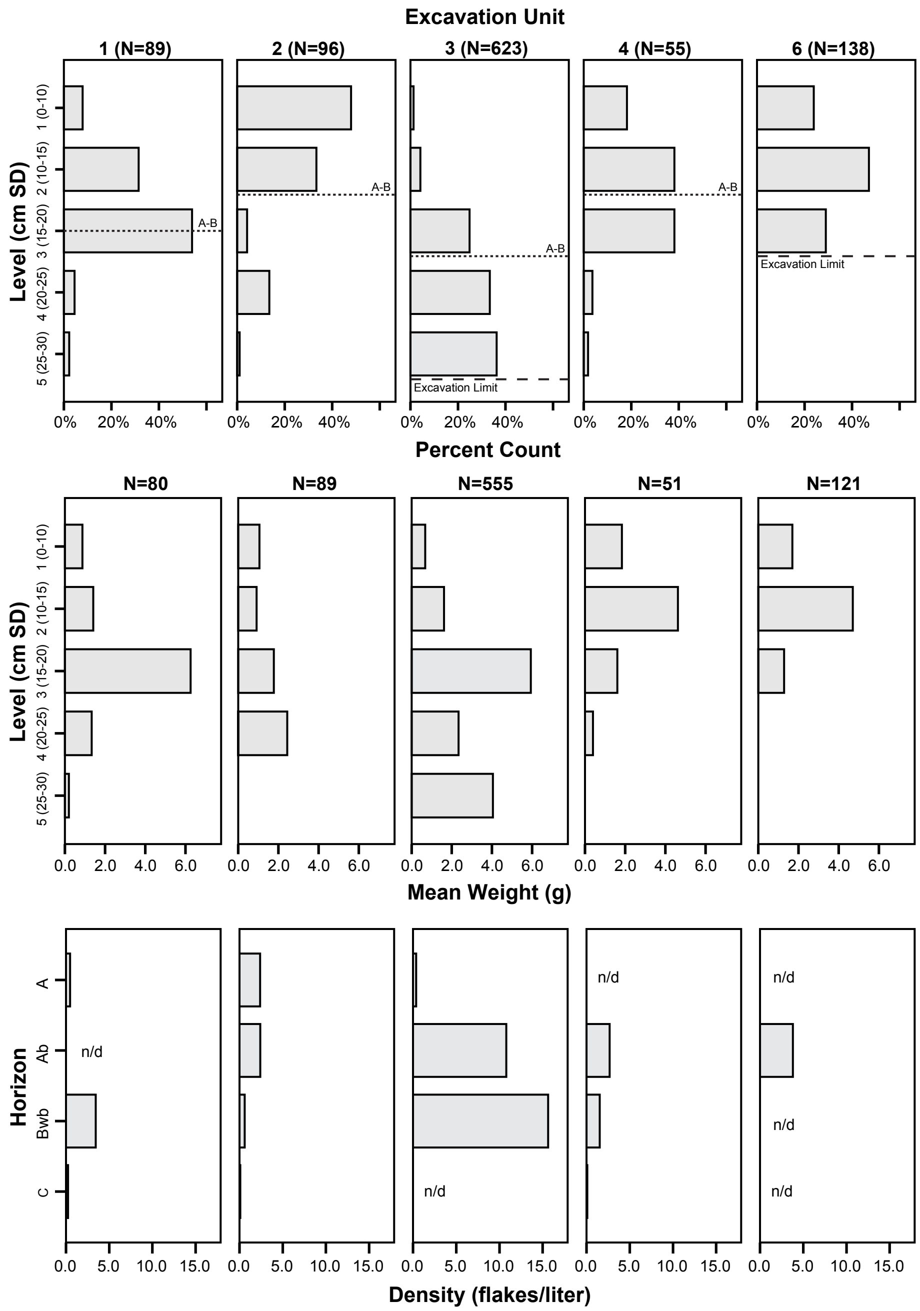

Figure 2.26. Three measures of the vertical distribution of artifacts in five tundra units. See discussion for description of data format.

is bolstered by data on the orientations of artifacts in the deposit (table 2.5). Half of the 52 plotted flakes or tools for which orientation data are available lay flat, while just 15 percent were vertical. Sixty-two percent dip at an angle of less than 30 degrees. These data suggest that artifacts mostly were deposited on a level surface and moved little as they were buried.

Table 2.5. Artifact orientation data.

Dip Increment	Frequency	Percent
0-15°	27	52
15-30°	5	10
30-45°	9	17
45-60°	2	4
60-75°	1	2
75-90°	8	15

Pedestrian Inventory

On July 14 and 15, the field crew carried out a systematic pedestrian survey on approximately 21 ha (52 ac) west of the Uncompahgre Cirque site (figure 2.27). Three- to five-person survey crews documented three sites, defined as artifact concentrations consisting of ten or more items, and two isolated finds (table 2.6). A third isolated find (5HN1139) was documented outside this survey block, adjacent to the hiking trail leading to Uncompahgre Peak. All three sites are open lithic scatters; two contain stone tool fragments in addition to chipped stone flaking debris.

Isolated find **5HN1139** consists of two items: a basal fragment of a stemmed projectile point made from brown quartzite and a flake made from local black chert. The projectile point's extant length is 35.5 mm. The blade originally was slightly wider than 21 mm.

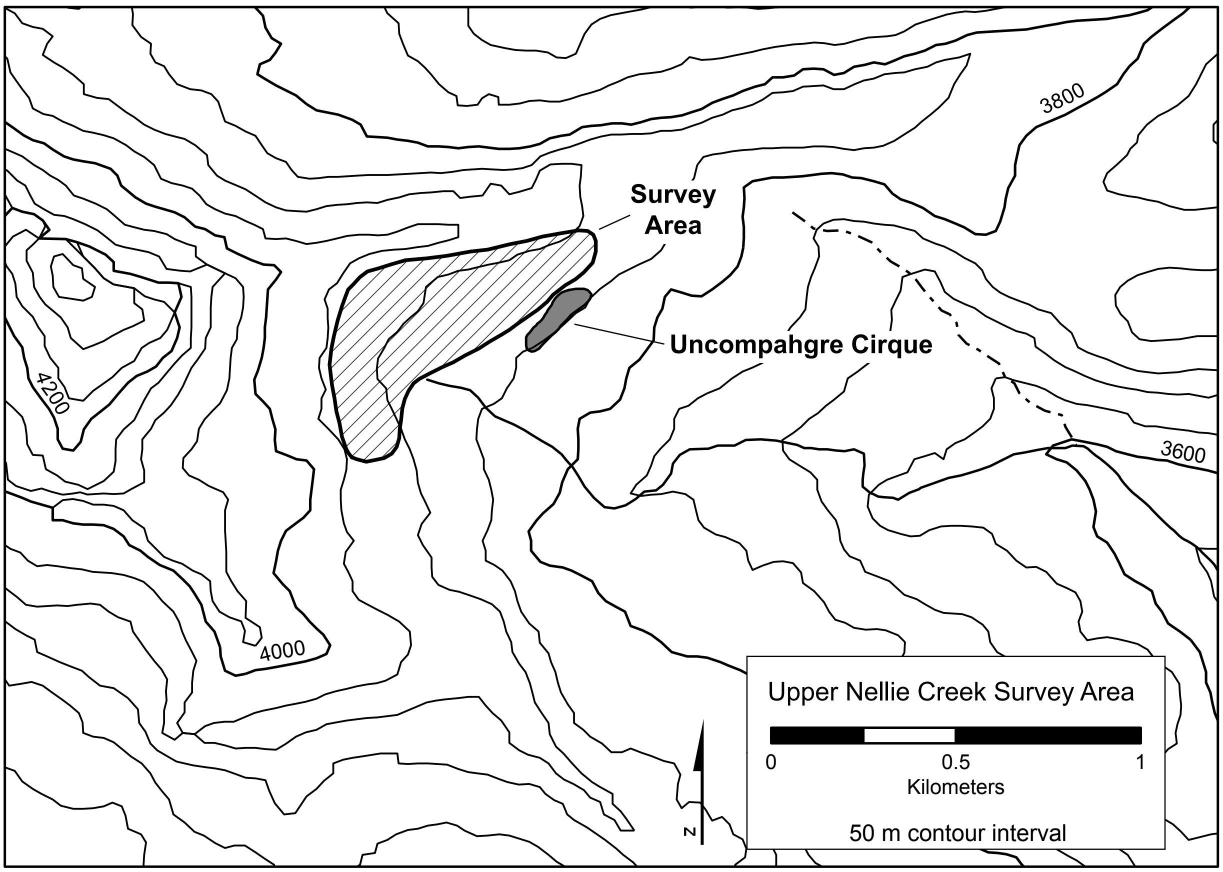

Figure 2.27. Map showing the 2010 survey area.

Table 2.6. Summary data on sites and isolated finds identified during pedestrian survey.

Smithsonian No.	Resource Type	Area	Artifact Inventory	NRHP Eligibility Recommendation
5HN1139	Isolated find	—	1 projectile point (CN2001) 1 flake	Not eligible
5HN1140	Open lithic	179 sq. m	17 flakes 1 core	Needs data
5HN1141	Open lithic	254 sq. m	61 flakes	Needs data
5HN1142	Open lithic	495 sq. m	76 flakes 1 biface (CN2003) 1 flake tool (CN2004)	Needs data
5HN1211	Isolated find	—	8 flakes	Not eligible
5HN1212	Isolated find	—	1 biface (CN2005)	Not eligible

Maximum thickness is 5.5 mm. The stem is slightly "earred." The distal haft width (distal stem) is 16.4 mm and the proximal haft width is 17.5 mm. The stem is rectangular in cross-section, but the blade is lenticular. The lateral edges and base of the stem are ground (figure 3.8[a]).

Morphologically, this point is similar to Pryor Stemmed points from northern Wyoming and southern Montana. However, it does not exhibit the alternate-face blade reworking characteristic of that type (Kornfeld et al. 2010:102). It also does not exhibit the parallel-oblique flaking common to many stemmed Foothills-Mountain complex points (Pitblado 1998).

Isolated find **5HN1211** consists of eight pieces of flaking debris scattered over roughly 100 sq. m. All eight are made from local chert.

Isolated find **5HN1212** is a fragment of an ovoid biface made from brown quartzite. The biface's maximum width is 64.6 mm and its extant length is 53.7 mm. Maximum thickness is 9.6 mm. Light use-wear is intermittently present on the cutting edge. This artifact was collected (CN2005).

Site **5HN1140** consists of 18 artifacts scattered across an area measuring 19 m long and 12 m wide at the edge of a sloping bench. Most of the assemblage, which includes one core and 17 flakes, is concentrated in the bench's eroded edge. Two flakes exhibit evidence of heat treatment. The differential presence of artifacts on the slope break suggests that buried cultural deposits or features may be present elsewhere on the bench.

Site **5HN1141** is a scatter of 61 flakes located on a sloping bench overlooking the Uncompahgre Cirque site. Ten additional flakes smaller than 5 mm were observed but not tallied. Artifacts are concentrated in an eroded area just above the slope break. Artifacts were also observed in marmot backdirt piles, further indicating that buried cultural deposits or features may present. The assemblage includes chert from the nearby quarry as well as four quartzite flakes imported from elsewhere. As much as one-quarter of the local chert flakes were heat treated. No tools were observed.

Site **5HN1142** consists of 76 flakes, one biface fragment, and one flake tool located on a tundra-clad bench. At least 25 more small flakes were noted but not counted. The majority of the documented assemblage (65 items) consists of flakes made from local yellow-brown chert; the crew collected a sample of this material (CN2002). Several of these flakes may be heat treated. One imported artifact, a red quartzite flake, was tallied. The majority of the observed artifacts occur in two discrete concentrations.

The biface fragment, which was collected (CN2003), is an end of an ovoid large patterned biface made from local brown chert with translucent inclusions. The maximum width of the tool is 30.7 mm and the maximum thickness is 7.9 mm. The biface was made on a flake blank and was broken during manufacture. The flake tool also was collected (CN2004). It is made from gray-green local chert and is 27.5 mm long, 15.8 mm wide, and 5.7 mm thick. The dorsal surface is almost entirely retouched, but only a few flakes were removed from the ventral. The function of this tool is unclear.

The three documented sites share a number of attributes. All three are located on benches overlooking the head of the valley. All three site assemblages contain imported raw materials. At all three sites, artifacts are more common where the tundra-capped loess deposit mantling the underlying till or bedrock is partly or wholly eroded. This pattern suggests that the upper Nellie Creek valley harbors many more similar sites, concealed by intact tundra. Despite the fact that each of the sites documented during the survey is much smaller than Uncompagre Cirque, the similarities in depositional context suggest that they may be coeval.

3

Site Chronology and Modified Stone Analysis

This chapter describes and analyzes the flaking debris and stone tool collections. The assemblage under study comprises all materials recovered from the site, including specimens obtained during excavation in 2010 as well as those collected from the surface in 2007 and 2010.

PCRG lab supervisor Chris Johnston designed the minimum analytical nodule analysis (MANA) and collected data on two of the three surface feature aggregates. University of Colorado (CU) anthropology graduate student Jeff Brzezinksi collected MANA data on the third feature aggregate. Morgan Koukopoulos, also a CU graduate student, carried out the initial individual flake analysis. Jenean Roberts conducted the final individual flake analysis. Roberts and Mark Mitchell together analyzed the stone tool assemblage. CU undergraduate anthropology student Thomas Sapin collected mass analysis data on the flaking debris collection. Marvin Goad illustrated selected stone tools. Mitchell supervised the analyses and wrote the chapter, with input from Johnston.

Site Chronology

Radiocarbon, obsidian hydration, and stratigraphic data are combined in this section to assess the site's age and occupation duration. Twenty-one charcoal samples were recovered from three excavation units, including 14 piece-plotted fragments and seven hand-picked bulk samples. Nineteen of these samples were analyzed to determine the species represented (Bach 2010). Each sample was examined under a SWIFT SM80 binocular microscope (10-40X) and identified with the aid of a comparative charcoal collection and wood identification manuals (Core et al. 1979; Hoadley 1990). Appropriate precautions were taken to prevent cross-sample contamination in the lab. Charcoal preservation was deemed excellent and no visible evidence of organic or inorganic contamination was noted on either the outer or inner cell walls. Two species were identified: spruce (*Picea* sp.) and willow (*Salix* sp.). One sample (CN1185) is too small to be confidently identified. Three samples, including two willow twigs (CN1174 and CN1176) and one spruce twig (CN1196), exhibit radial cracks in the cell walls indicating that they burned while still green (Boonstra et al. 2006a, 2006b).

Four of the eighteen positively identified samples were selected for AMS radiocarbon dating (table 3.1). Paired samples were chosen from two different contexts: the Feature 5 hearth in Unit 5 and a dense concentration of charcoal and flaking debris in Unit 3. Both hearth samples consist of small-diameter willow twigs burned when green. The Unit 3 samples consist of small-diameter spruce twigs. Dr. Herbert Haas carried out sample pre-treatment and dates were obtained from the Accelerator Mass Spectrometry Laboratory at the University of Arizona. Table 3.2 presents the dating results.

All four dates are statistically equivalent, yielding a weighted mean age of 5038±19 ^{14}C yr B.P. Owing to a shallow plateau in the radiocarbon calibration curve, this mean age spans at two standard deviations the period from 3944 cal B.C. to 3776 cal B.C., or a total of 168 calendar years (figure 3.1).

Stratigraphic and obsidian hydration data together can be used to gauge the duration of the occupation within this span. Eighty-two artifacts made from obsidian were recovered during the field investigation, including 14 from subsurface contexts and 68 from the surface. Sixty-five of these are flakes and 17 are tools, one of which exhibits two technological cases. A total

Table 3.1. Provenience and other data on charcoal samples submitted for AMS radiocarbon dating.

Catalog No.	Unit	GL	North (cm)	East (cm)	Depth (cm)	Species	Weight (g)	Diameter (mm)	Comment
1161	3	4	47	16	20	*Picea* sp.	.07	--	
1174	5	2	83	36	9	*Salix* sp.	.05	5	Burned when green
1176	5	2	52	67	10	*Salix* sp.	.10	4	Burned when green
1202	3	5	13	16	29	*Picea* sp.	.30	13	

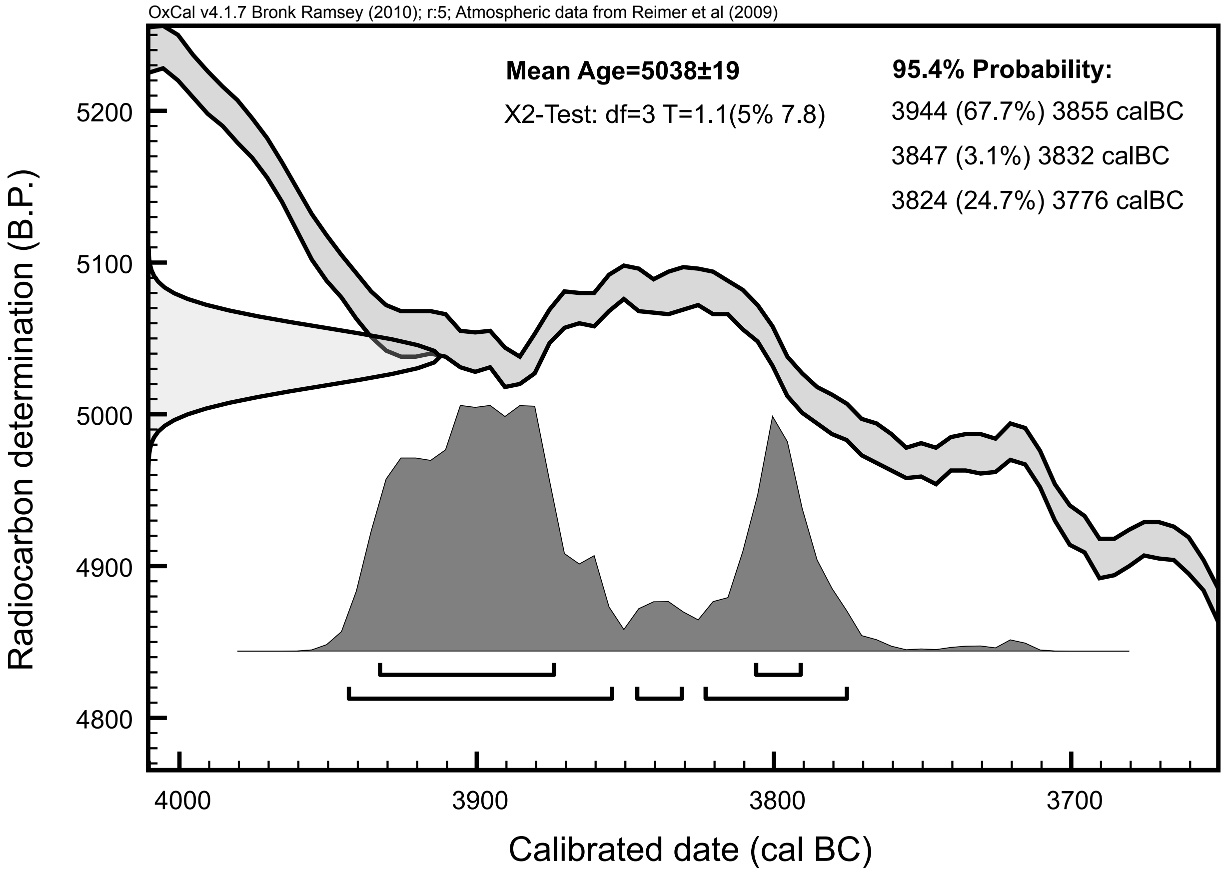

Figure 3.1. A section of the IntCal09 radiocarbon calibration curve showing the calibrated date distribution of the weighted mean age of four dates from Uncompahgre Cirque.

Table 3.2. AMS radiocarbon dating results for four charcoal samples. Calibrated calendar dates were obtained from OxCal Version 4.1.7 (Bronk Ramsey 2010), using the IntCal09 calibration dataset (Reimer et al. 2009).

Lab No.	Unit No.	CN	Species	$\delta^{13}C$	Corrected Age (^{14}C yr B.P.)	2σ Calibrated Date Range (yr cal B.P.)
AA93558	3	1161	*Picea* sp.	-22.8	5043±35	5904 (93.8%) 5710 and 5674 (1.6%) 5664
AA93359	5	1174	*Salix* sp.	-27.1	5058±42	5912 (94.4%) 5712 and 5673 (1.0%) 5665
AA93560	5	1176	*Salix* sp.	-27.0	5002±40	5893 (30.2%) 5803 and 5797 (65.2%) 5645
AA93561	3	1202	*Picea* sp.	-22.9	5044±32	5903 (94.9%) 5714 and 5671 (0.5%) 5668

of 78 specimens large enough for source analysis were analyzed by the Archaeometry Lab at the University of Missouri's Research Reactor Center (Ferguson 2011). Compositional analysis was conducted using a portable Bruker Tracer III-V Handheld XRF Spectrometer, which uses a rhodium-based X-ray tube operated at 40 kV and a thermoelectrically-cooled silicon detector. The samples were counted for three minutes to measure the minor and trace elements present. The most reliable elements measured include Fe, Rb, Sr, Y, Zr, and Nb; however, due to the small size of some of the samples artifacts, iron was not usually included in the source assignment. The resulting chemical compositions were compared with the signatures of over 45 known obsidian sources in the Southwest and surrounding regions derived from previous XRF and neutron activation analysis (NAA) studies.

All 78 analyzed specimens are assigned to two sources in the Jemez Mountains of northern New Mexico (Baugh and Nelson 1987; Glascock et al. 1999; Shackley 2005). Twenty-one specimens (27 percent) come from the Cerro del Medio source, while the balance comes from Polvadera Peak/El Rechuelos. Figure 3.2 illustrates these compositional data.

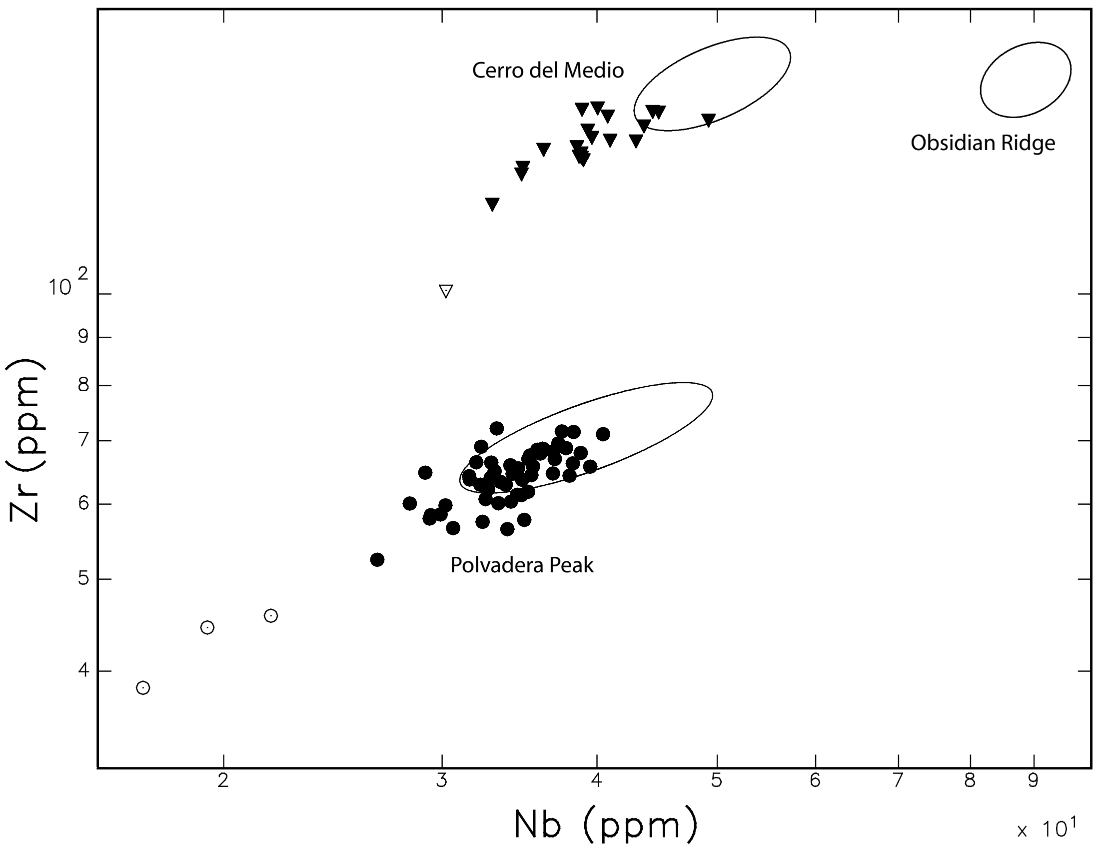

Figure 3.2. Bivariate plot of niobium and zirconium concentrations (ppm) showing three major Jemez sources. Source groups are plotted with ellipses only. Ellipses represent 90 percent confidence intervals for membership in the source group. Solid symbols are confidently assigned samples from Uncompahgre Cirque, and open symbols are tentatively assigned samples (Ferguson 2011).

The Jemez region includes at least four compositionally distinct obsidian sources within and adjacent to the Valles Caldera, all of which are located with a few km of one another. Most obsidian assemblages in New Mexico are dominated by material from the Obsidian Ridge source, but no specimens of this material are present in the Uncompahgre Cirque collection. The absence of material from Obsidian Ridge at Uncompahgre Cirque is not simply a chance occurrence. Rather, the dominance of Cerro del Medio and, especially, Polvadera Peak/El Rechuelos obsidian in the Uncompahgre Cirque sample is also seen at other sites located in and around the San Juan Mountains. Of the 234 sourced obsidian artifacts in Ferguson and Skinner's (2003) compilation from sites in the 13 counties encompassing the San Juans, just 40 (17 percent) derive from sources other than Polvadera Peak or Cerro del Medio. Just two specimens (less than 1 percent) come from Obsidian Ridge.

At Uncompahgre Cirque, the spatial distributions of obsidian artifacts from the two identified sources are roughly conterminous (figure 3.3). Both center around the high point on the west end of Locus 1. Artifacts from both sources also co-occur in subsurface contexts at the site. Two or more obsidian artifacts were recovered from four different levels in three excavation units. Artifacts made of stone from each of the two identified sources co-occur in two of these four levels. Together, these spatial and stratigraphic data suggest that toolstone from both sources was used concurrently during the occupation at Uncompahgre Cirque.

Fifty-two obsidian artifacts were submitted to Northwest Research Obsidian Studies Laboratory for hydration analysis (Skinner 2011). Hydration analysis measures the depth of penetration of water into the interior of an obsidian artifact. The rate of hydration rim formation is time-dependent, though it is also affected by the chemical composition of the stone, temperature, water vapor pressure, and soil pH.

To measure a hydration rim, two parallel cuts are first made into the edge of the artifact using a lapidary saw equipped with 4-inch-diameter, diamond-impregnated

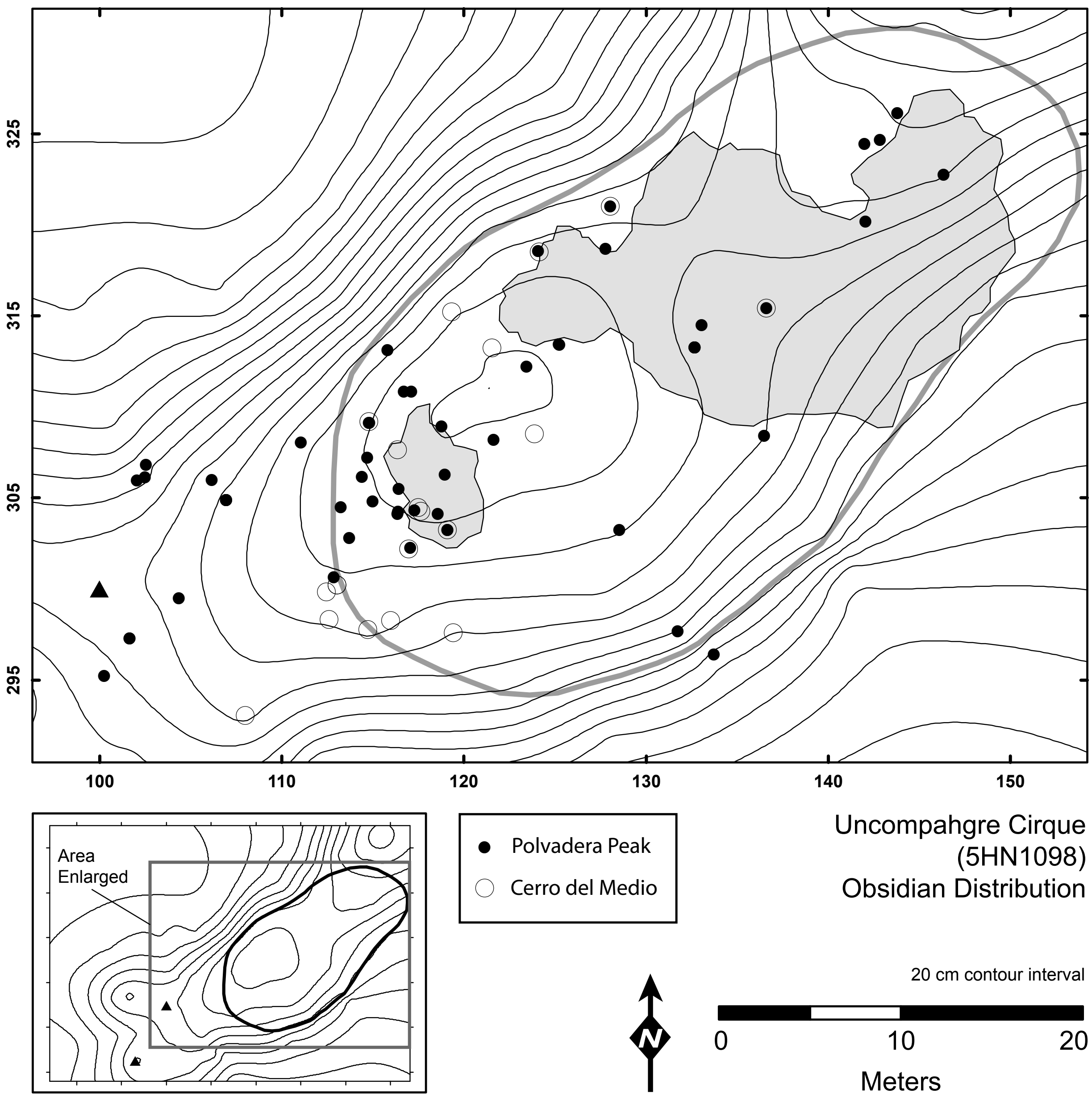

Figure 3.3. Distribution of sourced obsidian artifacts.

.004" thick blades, creating a 1-mm-thick section. The section's location is determined by the morphology of the artifact and the perceived potential of the location to yield information on the artifact's manufacture, use, or discard. The removed section is mounted on a petrographic microscope slide and ground in several stages, ultimately yielding a section roughly 30 to 50 microns thick.

The prepared slide is measured using an Olympus BHT petrographic microscope fitted with a video micrometer unit and a digital imaging video camera. When a clearly defined hydration layer is identified, the section is centered in the field of view to minimize parallax effects. Four rim measurements are typically recorded for each section. Narrow rims (under approximately two microns wide) are usually examined under a higher magnification. Hydration rims smaller than one micron often cannot be resolved by optical microscopy. Hydration thicknesses are reported to the nearest 0.1 micron and represent the mean value for all readings. Standard deviation values estimate variability in hydration thickness measurements recorded for each specimen. These values reflect only the reading uncertainty of the rim values and do not take into account the resolution limitations of the microscope or other sources of uncertainty that enter into the formation of hydration rims (Meighan 1981, 1983; Skinner 1995:5.13-5.19; Anovitz et al. 1999).

Table 3.3 presents the Uncompahgre Cirque hydration rim data. Because hydration rates vary among sources, rim thicknesses measured on artifacts made from Polvadera Peak/El Rechuelos obsidian are analyzed separately from those made from Cerro del Medio obsidian. Hydration thickness distributions from Uncompahgre Cirque are illustrated in figure 3.4. The Polvadera Peak/El Rechuelos histogram (lower panel) exhibits a unimodal distribution, suggesting that the artifacts date to a single period and therefore that the site was occupied either briefly or several times in quick succession. The histogram for Cerro del Medio stone (upper panel) exhibits an elongated rectangular distribution. This may indicate that the hydration rate for this material is more variable than the rate for material from Polvadera Peak/El Rechuelos. Alternatively, the elongated distribution for Cerro del Medio specimens may indicate that local environmental conditions play a more variable role in the hydration of stone from that source.

Table 3.3. Obsidian hydration results.

Catalog Number	Source[a]	Artifact Class[b]	Context	Mean Rim (microns)
1002	Polv.	CSFD	Exc.	3.3±0.1
1006	CDM	CSFD	Exc.	3.5±0.1[c]
1008.301	Polv.	CSFD	Exc.	3.0±0.1
1008.401	CDM	CSFD	Exc.	3.9±0.1
1012	CDM	CSFD	Surf.	3.5±0.1
1013	Polv.	CSFD	Surf.	3.2±0.1
1015.401	CDM	Tool	Surf.	4.1±0.1
1016	Polv.	CSFD	Surf.	3.1±0.1
1018	Polv.	CSFD	Surf.	3.1±0.0
1019	Polv.	CSFD	Surf.	3.1±0.1
1020	Polv.	CSFD	Surf.	3.1±0.1
1022	Polv.	CSFD	Surf.	3.1±0.1
1023	Polv.	CSFD	Surf.	3.1±0.1
1024	Polv.	Tool	Surf.	3.1±0.1
1025	Polv.	Tool	Surf.	3.2±0.1
1026.301	CDM	CSFD	Surf.	4.2±0.1
1027	CDM	Tool	Surf.	4.1±0.1
1028	CDM	CSFD	Surf.	4.0±0.1
1029	CDM	CSFD	Surf.	3.6±0.1
1030	CDM	CSFD	Surf.	4.0±0.1
1031	Polv.	Tool	Surf.	3.1±0.1
1032	Polv.	CSFD	Surf.	3.3±0.1
1033	Polv.	Tool	Surf.	3.3±0.1[c]
1035	Polv.	CSFD	Surf.	3.5±0.1
1036	Polv.	CSFD	Surf.	3.2±0.1
1037	Polv.	CSFD	Surf.	3.2±0.1

Table 3.3. Obsidian hydration results (continued).

Catalog Number	Source[a]	Artifact Class[b]	Context	Mean Rim (microns)
1038	Polv.	Tool	Surf.	3.2±0.1
1039	CDM	CSFD	Surf.	4.0±0.1
1040	Polv.	CSFD	Surf.	3.1±0.1
1042	Polv.	CSFD	Surf.	3.2±0.1
1043	CDM	Tool	Surf.	3.7±0.1
1047	Polv.	Tool	Surf.	3.4±0.1[c]
1048	Polv.	CSFD	Surf.	3.7±0.1
1049	CDM	CSFD	Surf.	3.3±0.1
1051	Polv.	Tool	Surf.	3.1±0.1
1053	Polv.	CSFD	Exc.	3.2±0.1
1070	CDM	CSFD	Exc.	3.2±0.0
1077	Polv.	CSFD	Surf.	3.2±0.0
1078	CDM	CSFD	Surf.	3.2±0.1
1081	CDM	CSFD	Surf.	3.9±0.1
1082	Polv.	CSFD	Surf.	3.1±0.1
1083	Polv.	CSFD	Surf.	3.1±0.1
1087	Polv.	Tool	Surf.	3.3±0.1
1088	Polv.	CSFD	Surf.	3.0±0.1
1099.301	Polv.	CSFD	Exc.	3.1±0.1
1139	Polv.	CSFD	Surf.	3.1±0.1
1142	Polv.	CSFD	Surf.	3.0±0.1[c]
1145	Polv.	Tool	Surf.	3.2±0.1
1146	Polv.	CSFD	Surf.	3.1±0.1
1156	CDM	Tool	Surf.	4.0±0.1
1163.301	Polv.	Tool	Exc.	3.0±0.1
1163.302	Polv.	Tool	Exc.	3.0±0.1

[a] Polv.=Polvadera Peak/El Rechuelos; CDM=Cerro del Medio
[b] CSFD=Chipped stone flaking debris
[c] Diffusion front vague

Artifacts from surface contexts have the thickest hydration rims, but no statistical differences exist in mean hydration values between artifacts recovered from excavated contexts and artifacts recovered from the surface (figure 3.4) (Cerro del Medio—$F=1.806$; $p=0.200$; Polvadera Peak/El Rechuelos—$F=1.683$; $p=0.203$). Though the sample of excavated artifacts is small, this suggests that specimens recovered from the surface—where diurnal and seasonal temperatures may be higher, speeding the hydration process—were exposed only recently. Tools and flaking debris also exhibit statistically equivalent hydration rim thicknesses.

Stratigraphic data, detailed in chapter 2, demonstrate that buried artifacts mostly occur in a single zone near the base of a prominent paleosol. Artifacts above this zone are smaller than those within the zone, suggesting that post-depositional translocation due to periglacial

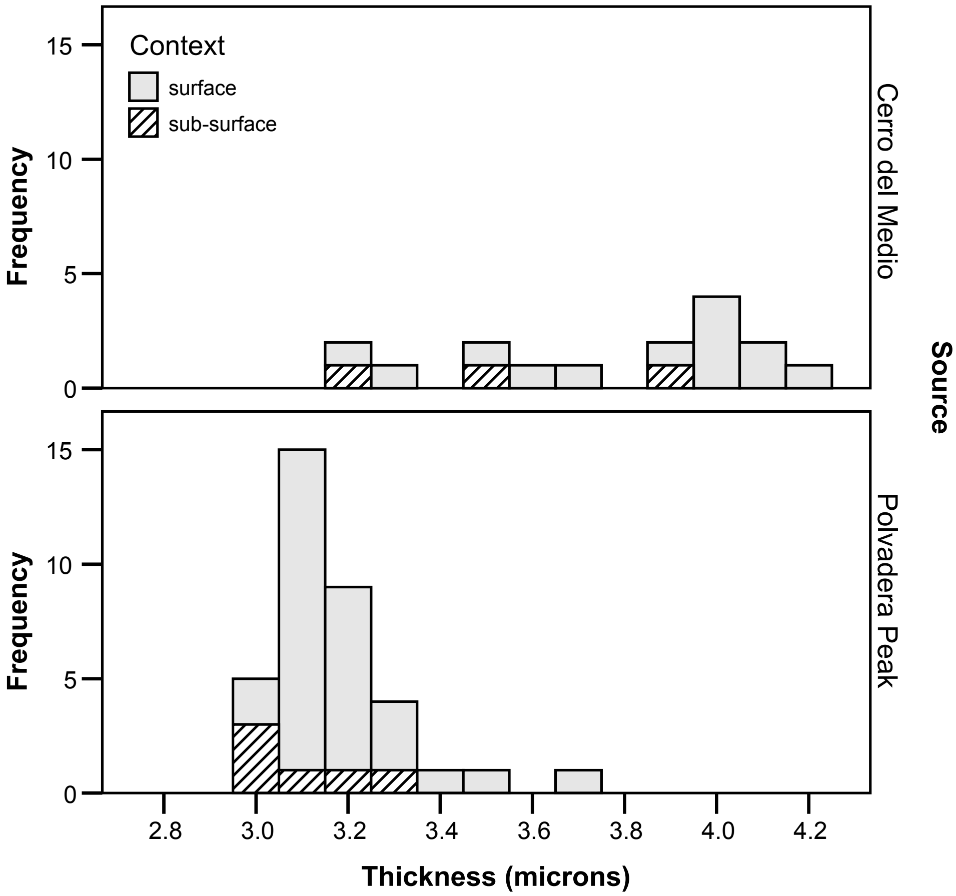

Figure 3.4. Histograms showing the distributions of hydration rim thicknesses in 52 obsidian artifacts from Uncompahgre Cirque.

processes was limited. Pedological data indicate that the occupation took place during a period of comparatively rapid sediment deposition, rather than during a period of surface stability. These data support the inference, drawn from radiocarbon and obsidian artifact distribution and hydration data, that the cultural deposit at Uncompahgre Cirque represents either a single occupation or a short series of closely spaced occupations. The two-standard-deviation calibrated age spans just 168 years, or 3 percent of the minimum calendar age of 5725 cal B.P. The range of hydration thickness values is narrow and, for specimens made from Polvadera Peak/El Rechuelos obsidian, the thickness distribution is unimodal. The spatial distribution of specimens made from Cerro del Medio stone is conterminous with that of specimens made from Polvadera Peak/El Rechuelos stone, further suggesting that they were used contemporaneously.

Analytic Units

To provide a framework for analysis and comparison, individual provenience lots (including both general level aggregates and piece plots) are grouped into composite "analytic units." Proveniences making up each analytic unit share a set of spatial, depositional, and temporal properties. Because both chronological and stratigraphic data point to a single occupation, or series of closely spaced occupations, all of the material from the site is treated in the balance of this chapter as archaeologically contemporaneous. However, three analytic units are defined on the basis of differences in artifact recovery method. These include the excavated sample, the surface grab sample, and the surface feature sample.

Overview of Technological Analysis Methods

The modified stone analysis first partitions the assemblage into two classes: chipped stone flaking debris and stone tools. A tool is any intentionally shaped object, an item exhibiting use-wear, or a remnant nodule of raw material from which flakes were removed. (For the minimum analytical nodule analysis [MANA] cores are included in the flaking debris aggregate rather than the tool aggregate [Larson and Kornfeld 1997]). Intentionally shaped objects range in complexity from flakes exhibiting macroscopic use-wear or retouched edges to items produced by flaking, pecking, grinding, or some combination of manufacturing techniques. Flakes, by contrast, are detached pieces discarded during lithic reduction, which therefore lack evidence of use or modification other than that produced by transport, tramping, or other post-depositional factors (Shott 2004).

The analysis emphasizes the assemblage's technological, rather than functional or morphological, properties. Technological analysis of stone tools focuses mainly on how they were manufactured. The most important production variable is technological class. A tool's technological class is defined primarily by the dominant method used to manufacture it and secondarily by the initial form of the raw material blank (Ahler et al. 1994). Each class is defined by a sequence of production steps and techniques. Sequences range from simple and expedient to complex and staged. For example, patterned large thin bifaces are produced by the staged application of soft-hammer percussion flaking and, to a lesser degree, pressure flaking to flake blanks or tabular pieces of stone. Unpatterned flake tools, by contrast, exhibit nothing more than simple edge modification, either through use or marginal retouch. Table 3.4 describes the stone tool technological classes used in the analysis.

Assessing tool technological class requires a series of interrelated judgments about the actual methods used to manufacture a tool as well as the intended outcome of the manufacturing process. Determinations about manufacturing stage and technological trajectory depend in part on the concept of "patternedness." Patterned tools exhibit bilateral symmetry. By contrast, unpatterned tools are asymmetrical, with their form dictated mainly by the shape of the original input blank. Use-wear traces, though not rigorously quantified in this analysis, provide additional information about whether the production process was complete when an artifact was lost or discarded. Variables recorded in the stone tool analysis include size grade, weight, raw material type, technological class, completeness, and evidence for burning or intentional heat treatment.

Technological analysis of flaking debris focuses on flake size distributions and on the details of striking platform type and preparation. Two datasets were collected on the flaking debris aggregate. A basic suite of variables was coded for all sizes of flaking debris. These variables include size grade, raw material type, presence of cortex, and presence of surface weathering. Counts and weights were recorded for each of the resulting sort groups. Burning and intentional heat-

Table 3.4. Stone tool technological class definitions.

Technological Class	Description
Small patterned biface	Produced by controlled and sequenced pressure flaking on small, thin flake blanks. When finished, artifacts in this class exhibit continuous bifacial retouch and are symmetrical in plan view and cross section. Includes arrow points, drills, and small cutting tools.
Large patterned biface	Produced by controlled and sequenced percussion flaking on various blank types. Symmetrical in plan view and cross section. Pressure flaking also is used, which sometimes obliterates evidence of earlier manufacturing stages. Includes dart points and hafted and unhafted bifacial cutting tools.
Unpatterned biface	Produced by hard hammer percussion on tabular, pebble, or flake blanks; pressure flaking is used only rarely. Tools in this class are not symmetrical and often exhibit discontinuous bifacial edging.
Patterned flake tool	Produced by pressure flaking on flake or tabular blanks. Patterned flake tools exhibit plano-convex cross sections, but are bilaterally symmetrical in plan view. Includes hides scrapers; a few hafted beak tools designed for wood or bone working also are included in this class.
Unpatterned flake tool	Produced by use-flaking or pressure-flaking on a flake blank. Edge modification is highly variable and may be discontinuous. Unpatterned flake tools lack symmetry. Includes a wide variety of tools used for many different tasks.
Non-bipolar core	Produced by free-hand, nonbifacial percussion on various blank types. May be irregular or symmetrical. Includes cores and tested cobbles.
Bipolar core/tool	Produced only or mainly by bipolar percussion. Irregular in plan view and cross section. Includes cores used for flake production, punches or wedges fractured during use, and tested cobbles.
Retouched plate tool	Produced by free-hand percussion flaking and pressure flaking on tabular or platy blanks. Tools in this class may exhibit unifacial or bifacial edging, but generally are asymmetrical in plan view. Includes a wide variety of tools used for many different tasks.

treatment were not systematically recorded; however, notes were taken documenting the presence of both burned and heat-treated flakes in the assemblage. This basic dataset was collected to assess raw material procurement patterns, differences in the ways different raw materials were used, the presence and distribution of intra-site activities areas, and post-depositional alteration to the assemblage.

To gather additional data on the technological procedures used to produce and modify stone tools, an individual-flake analysis was applied to specimens from EU3 and from two of the three surface feature assemblages. Variables coded in this phase of the analysis focus primarily on striking platform morphology and preparation methods.

A minimum analytical nodule analysis (MANA) was carried out on the three surface feature aggregates. Minimum analytical nodules (MANs) are groups of artifacts sharing a narrowly defined set of characteristics that differentiate them from other such groups (Larson and Kornfeld 1997). The items comprising each MAN are considered detached pieces of a single parent nodule. Attributes used to define MANs include color, color pattern, inclusions, texture, cortex type, and so forth. MANA commonly is limited to coarse-fraction samples (size grades 1 through 3; see next section) because smaller flakes and tools are more easily misclassified. The primary aim of MANA is a reconstruction of the organization of lithic technology by defining the spatial and temporal structure of tool manufacturing, use, and discard (Hall 2004).

Lists of the variables and attributes coded in the analyses are provided in appendix A. Additional discussion of the analytic methods applied to the collection can be found in Ahler (2002), Ahler and others (1994, 2003), Ahler and Toom (1993), Larson and Kornfeld (1997), and Root and others (1999).

Collection Summary

The stone tool assemblage includes 186 specimens (table 3.5). Eleven tools exhibit two different sequential technological processes, and one tool exhibits three, yielding a total of 199 distinct stone tool technological cases. The flaking debris assemblage comprises 2,181 specimens, together weighing roughly 3.8 kg (table 3.6). The figures reported in tables 3.5 and 3.6 include items in four size grades: grade 1 (items retained in a 1-inch square mesh screen), grade 2 (1/2-inch mesh), grade 3 (1/4-inch mesh), and grade 4 (1/8-inch mesh). Because excavated sediment was dryscreened in the field over 1/4-inch hardware cloth, the recovery of grade 4 specimens was essentially fortuitous. However, the fact that the excavated collection includes 294 grade 4 flakes is a testament to the field crew's careful work. Nevertheless, it is not possible to assess the representativeness of the grade 4 fraction, except to note that the collection as a whole likely underestimates the occurrence of flakes produced by tool finishing or maintenance activities. Size grade 4 flakes were also recovered from each of the surface lithic features, which were collected by hand without screening. However, counts and weights of flakes in this size class only were recorded for the Feature 1 assemblage, which includes 73 such items, together weighing 10.0 g. Those specimens are excluded from the surface feature analysis.

Table 3.5. Counts of stone tool technological cases, organized by analytic unit and size grade.

	Size Grade				
Analytic Unit	G1	G2	G3	G4	Total
Excavated	15	53	45	3	116
Surface	5	18	14		37
Surface Feature	7	32	7		46
Total	27	103	66	3	199

Raw Material Usage

Five raw material types are represented in the flaking debris assemblage (table 3.7). Ninety-five percent of the flakes are made from chert that comes from the extensive quarry (5HN1099) located on the ridge overlooking Uncompahgre Cirque (figure 3.5). Chert from the quarry varies in color from yellow through olive to black (figure 3.6). The quality varies from moderate to high. Some nodules exhibit vugs, chalcedony-filled fracture planes, and other defects, but most pieces fall approximately between 3.5 and 4.0 on Callahan's (1979:Table 3) ease of workability scale. A minority is very fine-grained and lustrous.

The chert that outcrops at Uncompahgre Cirque formed in Oligocene-age ash-flow tuff deposits that cover much of the eastern San Juans and surrounding areas to the north and east (figure 3.7). The actual distribution of chert within these flows is not known. However, macroscopically identical chert has been documented in flows of the same age and type located some 90 km east of Uncompahgre Cirque at the Upper Crossing site (Mitchell 2012). Archaeologists have also noted sources of similar stone to the south, on the west side of the San Luis Valley, in and around the La Garita Mountains (Robert Wunderlich, personal communication, 2011).

The flaking debris assemblage also includes imported raw materials. Obsidian is the most conspicuous, but

Table 3.6. Count and weight data on the flaking debris assemblage, organized by artifact size grade.

	Count					Weight (g)				
	Size Grade					Size Grade				
Analytic Unit	G1	G2	G3	G4	Total (N)	G1	G2	G3	G4	Total (g)
Excavated	3	121	585	294	1,003	44.6	518.2	349.8	38.0	950.6
Surface	1	15	39	14	69	38.2	94.4	27.0	2.6	162.1
Surface Feature	30	258	748	73	1,109	780.9	1,296.4	648.1	10.0	2,735.4
Total	34	394	1,372	381	2,181	863.7	1,909.0	1,024.9	50.5	3,848.1

Table 3.7. Raw material composition of the flaking debris assemblage.

		Analytic Unit			
Raw Material Origin	Raw Material Type	Excavated	Surface	Surface Feature	Total (N)
Local (5HN1099)	chert	980	8	1,077	2,065
Imported	chert	4	5	8	17
	chalcedony	5	3	18	26
	quartzite	2	2	2	6
	basalt		1	1	2
	obsidian	12	50	3	65
Imported Subtotal		*23*	*61*	*32*	*116*

Figure 3.5. A section of the ridge-top chert quarry (5HN1099). Chert nodules currently exposed on the surface are moderate- to high-quality and range in color from yellow, to olive, to gray and black (see figure 3.6).

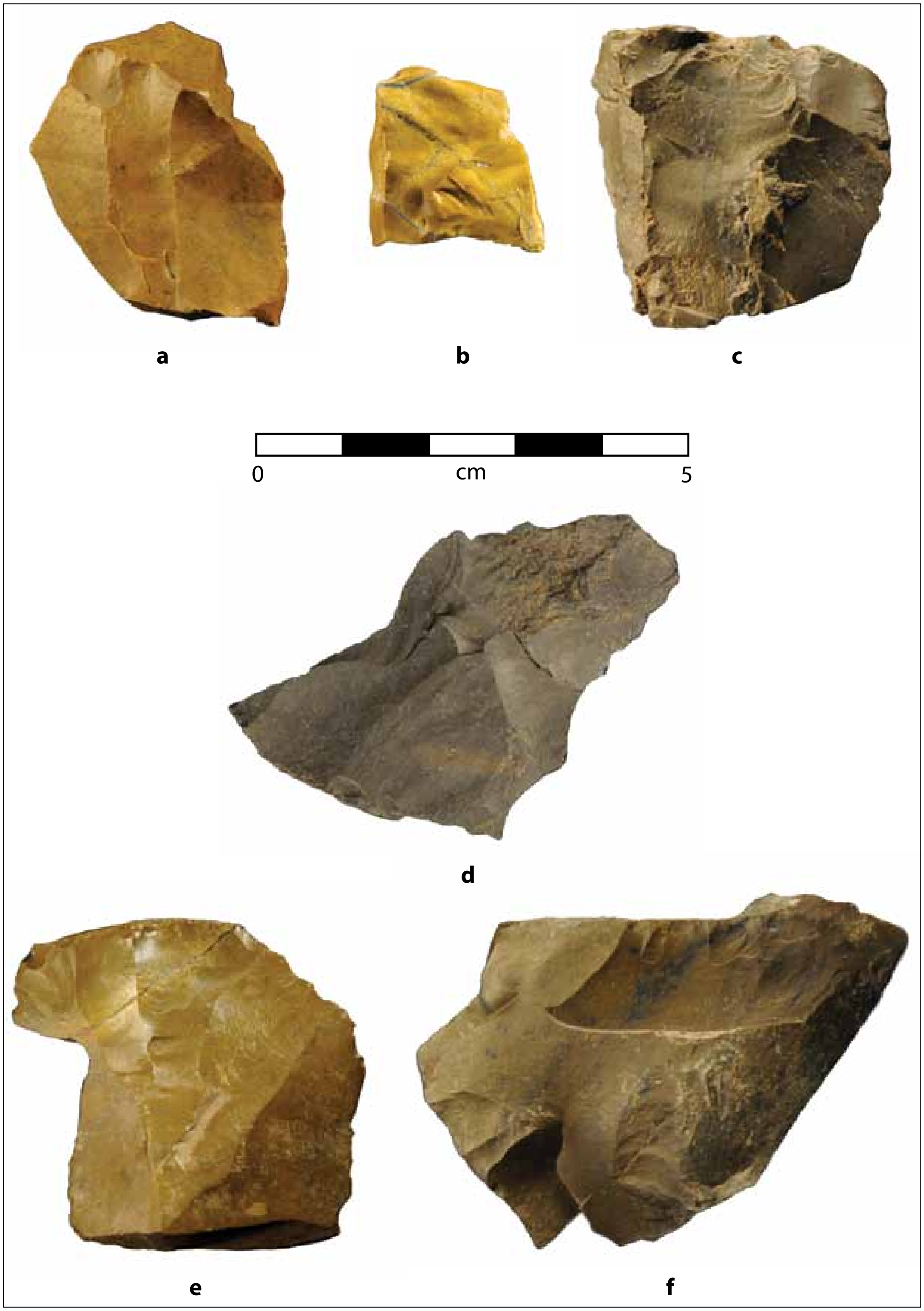

Figure 3.6. Artifacts made from local chert. a: Nodule 24; b: Nodule 46; c, f: Nodule 1; d: Nodule 4; e: Nodule 16.

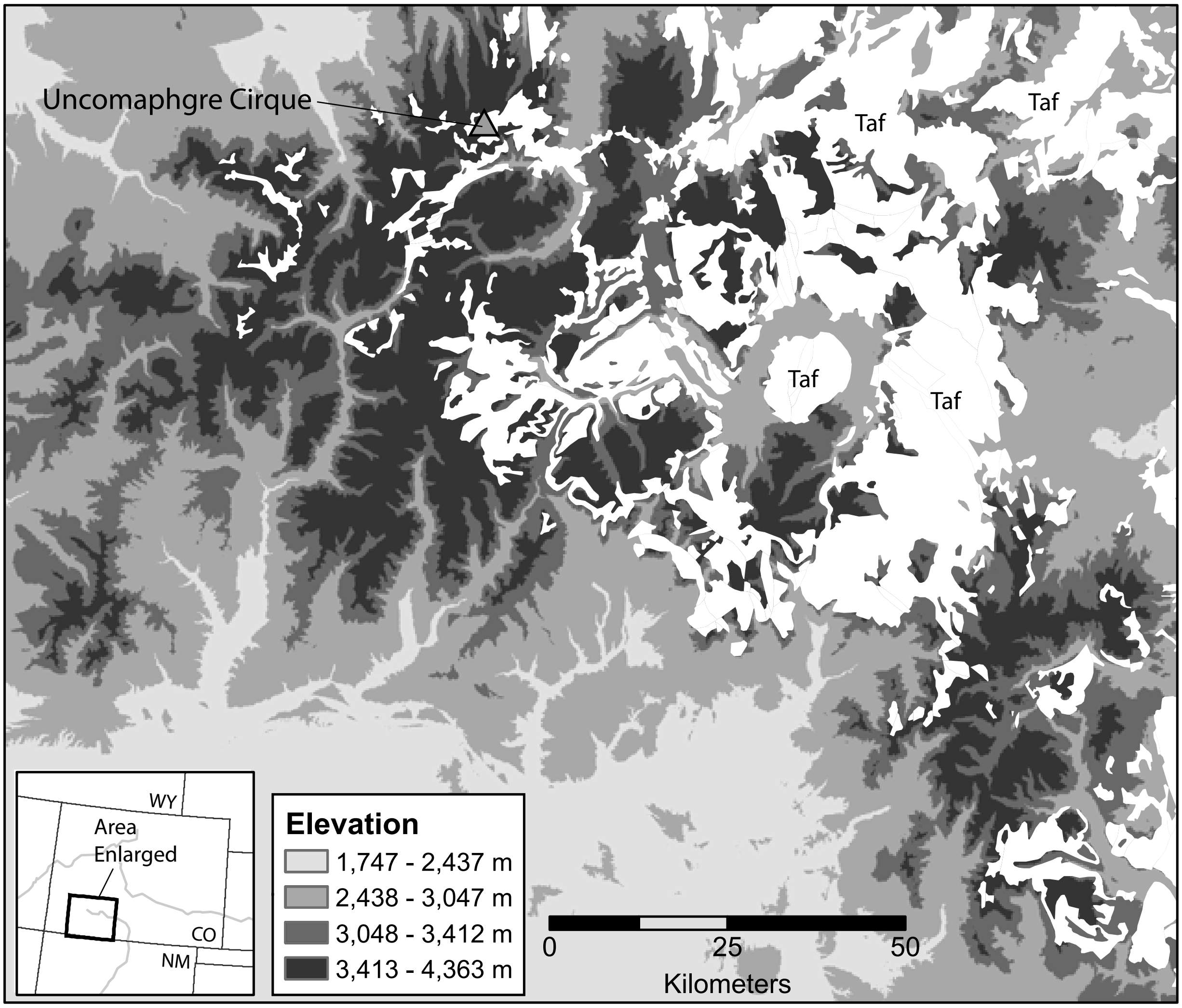

Figure 3.7. Map showing the distribution of Oligocene tuff flows (Taf) across the northern and eastern San Juan Mountains.

non-local cherts, chalcedonies, basalts, and quartzites also are present. Imported cherts range from a tough green material to fine-grained red and white varieties. A milky white to translucent chert in the collection bears some resemblance to Miocene-age stone that outcrops to the north in Grand, Routt, Eagle, and Jackson counties, especially the so-called "Kremmling chert" found in the Troublesome and Brown's Park formations east and west of the Gore Range, respectively (Black 2000; Miller 2010). Black (2000) and Stiger (2001) describe numerous orthoquartzite sources located in the Gunnison River basin to the north. These quartzites vary greatly in color and quality. Quarry localities for the other imported materials present in the Uncompahgre Cirque flaking debris assemblage are not known; however, numerous sources of flakeable stone occur throughout the Colorado mountains (Black 2000). Between two and three percent of the excavated and surface feature flaking debris samples is made from imported stone. This value likely approximates the proportion of imported flakes at the site as a whole.

The raw material make-up of the stone tool assemblage is comparable to that of the flaking debris assemblage, apart from two tools made from rhyolite and one made from silicified wood in the general surface collection (table 3.8). At about 5 percent, tools made from imported stone are roughly twice as common as flakes made from imported stone in the excavated and surface feature assemblages. In the excavated assemblage, tools and flakes are made from the same suite of imported materials. In the surface feature assemblage, flakes made from imported chert and chalcedony are not matched by tools made from those materials.

Table 3.8. Raw material composition of the stone tool aggregate. Values represent number of individual specimens, not technological cases.

		Analytic Unit			
Raw Material Origin	Raw Material Type	Excavated	Surface	Surface Feature	Total (N)
Local (5HN1099)	chert	102	8	40	150
Imported	chert	1	1		2
	chalcedony	1	2		3
	quartzite	2	7	1	10
	rhyolite		2		2
	basalt		1		1
	silicified wood		1		1
	obsidian	2	14	1	17
Imported Subtotal		*6*	*28*	*2*	*36*

Post-Occupation Weathering

A portion of the flaking debris aggregate is weathered or desilicified. Weathered flakes exhibit chalky exterior surfaces and are lighter in color and lower in density. Some weathered pieces exhibit a distinctive light purplish-salmon color. Desilicification also accentuates natural fracture planes in the stone.

Weathering is confined almost entirely to specimens composed of local yellow chert. The near absence of weathering on olive, gray, or black stone from the ridge-top quarry suggests that the desilicification process is a function of the specific elemental composition or microcrystalline structure of the yellow stone. Several flakes in the collection that exhibit both yellow- and olive-colored facies clearly illustrate the differential effects of weathering: the portions of the flakes composed of yellow stone are weathered while the portions composed of olive stone are unaltered.

Some artifacts exhibiting obvious flake morphology are desilicified, indicating that the process has occurred over the last 5,000 years. The occurrence of weathered flakes in secure subsurface contexts also indicates that desilicification does not require surface exposure, though yellow chert flakes and cores recovered from the surface appear more weathered than specimens from buried contexts.

The collection also includes many pieces of weathered flakeable stone that by their shape are not obviously byproducts of intentional lithic reduction. These angular chunks could represent initial reduction of partially weathered nodules. However, some chunks clearly represent unmodified, naturally occurring pieces of stone. Distinguishing between weathered natural chert pieces and weathered angular debris produced by lithic reduction presents an acute analytic challenge, because initial reduction of quarried nodules was a major activity at Uncompahgre Cirque.

The analysis takes a conservative approach to this problem. Weathered specimens exhibiting a platform, a single ventral surface, or evidence of multiple controlled prior flake removals are classified as "desilicified flakes." Pieces of angular debris exhibiting differential weathering, where a core of unweathered stone is exposed on one or more faces, also are coded as desilicified flaking debris. By contrast, pieces of weathered stone lacking clear flake morphology, as well as pieces that exhibit uniformly weathered surfaces, are classified as natural rock. This approach likely slightly underestimates the amount of angular debris and number of flake fragments made from local yellow chert in the collection.

Surface Features

The surface feature assemblage consists of artifacts recovered from three dense concentrations of flaking debris located on the eroded till surface in Locus 1 (see chapter 2 for complete feature descriptions and maps). Each concentration exhibits a distinct boundary, with the density of flaking debris outside the perimeter only a small fraction of the density inside. The color and texture of the raw materials making up each feature are notably homogeneous. Feature 1 consists mostly of artifacts made from local dark gray to black chert. Feature 2 consists of local tan- to olive-colored chert. The items making up the Feature 3 aggregate are somewhat more varied, but the majority consists of local yellow chert. The compactness of these artifact concentrations, along with their material distinctiveness, indicate that they represent either discrete, in-situ activity loci, where one or more flint knappers reduced raw nodules or produced tools, or dumps of waste flakes and discarded tools that initially accumulated on another part of the site. The chronological and stratigraphic data discussed previously further indicate that these features are archaeologically, if not strictly, contemporaneous. Table 3.9 summarizes basic data on these concentrations.

The minimum analytical nodule analysis (MANA) identified a total of 53 separate nodules (MANs) comprising the three features. Seven of these nodules consist of isolated burned specimens. The original color and texture of these nodules could not be determined. Two others, both of which occur in the Feature 3 aggregate, consist of weathered specimens. All nine of these burned or weathered MANs, which together consist of 29 flakes, are excluded from the analysis.

Table 3.10 tallies the numbers of unburned, unweathered single- and multiple-item MANs making up each feature. Each feature assemblage includes both MAN classes. However, single-item nodules account for less than 2 percent by count or weight of each aggregate (table 3.11).

Unsurprisingly, 13 of the 16 single-item nodules consist of flakes or tools made from imported stone (table 3.12). Nodules consisting of a single imported tool represent transported items exhausted or discarded on-site without modification (Larson and Kornfeld 1997). Because the studied sample from Uncompahgre Cirque is small and spatially restricted, these single-item MANs could also represent artifacts that were modified elsewhere on site before they were discarded. Single-item nodules consisting of imported flakes represent on-site modification of curated tools. The fact that all three feature aggregates contain single-item nodules made from imported stone confirms the widespread on-site use and modification of curated items. The presence of single-item MANs made from local as well as imported stone further suggests either that the features represent something more than just simple single-function activity loci or that a small number of artifacts were fortuitously translocated short distances during or after the occupation.

Figure 3.8 illustrates the distribution by decreasing total weight of multiple-item nodules in the three feature assemblages. MANs comprised solely of flaking debris and cores are indicated by solid gray bars, while those comprised of both flaking debris and flake tools are indicated by hatched bars. Three minor MANs in the Feature 3 aggregate, identified by asterisks, consist of multiple imported flakes.

Each feature is dominated by one multiple-item MAN, which accounts for their visual distinctiveness. Nodule 1 makes up roughly 71 percent of the Feature 1 aggregate (figure 3.6[c,f]). Fifty-three percent of Feature 2 consists of Nodule 17, while 42 percent of Feature 3 consists of Nodule 46 (figure 3.6[b]). Thus, a majority or plurality of artifacts in each feature represents the reduction of a single nodule.

Feature 2 is the clearest example of a primarily single-function activity locus. Just two nodules (Nodules 16 and 17) make up 94 percent of the Feature 2 assemblage. Nodules 16 and 17 are in fact quite similar in color and texture, suggesting that they may derive from the same quarry outcrop. Just one flake tool occurs in the Feature 2 assemblage (in Nodule 16), indicating a narrow focus on primary lithic reduction (table 3.13).

Feature 1 also represents a primarily single-function activity locus, judging by the abundance of items assigned to Nodule 1. However, Nodule 1 also contains seven expedient tools, suggesting that tool production and use occurred concurrently with initial core reduction and flake production. The interpretation that the Feature 1 aggregate represents multiple activities is further supported by the fact that three of the six constituent MANs contain flake tools.

The Feature 3 assemblage differs from the Feature 1 and Feature 2 assemblages. Though a plurality of specimens is assigned to one MAN (Nodule 46), the assemblage is partitioned into a total of 18 multiple-item MANs, including 3 made from imported materials. Six of the seven largest MANs include both flaking debris and expedient flake tools. The Feature 3 assemblage therefore represents multiple activities, including core reduction, tool production and maintenance, and tool use. The feature assemblage's raw material diversity further suggests that it may represent a secondary deposit of waste flakes and spent tools gathered up from another part of the site.

Table 3.9. Summary data on three chipped stone surface features.

		Flaking debris		Stone Tools			
Feature	Area (sq. m)	Count	Weight (g)	Count	Weight (g)	Number of MANs	Number of Burned or Weathered MANs
1	3.3	476	1145.5	13[a]	113.7	14	2
2	2.7	293	813.7	1	3.2	8	
3	3.1	340	776.2	28[b]	551.5	31	7
Total		1109	2735.4	42	668.4	53	9

[a] Two of the 13 tools exhibit two technological cases.
[b] Two of the 28 tools exhibit two technological cases.

Table 3.10. Counts of unburned and unweathered MANs.

	Surface Feature Number			
MAN Class	1	2	3	Total
Single Item	6	4	6	16
Multiple Item	6	4	18	28
Total	12	8	24	44

Table 3.12. Counts of single-item MANs, organized by artifact class and raw material origin.

Feature No.	Raw Material Origin	flake	tool	Total
1	local	1		1
	imported	4	1	5
2	imported	4		4
3	local	1	1	2
	imported	3	1	4

Table 3.11. Total counts and weights of specimens organized by feature and MAN class.

	MAN Class							
	Single-Item				Multiple-Item			
Feature No.	Count	Percent	Weight (g)	Percent	Count	Percent	Weight (g)	Percent
1	6	1.2%	20.1	1.6%	481	98.8%	1206.5	98.4%
2	4	1.4%	1.9	0.2%	290	98.6%	815.0	99.8%
3	6	1.8%	13.4	1.2%	335	98.2%	1134.8	98.8%

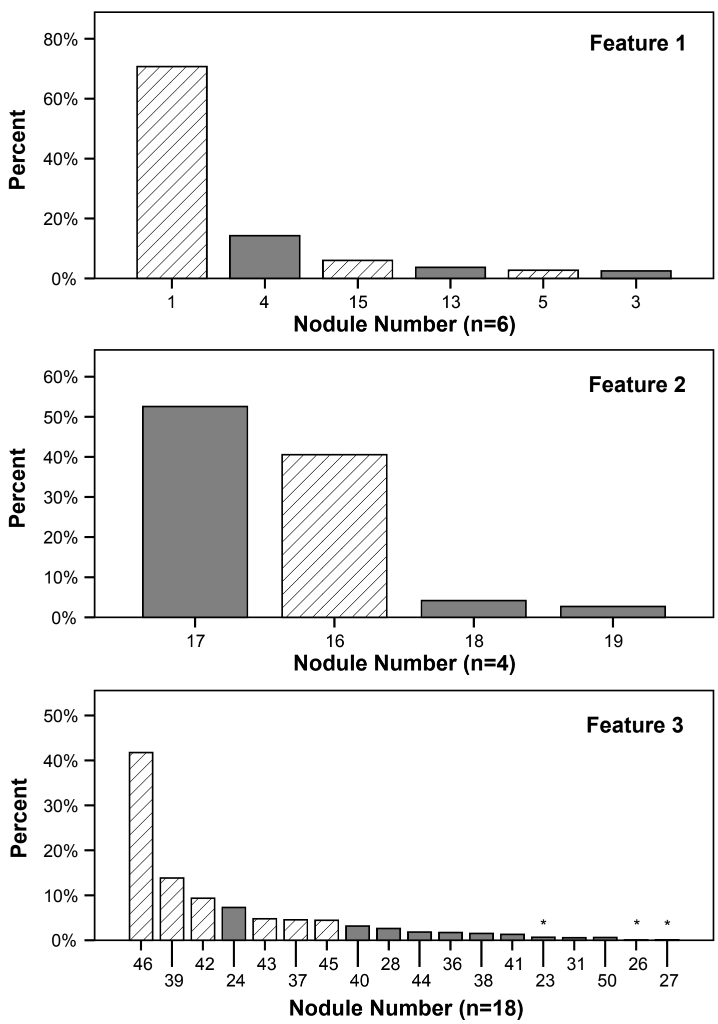

Figure 3.8. Histogram showing weight distributions of multiple-item MANs in three surface feature assemblages. Shaded bars indicate MANs lacking stone tools; asterisks indicate MANs composed of imported stone.

Table 3.13. Counts of flake tools in multiple-item MANs from three surface features. Nodule numbers are listed by decreasing weight proportion within each feature; see figure 3.8.

Feature No.	Nodule No.	Number of Flake Tools
1	1	7[a]
	15	2
	5	2[a]
2	16	1
3	46	1
	39	1
	42	1
	43	1[b]
	37	2
	45	1[a]

[a] Includes one spent core recycled by marginal retouch into an expedient cutting or scraping tool.
[b] Specimen subsequently recycled into a bipolar wedge.

Table 3.14. Weight distributions by size grade of surface feature flaking debris assemblages. Nodule numbers are listed by decreasing weight proportion within each feature; see figure 3.8.

		Size Grade			
Feature No.	Nodule No.	G1	G2	G3	Total (g)
1	1	27.1%	49.3%	23.6%	765.7
	4	34.8%	29.9%	35.2%	167.7
	15		81.5%	18.5%	63.3
	13	70.0%	19.9%	10.1%	44.7
	3	98.7%		1.3%	30.3
	5		65.3%	34.7%	22.5
2	17	18.8%	61.0%	20.2%	428.5
	16	13.8%	55.4%	30.8%	327.3
	18	86.5%		13.5%	34.0
	19		75.0%	25.0%	22.0
3	46	26.1%	48.1%	25.8%	218.6
	39		68.8%	31.2%	74.1
	43	54.9%	20.5%	24.5%	49.7
	24		47.1%	52.9%	45.2
	40	63.9%	24.6%	11.5%	35.7
	28	93.6%		6.4%	29.6
	42		74.8%	25.2%	27.0
	45		83.9%	16.1%	23.6
	36		82.9%	17.1%	19.3
	37	76.2%	13.0%	10.9%	19.3
	38		27.6%	72.4%	17.0
	41		61.9%	38.1%	14.7
	44		57.0%	43.0%	10.0
	23			100.0%	7.5
	31		37.5%	62.5%	6.4
	50			100.0%	1.5
	27			100.0%	1.0
	26			100.0%	0.9

MANA is designed partly to facilitate refitting studies by partitioning an assemblage into potentially refittable specimens. A number of factors affect refitting rates, including analyst experience, reduction technique, and flake size (Laughlin and Kelly 2010). The amount of time devoted to refitting also affects success rates. No refits were identified in any of the Uncompahgre Cirque MANs. Though additional time spent searching for refits likely would have revealed a number of matches, the study result suggests that larger usable flakes have been intentionally culled from the feature aggregates, either for use as tools elsewhere on the site or for transport and later use off-site (Ahler 1989). The inference that usable items were selectively removed is supported by the character of the remaining flaking debris: many of the larger specimens exhibit highly irregular shapes and material flaws that make them unsuitable for use as flake tools or patterned tool blanks. The apparently large number of removed items further suggests that one of the primary products of the quarry workshop was large flakes.

Mass analysis and individual flake analysis data add to these interpretations. Table 3.14 provides a breakdown of multiple-item MANs by size grade. Among the five largest MANs by weight (Nodules 1, 4, 17, 16, and 46), the proportion of grade 1 flakes ranges from 13.8 percent to 34.8 percent. For all but Nodule 4, the grade 2 fraction is the heaviest. The weight proportion of grade 3 flakes exceeds 50% for just seven of the 28 MANs. All of these occur in the Feature 3 aggregate and three of the seven are made from imported materials (Nodules 23, 26, and 27).

Ahler's (1989) experimental data indicate that debris distributions weighted toward the largest size grades are generated mainly by hard hammer production of flakes, blades, and thick bifaces. Biface production by soft hammer percussion also generates flake distributions skewed toward the larger size grades. Distributions skewed toward smaller size grades result from biface and other patterned tool resharpening by pressure flaking, as well as soft hammer flake tool production. The Uncompahgre Cirque distributions thus point to a combination of hard hammer flake and biface production for the largest nodules, coupled with soft hammer and pressure tool production and resharpening for many of the smaller nodules in the Feature 3 aggregate.

A qualitative assessment of grade 4 (smaller than 1/4-inch) flakes in the three surface feature aggregates augments these interpretations. The grade 4 fraction from Feature 3 includes a number of complete flakes and broken flakes, made from both local and imported materials, which likely were produced by soft-hammer biface trimming or rejuvenation. The aggregate also includes several complete pressure flakes. Fewer complete flakes occur in the grade 4 fractions from Feature 1 and Feature 2, though the Feature 2 sample does include one complete pressure flake. Most of the grade 4 flakes in the Feature 1 assemblage are assigned to the two largest MANs (Nodule 1 and Nodule 4) and consist of flake fragments or debris. Size grade 4 flakes from Feature 2 and Feature 3 were not included in the MANA.

Individual flake data on complete flakes and broken flakes in the Feature 1 and Feature 2 coarse-fraction (size grades 1 through 3) assemblages further define the technological processes represented (see Sullivan and Rozen [1985:Figure 2] for flake class descriptions). Table 3.15 gives the distribution of four platform types. Cortical platforms only occur in Nodule 1. Cortex can be difficult to identify on much of the material from the ridgetop quarry; however, the apparent absence of cortical platforms does suggest that the nodules reduced at Uncompahgre Cirque were roughed out at the quarry prior to initial transport. Among the largest MANs by weight, between 25 and 43 percent of the flakes exhibit simple, flat platforms indicative of hard-hammer reduction of irregular or multi-directional cores. A larger share of the complete and broken flake assemblage exhibits complex platforms indicative of biface production, likely by soft-hammer percussion. The crushed or indeterminate class consists primarily of collapsed platforms, produced either by bipolar reduction (and wedging initiation) or by hard-hammer percussion.

Table 3.16 provides data on platform preparation methods. One-quarter to one-half of the preserved platforms exhibit no special preparation. These are indicative flakes removed from irregular cores by hard-hammer percussion. A small number of flakes exhibit dorsal reduction intended to adjust the orientation or angle of the platform. Between one-quarter and one-half of the platforms on flakes made from the four largest nodules exhibit multiple facets, indicative of biface production. A smaller number of flakes exhibit ground platforms. These likely were produced during the later stages of biface manufacture.

The results of the mass analysis and the individual flake analysis, combined with the MANA results, indicate that the three surface feature assemblages primarily represent a combination of large flake production and biface production. Biface and flake tool production and maintenance, by soft-hammer percussion and pressure flaking, also are represented, especially in the Feature 3 aggregate.

Excavated Flaking Debris

The excavated flaking debris assemblage comprises 709 coarse-fraction specimens (size grades 1 through 3) weighing 912.6 g (table 3.17). The grade 3 fraction is the largest numerically, but the grade 2 fraction is the heaviest. This pattern contrasts with the pattern seen in the surface feature assemblage, in which the grade 1 fraction makes up a much greater share by weight (table 3.14). Weight distributions of experimental assemblages suggest that the portion of the excavated sample made of local chert represents a combination of hard hammer flake production and soft hammer

Table 3.15. Distribution of platform types observed on complete flakes and broken flakes, organized by feature and MAN. Nodule numbers are listed by decreasing weight proportion within each feature; see figure 3.8.

		Platform Type				
Feature No.	Nodule No.	cortical	simple	complex	crushed/indeterminate	Total (N)
1	1	4.2%	43.8%	33.3%	18.8%	96
	4		25.0%	60.7%	14.3%	28
	15		20.0%	50.0%	30.0%	10
	13			66.7%	33.3%	3
	5		33.3%		66.7%	3
	3		100.0%			1
Subtotal		*2.8%*	*37.6%*	*39.7%*	*19.9%*	*141*
2	17		28.2%	46.2%	25.6%	39
	16		31.9%	46.4%	21.7%	69
	18			50.0%	50.0%	2
	19		50.0%		50.0%	2
Subtotal			*30.4%*	*45.5%*	*24.1%*	*112*

Table 3.16. Distribution of platform preparation methods observed on complete flakes and broken flakes, organized by feature and MAN. Row percentages exclude specimens for which preparation method could not be determined. Nodule numbers are listed by decreasing weight proportion within each feature.

		Platform Preparation Method					
Feature No.	Nodule No.	none	faceted	dorsally reduced	ground	Total (N)	Unknown Method (N)
1	1	55.1%	25.6%	7.7%	11.5%	78	18
	4	25.0%	41.7%	4.2%	29.2%	24	4
	15	28.6%	71.4%			7	3
	13		100.0%			2	1
	5	100.0%				1	2
	3	100.0%				1	0
Subtotal		*46.9%*	*32.7%*	*6.2%*	*14.2%*	*113*	*28*
2	17	37.9%	55.2%		6.9%	29	10
	16	40.7%	38.9%	1.9%	18.5%	54	15
	18				100.0%	1	1
	19	100.0%				1	1
Subtotal		*40.0%*	*43.5%*	*1.2%*	*15.3%*	*85*	*27*

biface production and maintenance (Ahler 1989). The differences between the excavated and surface feature assemblages further highlight the distinctive character of the latter and bolster the interpretation of Features 1 and 2 as primarily limited-function activity loci.

Individual flake data on 363 coarse-fraction flakes from EU3 provide additional insights into the range of technological processes represented. Table 3.18 gives counts of platform types observed on 146 complete or broken flakes. More than half exhibit complex platforms, indicative of biface manufacture or maintenance. About one-third exhibit cortical or simple, flat platforms indicative of primary core reduction. Platform preparation data largely parallel the platform type data. However, about 4 percent of complete and broken flakes exhibit ground platforms, suggesting that they were produced during the later stages of biface manufacture.

Flake type data also were collected on the EU3 aggregate (table 3.19). The analysis recognizes five types of flakes (Ahler et al. 1994). Two are minimally defined classes: simple flakes are specimens exhibiting two or fewer dorsal flake scars reflecting prior flake removals while complex flakes are those exhibiting three or more dorsal scars. Later stages of lithic reduction generally produce a greater number of complex flakes. The other three flake classes are narrowly defined. Shatter or angular debris consists of chunks of stone lacking the landmarks necessary for reliable orientation with respect to flake separation face or with respect to the direction of applied force. Bipolar flakes are produced by wedging initiation and propagation of applied force. Bipolar flakes exhibit shattered, often pointed platforms with little or no surface area; pronounced, often asymmetrical ripple marks; parallel lateral margins; angular and polyhedral transverse cross-sections; and evidence that force was applied to both ends. Bulbs of force are usually absent and ventral surfaces are flat. Biface thinning flakes are produced by bending initiation of applied force. They exhibit wide but thin faceted or ground platforms; expanding plan view shapes; thin, slightly curving longitudinal cross-

Table 3.17. Count and weight distributions of excavated flaking debris.

		Weight				Count			
		Size Grade				Size Grade			
Raw Material Origin	Raw Material Type	G1	G2	G3	Total (g)	G1	G2	G3	Total (n)
Local	chert	4.9%	57.1%	38.0%	907.7	0.4%	17.3%	82.3%	699
Imported	chert			100.0%	1.0			100.0%	2
	chalcedony			100.0%	1.7			100.0%	3
	quartzite			100.0%	<0.1			100.0%	1
	obsidian			100.0%	2.2			100.0%	4

Table 3.18. Counts of platform types observed on complete flakes and broken flakes in the excavated assemblage.

Material Origin	Platform Type	Size Grade G2	Size Grade G3	Total (N)
Local	cortical	3	6	9
	simple	8	30	38
	complex	12	73	85
	crushed	2	11	13
Imported	complex		1	1

sections; small, flattened or diffuse bulbs of force; and three or more dorsal flake scars, often with divergent or opposing orientations.

Approximately 10 percent of the EU3 aggregate consists of angular debris. All percussion technologies produce shatter in all stages of manufacture, but it is most commonly produced during hard-hammer cobble testing and bipolar reduction (Ahler 1989). A small number of bipolar flakes are present in the collection, as are a few biface thinning flakes. Thinning flakes are produced primarily, though not exclusively, during soft-hammer biface thinning. Slightly less than half of the EU3 aggregate consists of other complex flakes.

In sum, data on the excavated flaking debris assemblage point to a mix of reduction strategies, including both hard-hammer flake production from multi-directional cores and hard- and soft-hammer biface production. The evidence further points to late- as well as early-stage biface manufacture. Bipolar reduction may constitute a minor component of the technological repertoire. Differences between the excavated flaking debris aggregate and the Feature 1 and Feature 2 aggregates discussed in the previous section suggest that the latter represent only a limited subset of the total range of production activities carried out at Uncompahgre Cirque.

Stone Tools

The stone tool assemblage includes 199 technological cases observed on 186 individual specimens (table 3.5). More than half of the tools derive from subsurface contexts. Three grade 4 tools occur in the excavated sample; however, as discussed previously, this fraction is likely not representative of the small tool fragments present at the site and is therefore excluded from the analysis. Three-quarters of the surface grab sample consists of items made from imported raw materials. Tools made from imported stone constitute just 6 percent of the excavated assemblage. Four percent of the tools recovered from surface features are made from imported stone.

Table 3.20 details the tool inventory by raw material, technological class, and analytic unit. Unsurprisingly, half of the excavated and surface feature assemblages consist of non-bipolar cores and core fragments. The site assemblage also includes imported cores: two obsidian core fragments occur in the excavated assemblage and the surface grab sample includes exhausted chalcedony and rhyolite cores.

The analysis takes a conservative approach to flake tool identification, owing to the possibility of edge damage caused by trampling, either during or after the occupation (McBrearty et al. 1998). Items identified as flake tools mostly exhibit continuous, low-angle invasive re-touch on one or more edges. Most exhibit macroscopic use-wear consisting of blunting, smoothing, or crushing. A minority exhibit use-wear visible under low-power (less than 45X) magnification.

Unpatterned flake tools account for 35 percent of the excavated assemblage and half of the combined surface feature assemblage. Two edge-modified pieces of local tabular stone (plate tools), whose functions likely were similar to those of unpatterned flake tools, also occur in the excavated assemblage. Six of the nine tools made from imported stone in the excavated and surface feature assemblages are unpatterned flake tools.

Table 3.19. Counts of flake types in the Excavation Unit 3 assemblage, organized by Sullivan and Rozen's (1985) flake completeness classes.

Flake Type	Completeness Class: complete flake	broken flake	flake fragment	debris	Total (N)
shatter/angular debris				35	35
bipolar	3	3	1		7
biface thinning	3	1	7		11
other simple	29	31	67		127
other complex	33	41	93		167
indeterminate	2		14		16
Total	70	76	182	35	363

Table 3.20. Counts of stone tool technological cases, organized by raw material type, technological class, and analytic unit.

		Raw Material Origin and Type								
		Local	Imported							
Analytic Unit	Technological Class	chert	chert	chalcedony	quartzite	rhyolite	basalt	sil. wood	obsidian	Total
Excavated	large patterned biface	5								5
	unpatterned biface	4								4
	patterned flake tool	1								1
	unpatterned flake tool	36	1	1	2					40
	non-bipolar core	54							2	56
	bipolar core/wedge	4	1							5
	plate tool	2								2
Subtotal		*106*	*2*	*1*	*2*				*2*	*113*
Surface Grab	large patterned biface		1		2				3	6
	unpatterned biface								2	2
	patterned flake tool				2			1		3
	unpatterned flake tool	5		1	3	1	1		10	21
	non-bipolar core	2		1		1				4
	bipolar core/wedge	1								1
Subtotal		*8*	*1*	*2*	*7*	*2*	*1*	*1*	*15*	*37*
Surface Feature	unpatterned flake tool	21			1				1	23
	non-bipolar core	22								22
	bipolar core/wedge	1								1
Subtotal		*44*			*1*				*1*	*46*
Total		158	3	3	10	2	1	1	18	196

Many of these bear evidence of transport wear in the form of macroscopic dorsal smoothing. Most are still serviceable.

Large patterned bifaces and unpatterned, expedient bifaces, all made from local stone, constitute about 8 percent of the excavated assemblage. (In addition, all three grade 4 specimens in the excavated collection are margin fragments or indeterminate pieces of large patterned bifaces). One unpatterned biface is complete, but the remainder consists of end or margin fragments. Most of the large patterened and unpatterned bifaces are fragments broken during manufacturing; however, one unpatterned biface, which later was recycled into a core, exhibits intensive macroscopic use-wear.

The surface grab sample includes six large patterned bifaces and two unpatterned bifaces, all but one of which are made from imported materials. Three are nearly complete. The lone specimen made from local stone is one end of a distinctive tool form known as an "alternately beveled knife" (figure 3.9[c]). These diamond-shaped tools exhibit unifacial pressure retouch on both faces, which creates four separate working edges, two on one face and two on the other. Edge angles range from about 40 to 60 degrees. Faces are parallel, and transverse and longitudinal cross-sections are trapezoidal. The Uncompahgre Cirque specimen is 6.2 mm thick and both faces are completely flaked. Its maximum width is 25.3 mm and it originally would have been roughly 45 mm long. A bending break occurs just above the longitudial midline, suggesting that the tool failed during use or rejuvenation. The working edges exhibit use-wear, in the form of smoothing and crushing.

Alternately beveled knives are best known from Plains Village contexts in Oklahoma and Texas, especially Antelope Creek phase assemblages dating to between A.D. 1200 and A.D. 1500 (Brooks 1989; Drass 1998; Lintz 1986). However, Husted and Edgar (2002:62, Plate 25j) describe an alternatively beveled knife from Culture Layer 30 at Mummy Cave, located in northern Wyoming's Absaroka Range. Cultural Layer 30 contains McKean complex projectile points and is dated to between 4500 ^{14}C yr B.P. and 4000 ^{14}C yr B.P. The example from Uncompahgre Cirque may therefore be the oldest known dated example of this distinctive artifact type.

Each analytic unit includes a small number of bipolar cores or wedges. The function or functions of bipolar tools are not well understood, a fact reflected in the large number of terms used to describe them, including punch, wedge, chisel, and core (Hayden 1980; Le Blanc 1992; Shott 1989). Larger specimens commonly are considered cores that were reduced wholly or in part by bipolar percussion. Smaller specimens more likely represent wedges or chisels used to work wood, bone, or antler. Bipolar flaking on these smaller specimens is a byproduct of indirect percussion, with the bipolar object serving as a punch or chisel.

Five bipolar tools occur in the excavated sample, one of which is made from imported stone. One occurs in the surface grab assemblage and another occurs in the surface feature assemblage. Both of these are made from local stone. The specimen in the surface grab sample was fractured by burning, but is large enough to be considered a core fragment. Owing to their small size, the remaining six are best classified as wedge tools. The bipolar tool in the surface feature assemblage is the second use of a specimen used first as an expedient flake tool.

Four patterned flake tools or end scrapers are present in the tool assemblage, including three in the surface collection that are made from imported materials, and one made from local stone in the excavated collection. Two of the scrapers in the surface collection are made from quartzite and one is made from silicified wood. Tools of this type commonly are hafted and are used to clean hides or work wood, bone, or antler. One complete specimen in the surface assemblage that is 103 mm long, 62 mm wide, and weighs 146.8 g, is large enough to have been used without a handle. The presence of this large and still-serviceable tool suggests that some items may have been cached at Uncompahgre Cirque in anticipation of future use.

About 6 percent of the Uncompahgre Cirque tool assemblage consists of recycled, or multi-case, tools. This recycling rate is similar to that observed in large tool assemblages recovered from permanent village sites located near the confluence of the Missouri and Heart rivers in central North Dakota, a location well away from productive toolstone sources (Mitchell 2011). The comparatively high recycling rate at Uncompahgre Cirque may indicate a protracted use of the site. For instance, the single three-case tool in the collection, made from local stone, was first an unpatterned biface, subsequently was recycled into an expedient scraping tool, and finally was heat-treated and refashioned into an unpatterned biface. A bending break indicates that the tool failed during the final recycling phase. It is likely that these multiple uses took place over many days, especially in view of the time required to successfully heat treat stone.

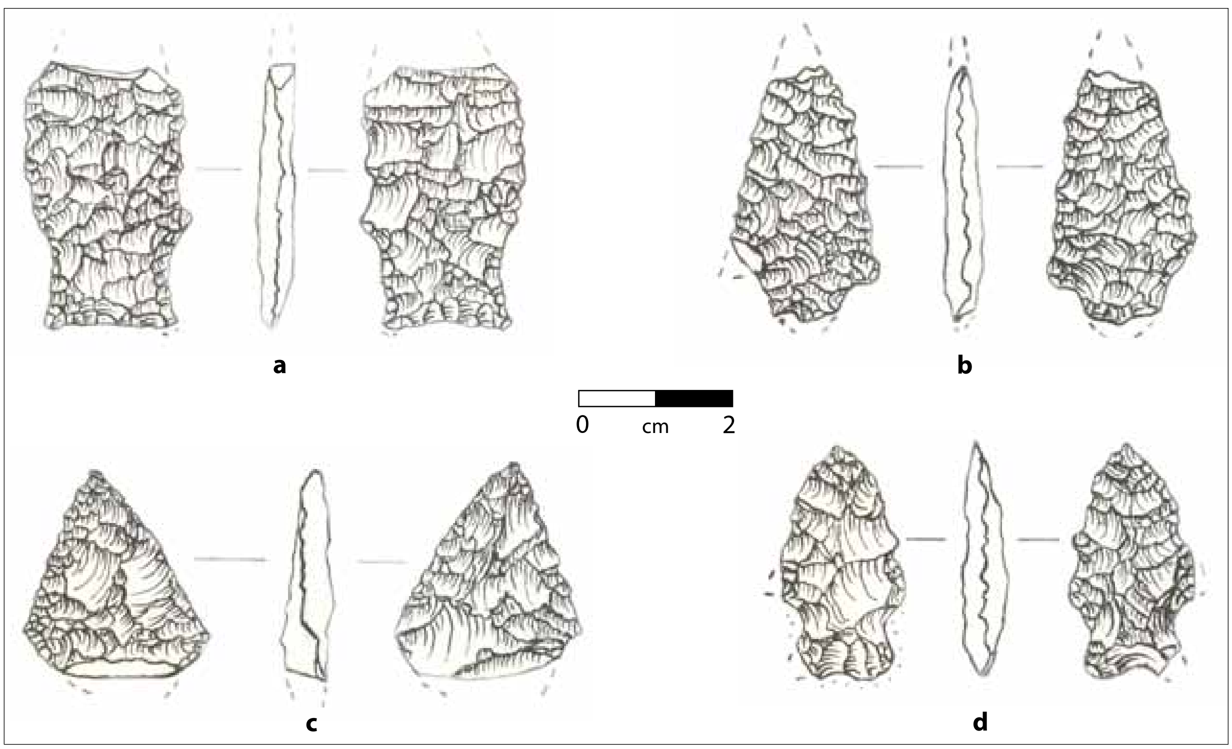

Figure 3.9. Selected bifacial chipped stone artifacts. a: possible Foothills-Mountain complex point from isolated find 5HN1139, made from light brown, medium-grained quartzite; b: stemmed or side-notched dart point from Uncompahgre Cirque, made from coarse brown quartzite; c: alternately beveled knife from Uncompahgre Cirque, made from local chert; d: stemmed indented base dart point from Uncompahgre Cirque made from fine-grained gray quartzite. Illustrations by Marvin Goad.

Projectile Points

The surface assemblage includes two quartzite dart points (figures 3.9[b] and 3.9[d]). Another stemmed dart point fragment, also made from quartzite, was observed and photographed during the initial 2007 inventory but was not collected (Bennett et al. 2007; Lawrence 2009). This specimen is the proximal half of a stemmed projectile point made from fine-grained gray quartzite. The latter specimen is relatively small, with a distal haft width of approximately 10 mm, but its form suggests that it is a dart point and is Archaic in age. Table 3.21 gives metric data on the collected specimens, along with data on a point from 5HN1139, an isolated find located roughly 600 m east-southeast of Uncompahgre Cirque (figure 3.9[a]).

Specimen CN1005 (figure 3.9[b]) is a stemmed or side-notched dart point made from homogeneous, coarse-grained brown quartzite. The transverse cross-section is bi-convex and symmetrical. Blade margins are straight and weakly serrated. The base has broken away and a small impact fracture is evident on the tip. A minor burination spall on the lower edge of one blade margin may also be due to impact.

This specimen cannot be assigned to a named type because the base is broken away. However, various types of stemmed points as well as large side-notched points occur in high country assemblages dating between about 7500 B.P. and 3000 B.P. (Mullen 2009; Reed and Metcalf 1999).

Specimen CN1236 (figure 3.9[d]) is a stemmed, indented-base point made from fine-grained gray quartzite. Amorphous yellow-brown bands and sparse white inclusions are present in the stone. The stem is short and the basal "ears" are robust. The base and notches are ground. The tip exhibits an impact fracture. The point's irregular flaking patterns, along with its comparatively low width to thickness ratio and slight longitudinal curvature, suggest that it was reworked prior to or following its final use as a projectile. Both faces exhibit moderate to pronounced use-wear in the form of arris smoothing.

Stemmed indented-base points are common in the mountains and in the Plains-foothills ecotone (Benedict 1990; Black 1991; Gantt 2007; Gilmore 2011; Kalasz et al. 2003; Metcalf and Black 1991; Reed and Metcalf 1999). Points of this type can co-occur with McKean points, but also are recovered from Early Plains Archaic and Late Plains Archaic (Yonkee) contexts (Kornfeld et al. 2010). They also occur in Middle Archaic Great Basin and Colorado Plateau assemblages where they are included in the Little Lake series (Pinto and Humboldt Concave Base points). Pinto points appeared in the Great Basin earlier than McKean complex points appeared in the Northern Plains. In the high country, stemmed indented-base points occur in assemblages dating between about 7000 B.P. and 2000 B.P. (Mullen 2009; Reed and Metcalf 1999).

The third collected projectile point (5HN1139, CN2001; figure 3.9[a]) is a basal fragment of a stemmed specimen made from light brown, medium-grained quartzite. Sparse dark mineral inclusions occur throughout the stone. The remaining intact blade margin is straight to slight convex. The blade is bi-convex and symmetrical in transverse cross-section, but the stem is rectangular. The concave lateral margins of the stem are ground, as is the base. The base is slightly "earred." The tip bears a nondescript lateral break, along with two high-angle fractures that likely are recent.

This point is morphologically similar to Pryor Stemmed points from northern Wyoming and southern Montana. However, it does not exhibit the alternate-face blade reworking characteristic of that type (Kornfeld et al. 2010:102). It also does not exhibit the parallel-oblique flaking characteristic of many stemmed Foothills-Mountain complex points (Pitblado 1998). In the Central Rocky Mountains, the Foothills-Mountain complex dates to between 10,000 and 8000 ^{14}C yr B.P. Possibly related Deception Creek points occur in western-slope contexts dating between about 9000 B.P. and 5500 B.P. (Mullen 2009; Reed and Metcalf 1999).

Burning and Heat Treatment

Only a small number of stone tools in the Uncompahgre Cirque assemblage are burned (table 3.22). None of the tools in the excavated assemblage exhibit evidence of burning. Roughly 13 percent of the tools comprising

Table 3.21. Projectile point metric data (see Ahler [1971] for measurement definitions).

Site Number	Catalog Number	Figure Reference	Measurements (mm) Extant Length	Extant Base Width	Hafting Width	Hafting Length	Blade Base Width	Maximum Thickness	Weight (g)
5HN1098	1005	3.8(b)	33.7	9.4	11.0	-	-	5.1	3.5
5HN1098	1236	3.8(d)	30.6	13.2	11.2	6.6	-	6.1	3.0
5HN1139	2001	3.8(a)	35.5	17.5	16.2	11.7	20.9	5.6	5.3

Table 3.22. Counts of burned and unburned stone tools, organized by analytic unit. The second and third cases of multi-function tools are omitted.

	Burning		
Analytic Unit	Unburned	Burned	Total (N)
Excavated	108		108
Surface	32	4	36
Surface Feature	41	1	42
Total	181	5	186

the surface grab sample are burned. The frequency of burning was not quantified for the flaking debris assemblage, but qualitative observations suggest that less than 1 percent is burned.

Data on the occurrence of intentional heat treatment were not systematically collected for tools or flaking debris. However, unmistakable examples of heat treated flakes and tools are present in the collection. Evidence for heat treatment includes the presence of a thin red patina on previously flaked surfaces as well as post-heating alteration of surface luster from matte to waxy on newly flaked surfaces. All of the treated stone derives from the ridge-top quarry. The fact that treated flakes in the assemblage were struck after heating occurred indicates that the treatment process took place on-site. Feature 5, a large rock-lined pit hearth, may have been used to treat stone.

Summary

Multiple lines of evidence—including radiocarbon dates, obsidian hydration rim thicknesses, and stratigraphic data—together indicate that the Uncompahgre Cirque site was occupied briefly between about 5900 and 5700 calendar years ago. All four radiocarbon dates from the site are statistically equivalent, yielding a weighted mean age of 5038±19 ^{14}C yr B.P. This mean age spans at two standard deviations the period from 3944 cal B.C. to 3776 cal B.C., or a total of 168 calendar years. Hydration rim thickness distributions point to a brief occupation or series of occupations within this period. The thickness distribution for Polvadera Peak/El Rechuelos stone is strongly unimodal, while the distribution for Cerro del Medio stone exhibits an elongated rectangular distribution. Stratigraphic data bolster the view that the occupation at Uncompahgre Cirque was brief. Artifacts mostly occur in a single zone near the base of a prominent paleosol. Pedological data indicate that the occupation took place during a period of comparatively rapid sediment deposition. The majority of artifacts are flat-lying.

The major activity at the site was initial reduction of quarry blanks for off-site transport and later use. Local toolstone nodules were first roughed out at the ridge-top quarry (5HN1099), judging by the limited occurrence of cortex on the waste flakes in the surface feature and excavated assemblages. These nodules were further reduced at Uncompahgre Cirque. The resulting transportable raw material blanks include large flakes as well as both early- and late-stage bifaces. Multi-directional cores may also have been carried away from Uncompahgre Cirque: though half of the tool assemblage consists of non-bipolar cores, most of these are exhausted fragments.

Apart from raw material blanks produced for transport, flint knappers at Uncompahgre Cirque also produced a variety of tools for on-site use, including flake tools, end scrapers, and bifaces. An alternately beveled knife in the collection may be the most ancient example known of this distinctive tool form. Some of the tools manufactured from local stone for on-site use were made from heat treated flakes or nodules. It seems likely that a portion of the transported assemblage was heat treated as well. The presence of tools made from both imported and local stone bearing use-wear traces indicates that a variety of tasks other than lithic reduction and tool manufacturing also took place at Uncompahgre Cirque. Such tasks could have included animal butchery, hide processing, or woodworking.

Uncompahgre Cirque's occupants brought with them toolstone from numerous distant sources, including obsidian from northern New Mexico and quartzite, chert, and other materials likely from the Gunnison basin and central Colorado. The diversity of imported raw materials suggests that multiple groups from different regions came together to use the chert quarry at Uncompahgre Cirque, bringing their local toolstone with them. Trade occurring at other localities during the weeks or months prior to the occupation at Uncompahgre Cirque could also account for this pattern, but aggregation and interaction at Uncompahgre Cirque itself is a more parsimonious explanation, given the great distances to, and divergent directions of, the sources of imported stone.

Stone was imported both as finished tools and as cores, and was used at Uncompahgre Cirque in much the same way as the local chert was used. Initial core reduction of imported stone is indicated by the presence in the surface grab sample of large, unused flakes bearing cortex. Exhausted cores of obsidian, rhyolite, and chalcedony also occur in the collection. In addition, a large and serviceable red quartzite core (measuring roughly 10 to 15 cm across) was observed on the surface roughly 200 m east of Uncompahgre Cirque. Smaller flakes of imported stone, indicative of tool manufacturing or maintenance, also occur in the excavated and surface feature assemblages. These include thinning flakes produced during the late stages of biface production as well as small flakes produced by soft-hammer percussion and pressure flaking during tool rejuvenation. Many of the finished tools imported to Uncompahgre Cirque consist of end scrapers made from quartzite, suggesting that this material was preferred for certain tasks, possibly including hide preparation. The fact that serviceable end scrapers made from imported materials occur at Uncompahgre Cirque suggests that some items may have been cached there for later use.

4

Living Above Timberline: Archaeology of the San Juan High Country

Alpine environments in the Southern Rocky Mountains permit only seasonal occupation and so the record of past activity there must ultimately be tied to larger-scale patterns of landscape use (Bettinger 2000). However, the reverse is also true: to the extent native peoples made use of high-elevation life zones, an understanding of what they did there affords a clearer picture of broader subsistence and settlement systems (Bender and Wright 1988). Data are available for many of the major valleys surrounding the San Juan Mountains (Lipe et al. 1999; Martorano et al. 1999; Reed and Metcalf 1999; Stiger 2001), but archaeologists so far have said little about the record above tree line. For that reason, this summary focuses exclusively on sites above 3,400 m, the approximate upper limit of dense timber stands in the San Juans. A variety of local factors control tree growth at this elevation, including temperature, aspect, topography, wind speed, cold-air drainage patterns, snow loading, and avalanche frequency (Carrara 2011). Timberline in the San Juans, defined as the maximum extent of upright trees (Englemann spruce and subalpine fir) taller than about 5 m, lies between 3,535 and 3,600 m. Treeline, defined as the extent of krummholz, lies at about 3,660 m. The lower 3,400 m cutoff was chosen to capture sites located in the patchy transition zone between dense subalpine forest and uninterrupted alpine tundra.

The study area is roughly bounded on the west by the upper tributaries of the Dolores River, on the east by the San Luis Valley, on the north by the Gunnison River, and on the south by the Colorado-New Mexico line. For this region, the database maintained by History Colorado's Office of Archaeology and Historic Preservation (OAHP) lists 156 American Indian sites or isolated finds above 3,400 m (figure 4.1). This count includes the Uncompahgre Cirque site, but excludes other nearby sites recorded by Lawrence (2009), which had not been entered into the OAHP database prior to January 2011. In several areas, the 3,400 m lower elevation limit excludes some sites forming obvious clusters with sites above 3,400 m. For instance, a cluster of four sites occurs on Squaw Pass in the Weminuche Wilderness, but three of these are located just below the 3,400 m cutoff.

Figure 4.2 illustrates the elevation distribution of the sample. The distribution is weakly bi-modal, with a frequency peak between about 3,425 and 3,625 m and another smaller peak between 3,725 and 3,825 m. The lower peak encompasses forest-edge settings that likely afforded maximum access to a broad spectrum of plant, animal, and other resources. The smaller frequency peak occurs entirely within the open tundra ecosystem and may indicate that native people targeted resources occurring more commonly at that elevation, especially in view of the fact that the area contained within each successive elevation band decreases steadily with increasing altitude (Reed and Metcalf 1999). However, it is not currently possible to rule out entirely the effects of uneven survey coverage or differential ground visibility. The mean elevation for sites is equivalent to the mean elevation for isolated finds, suggesting that both resource types represent a single settlement system ($F=.013$; $p=0.910$).

Site Types and Content

Sixty percent of the cultural resources in the OAHP dataset are classified as isolated finds or features (table 4.1). Another 30 percent are open lithic scatters. The balance, amounting to just over 10 percent, are open camps or open architectural sites. To better understand the types of resources represented, the 156-site sample is further partitioned into seven groups based on reported content. Table 4.2 gives definitions of the seven artifact association groups and table 4.3 provides a breakdown of the San Juan dataset by group.

About 30 percent of the sample consists of isolated tools, projectile points, or features. An equivalent proportion consists of flaking debris scatters not associated with stone tools or other kinds of artifacts. Sites composed of flaking debris associated with a variety of cutting, scraping, or grinding tools account for another 31 percent (figure 4.3). Sites in this latter association group may be somewhat more common in the eastern San Juans than in the western. The remaining sites in the OAHP sample consist of flakes associated with projectile points or flakes associated with cores.

In functional terms, roughly 23 percent of the resources comprising the dataset primarily represent animal procurement. These include isolated projectile points and projectile points associated with waste flakes. (Possible hunting blinds are discussed at the end of this

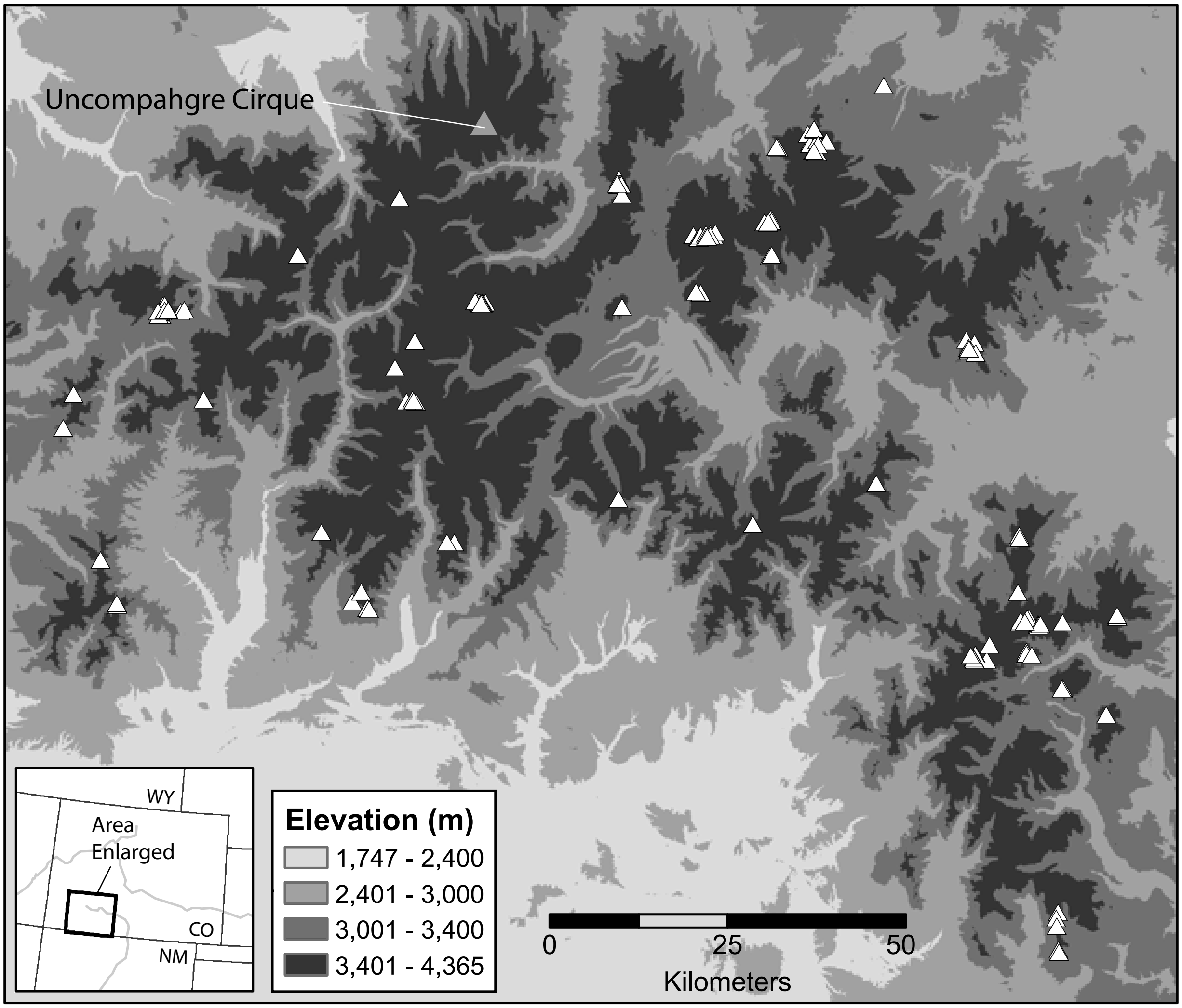

Figure 4.1. Map showing the distribution of 156 sites and isolated finds located above 3,400 m in the San Juan Mountains.

section). Another 40 percent of the resources in the OAHP dataset represent other types of activities, likely including hide preparation, animal butchery, and plant procurement and processing. These resources include isolated cutting or scraping tools as well as cutting or scraping tools, pottery, or ground stone tools associated with flaking debris. Ground stone implements occur on nine sites. The majority of the ground stone artifacts are small, minimally modified handstones. Millingstones occur on four sites. Sites with grround stone tools are slightly more common in the western San Juans.

Table 4.1. Distribution of resources according to History Colorado Office of Archaeology and Historic Preservation types.

Resource Type	Frequency	Percent
open camp	13	8.3
open lithic	46	29.5
open architectural	3	1.9
isolated find/feature	94	60.3
Total	156	100.0

Table 4.4 gives mean sizes and elevations of the resources in each association group. Isolated features occur at a significantly higher elevation than the other groups, but no differences exist in mean elevation among the remaining six categories. The elevation distributions of most of the association groups individually exhibit the same weakly bi-modal pattern discussed previously, again suggesting minor preferences for locations in those two elevation bands (figure 4.4). The fact that the distributions illustrated in figure 4.4 are roughly congruent also bolsters the idea that all of the resources

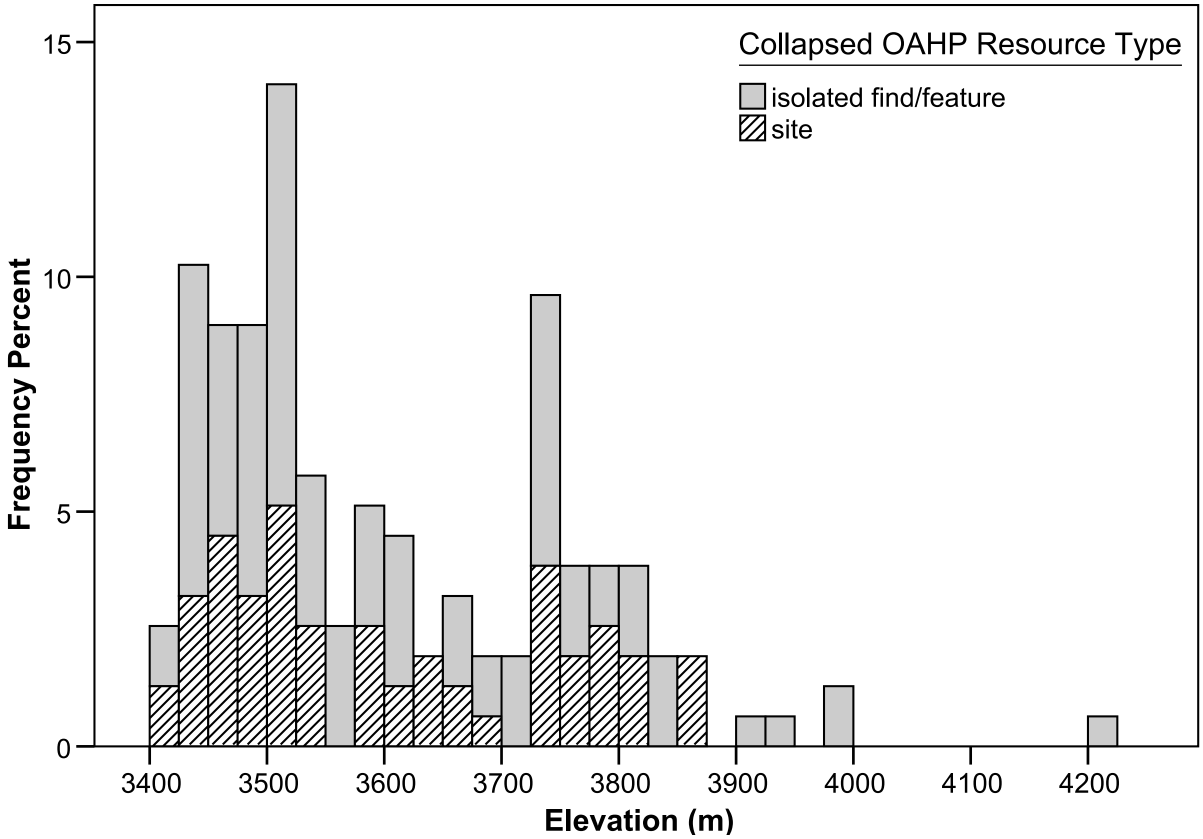

Figure 4.2. Elevation distribution of 156 sites and isolated finds above 3,400 m in the San Juan Mountains.

Table 4.2. Definitions of San Juan Mountains resource association groups.

Association Group	Description
Flake scatter	Flaking debris only
Flakes and tools	Flaking debris associated with bifaces, scraping tools, unpatterned flake tools, ground stone tools, or pottery; projectile points may or may not be present
Flakes and projectile points	Flaking debris associated with one or more projectile points but no other chipped stone tools
Flakes and cores	Flaking debris associated with one or more cores but no other chipped stone tools
Isolated stone tool	Single biface, scraper, core, or other chipped stone tool; does not include isolated projectile points
Isolated projectile point	One or more projectile points
Isolated feature	Cairn or stone enclosure not associated with chipped stone or other artifacts

Table 4.3. Distribution of artifact association groups.

Association Group	Frequency	Percent
flakes only	46	29.5
flakes and tools	48	30.8
flakes and projectile points	11	7.1
flakes and cores	5	3.2
isolated tool	16	10.3
isolated projectile point	24	15.4
isolated feature	6	3.8
Total	156	100.0

in the San Juan dataset represent a single mode or pattern of landscape use.

Sites comprised of flakes and other tools exhibit the highest mean artifact count, but in fact no statistically significant size differences exist among the four multiple-item association groups (F=0.418; p=0.795). Figure 4.5 shows that the majority of resources composed of three or more chipped stone artifacts include fewer than 33 items. However, the distribution shown in figure 4.5 excludes two outlier sites with extremely large surface assemblages. Both are quarry workshops located near chert outcrops. One is the

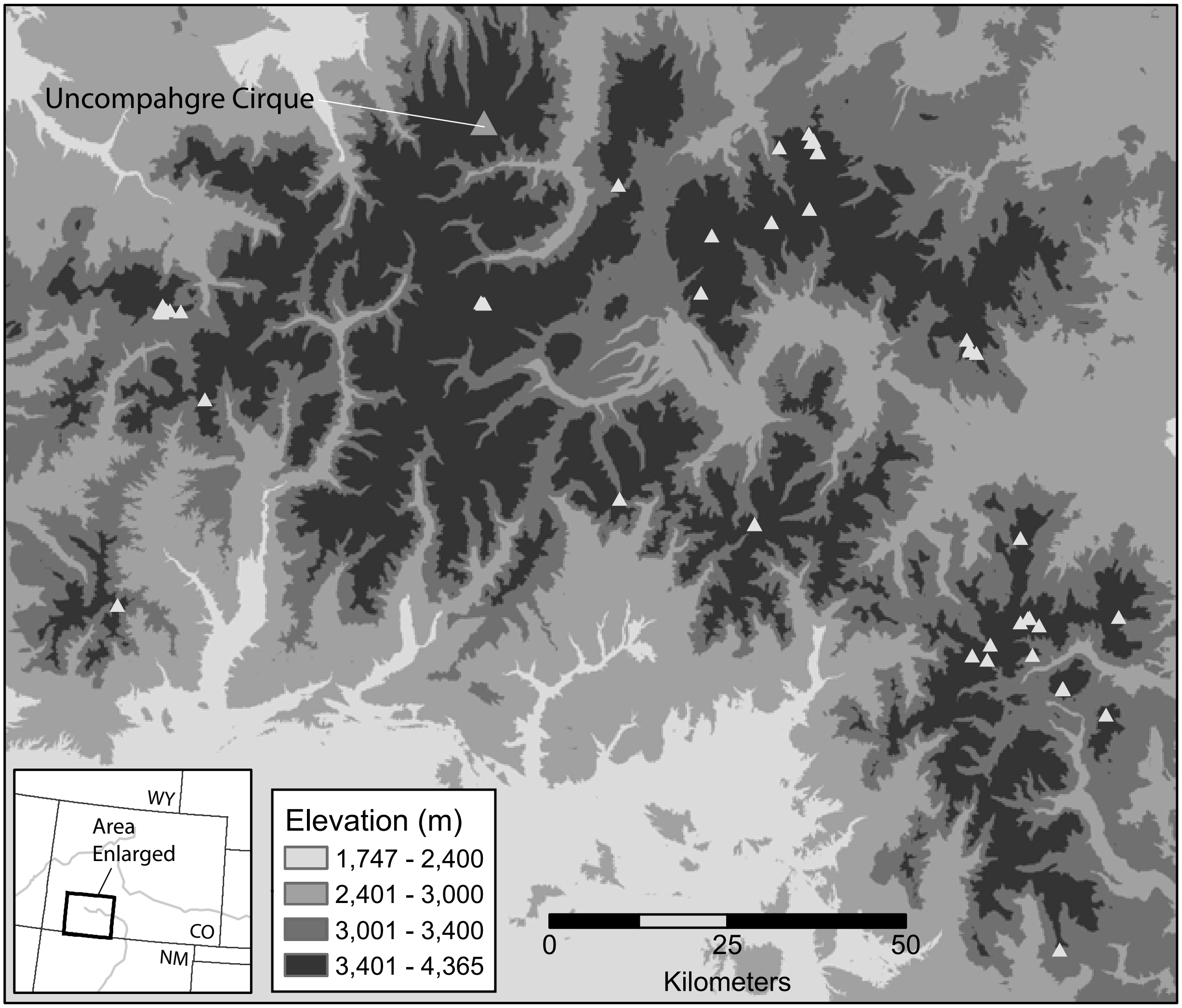

Figure 4.3. Map showing the distribution of 48 sites composed of flakes and other tools.

Uncompahgre Cirque site, with an estimated surface assemblage consisting of about 3,000 items. The other is 5ML302, which includes more than 2,295 items (Mauz 1995). (Sites 5ML45 and 5ML46, the only excavated sites above timberline in the San Juans apart from Uncompahgre Cirque, also are excluded from figure 4.5. A total of 2,404 items was recovered from surface and subsurface contexts at these two sites [Reed 1984]). Thus, a plurality of the resources in the OAHP dataset consist of small scatters of flaking debris and non-projectile tools, likely representing short-term multi-function camps. The largest sites above timberline are lithic workshops associated with raw material sources.

A distinctive feature of the resources comprising the OAHP dataset is the diversity of the chipped stone raw materials present. Few assemblages consist of just one raw material type and the majority incorporate several types, including multiple varieties of chert, orthoquartzite, obsidian, basalt, and rhyolite. Particularly notable is the relative commonness of obsidian tools and flaking debris. Artifacts made from obsidian were observed on 46 (31 percent) of the 147 sites or isolated finds for which data are available. Site assemblages incorporating obsidian are distributed throughout the San Juans, not jsut on the southern and eastern flanks, which are closest to the Jemez source area (figure 4.6). The presence of obsidian artifacts varies by association group: assemblages composed of flakes only, or flakes and cores, are much less likely to include obsidian artifacts than assemblages composed of flakes and tools or flakes and projectile points (table 4.5). In terms of raw counts, 14 percent of all chipped stone artifacts tallied during surface inventories are made from obsidian. At the only two previously excavated sites above timberline apart from Uncompahgre Cirque (5ML45 and 5ML46), 61 percent

Table 4.4. Assemblage size and mean elevations of San Juan sites, organized by artifact association group.

	Elevation		Total Chipped Stone Artifact Count			
Association Group	Number of Sites	Mean (m)	Number of Sites	Mean	Min.	Max.
flakes only	46	3594	22	25.6	2	353
flakes and tools	48	3575	38	37.3	3	344
flakes and projectile points	11	3640	8	21.3	2	64
flakes and cores	5	3663	5	10.0	2	40
isolated tool	16	3606				
isolated projectile point	24	3551				
isolated feature	6	3952				
Total	156	3602	73	30.1	2	353

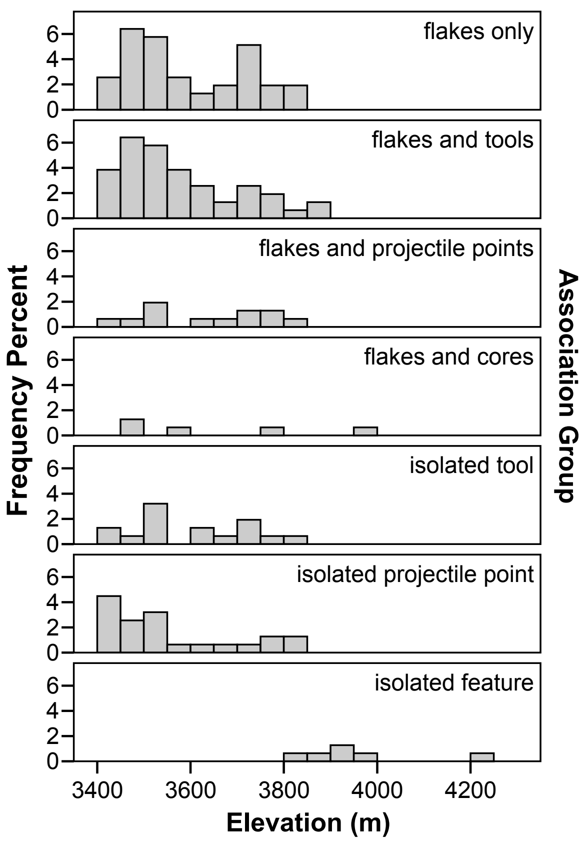

Figure 4.4. Elevation distributions of seven resource association groups.

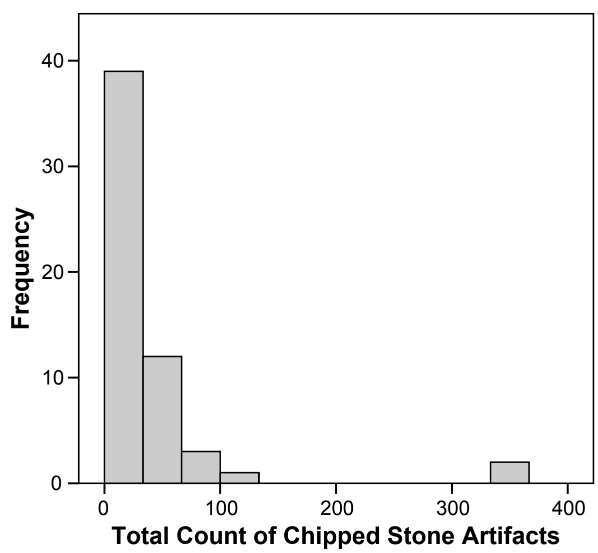

Figure 4.5. Assemblage size distribution of San Juan Mountains sites containing three or more chipped stone artifacts.

of the recovered flaking debris is made from obsidian (Reed 1984:Table 3). No difference exists in the mean elevations of sites with and without obsidian artifacts.

No significant obsidian sources are present in the San Juan Mountains region and trace-element sourcing studies indicate that the majority of the obsidian artifacts from sites above timberline are made from stone derived from two large quarry localities in northern New Mexico's Valles Caldera, known as Polvadera Peak/El Rechuelos and Cerro del Medio. Of the 234 sourced obsidian artifacts in Ferguson and Skinner's (2003) compilation of data from sites in the 13 counties encompassing the San Juans, just 40 specimens (17 percent) are made from stone obtained at sources other than Polvadera Peak or Cerro del Medio. Just two specimens (less than 1 percent) derive from Obsidian Ridge, a third source located in the Valles Caldera.

Architectural features occur on just nine resources in the OAHP dataset. Five of the nine are isolated features not associated with artifacts. The other four resources incorporating stone features are classified as open camps or open architectural sites.

A total of 11 architectural features occur on these nine resources. One feature is a stone enclosure measuring roughly 4 m in diameter, which is associated with a single core fragment. Four more features consist of shallow pits or "blinds" excavated into rocky slopes or benches. Each of these measures approximately 1

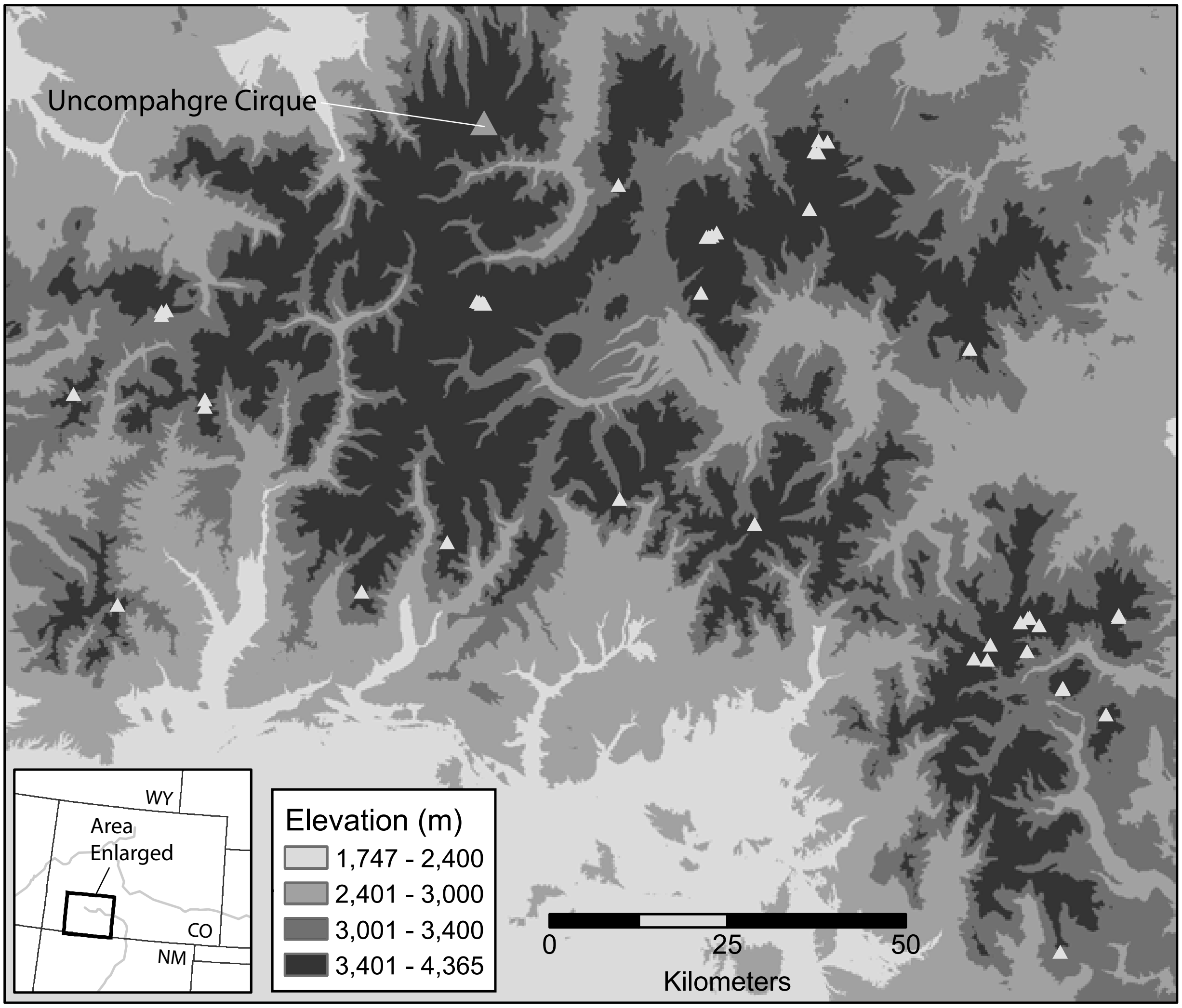

Figure 4.6. Map showing the distribution of sites containing obsidian artifacts.

Table 4.5. Distribution of sites with and without obsidian artifacts among four multi-item association groups.

	Obsidian Occurrence			
Association Group	not present	present	no data	Total (N)
flakes only	76.1%	15.2%	8.7%	46
flakes and tools	39.6%	54.2%	6.3%	48
flakes and projectile points	36.4%	45.5%	18.2%	11
flakes and cores	80.0%	20.0%		5
Total (N)	62	39	9	110

to 1.5 m in diameter. The remaining six features are stacked rock cairns. Mauz (1995) briefly mentions a suite of rock structures at 5ML302, including an enclosure, a wall, and possible cairns, but does not describe them and they are not mentioned on the site form. A "hunting blind" also occurs at site 5HN151 in the Weminuche Wilderness (Southwell 1995). This resource is located at 3,627 m but is not included in the San Juan Mountains sample analyzed for this study, possibly owing to a data coding error.

The stone enclosure and the four pits included in the OAHP dataset could represent isolated hunting blinds or portions of larger game-drive systems. The enclosure (at site 5DL1878) is located on a broad ridge that animals moving between two adjacent drainage basins might traverse. However, the feature's location—on top of the ridge, rather than on the downwind slope below the ridge—is not typical of the hunting blinds documented elsewhere in the Southern Rocky Mountains (e.g. Benedict 1996:33). The enclosure at 5DL1878 is asymmetrical, with the south wall higher than the north, east, or west walls. This type of "breastwork" construction has been noted at game drives in the Front Range, where Benedict (1996) shows that such blinds typically open downwind. If the enclosure at 5DL1878 is a hunting feature, then it likely would have been used only when prevailing winds were blowing from the south and animals were moving northward.

The four pit features in the OAHP dataset are superficially similar to hunting blinds built in blockfields in the Front Range, where walls were constructed by piling up stones in a rough arc or circle (Benedict 1996). However, none of the pits in the San Juan dataset is located on a landform typical of those documented in the Front Range (Benedict 1996; Cassells, ed. 2000). Instead, they are located on broad, steep slopes or minor ridges, locations that likely would not adequately conceal hunters from approaching herds.

None of the cairns documented at high-elevation sites in the San Juans appears to be associated with a larger game drive system. Four of the cairns, at three different sites, are not associated with flaking debris, chipped stone tools, or other artifacts. One of these four (at 5SH3461) may date to the 1800s or 1900s (McKeever 2008). Two other cairns occur at camps, including Uncompahgre Cirque. The cairn at Uncompahgre Cirque (Feature 4; see chapter 2 for a description) clearly is a constructed feature and likely is ancient. However, its position on the landscape, coupled with the fact that no other cairns are present in the vicinity, indicates that it is not part of drive system.

Sites Chronology

Chronological data are available for 48 of the 156 resources in the OAHP dataset (table 4.6). Ages of 43 sites or isolated finds are derived from morphological data on surface-collected projectile points. Pottery occurs on one site and another site assemblage includes both pottery and projectile points. Radiocarbon assays are available for three sites, including the Uncompahgre Cirque site and the Piedra Pass sites (5ML45 and 5ML46). Several sites in the OAHP dataset exhibit evidence of multiple occupations. For example, site 5SA51 produced both grayware pottery and Oshara tradition dart points, suggesting the presence of both Archaic and Late Prehistoric components. However, in view of the uncertainties inherent in inventory data, and to simplify the presentation, each site is assigned to just one temporal group.

Table 4.6. Breakdown of sites by major chronological period.

Temporal Group	Frequency	Percent
Late Prehistoric	9	5.8
Archaic	38	24.4
Late Paleoindian/Archaic	1	.6
unknown	108	69.2
Total	156	100.0

The 48 dated resources are further partitioned into a series of broad, partially overlapping temporal groups (table 4.7). Group assignments are based primarily on the original investigators' age estimates. A few of these age estimates were revised based on published artifact illustrations or other data presented in site forms.

The lone Paleoindian-age artifact in the dataset is a lanceolate point exhibiting parallel-oblique flaking, a slightly concave base, and ground lateral margins. Projectiles with these attributes commonly are typed as Angostura, Frederick, James Allen, or Foothills-Mountain Complex points and date to between 8000 and 9000 B.P. (Kornfeld et al. 2010; Pitblado 2003). Lipe and Pitblado (1999:Table 4-2) identify the specimen in the OAHP dataset as an Angostura point.

Thirty-eight (79 percent) of the 48 resources for which chronological data are available date to the Archaic. Some of these are assigned to discrete periods within the Archaic; however, the chaotic diversity of Archaic projectile point forms recovered from mountain contexts in Colorado severely limits the usefulness of such finer distinctions (Mullen 2009; Reed and Metcalf 1999:83-86). The four radiocarbon dates from the two excavated Piedra Pass sites, which range from 3390±130 to 7860±190 ^{14}C yr B.P. (Reed 1984:Table 1), also fall into the Archaic era, as do the four dates from Uncompahgre Cirque (see chapter 2).

Table 4.7. Breakdown of dated sites by detailed chronological period.

Temporal Group	Frequency	Percent
Late Prehistoric	7	14.6
Late Archaic/Late Prehistoric	2	4.2
Late Prehistoric Subtotal	*9*	*18.8*
Archaic	20	41.7
Early Archaic/Middle Archaic	8	16.7
Middle Archaic/Late Archaic	3	6.3
Late Archaic	7	14.6
Archaic Subtotal	*38*	*79.3*
Late Paleoindian/Early Archaic	1	2.1
Total	48	100.0

The remaining nine dated resources (19 percent) were occupied in the Late Prehistoric. One of the sites nominally assigned to the Late Archaic/Late Prehistoric group includes both large stemmed to corner-notched dart points and small, corner-notched arrowpoints. The other includes dart points and grayware pottery. Data from the Upper Crossing site (5SH134), located in the Saguache Creek valley northeast of the San Juans, shows that atlatl technology persisted in the Rio Grande basin as late as 1000 B.P. (Mitchell 2012). Six of the seven sites in the San Juans sample that are classified as Late Prehistoric in age contain small corner- or side-notched arrowpoints, while the seventh contains seven ceramic sherds representing at least two vessels.

Figure 4.7 shows the elevation distribution of dated resources. The Late Paleoindian lanceolate point (at site 5HN154) occurs in the lowest elevation band in the OAHP sample. Interestingly, this particular resource is also the highest in a sample of Paleoindian sites and isolated finds compiled by Lipe and Pitblado (1999:Table 4-2) for the Southern Colorado basin. This supports Pitblado's (1998) view that native people made only limited use of the San Juan high country during the Pleistocene/Holocene transition or early Holocene. Angostura or Foothills-Mountain Complex points, particularly those made from quartzite like the example from 5HN154, are the most common Paleoindian type in southwest Colorado, suggesting slighly greater use of the region after 9000 B.P.

The mean elevations of Archaic and Late Prehistoric sites in the OAHP dataset are not significantly different ($F=0.528$, $p=0.471$). However, just one Late Prehistoric site occurs in the higher-elevation site group, suggesting that the bi-modal altitude distribution discussed in the previous section is primarily a feature of Archaic-era land use.

The mean size of 16 Archaic sites composed of two or more items (51.8±81.9 artifacts) is larger than the mean size of five Late Prehistoric sites composed of two more items (39.0±44.8 artifacts), but not significantly so ($F=0.109$; $p=0.744$).

Summary and Discussion

Though the high-elevation San Juan dataset is small, and derived almost exclusively from surface surveys, several clear patterns are nevertheless evident. Chronological data point strongly to primarily Archaic-era use of the San Juan high country. Nearly 80 percent of the dated localities in the OAHP dataset were occupied sometime during the Archaic. Judging by the radiocarbon dates from Uncompahgre Cirque, intensive use of high-altitude resources began at least by 6000 cal B.P. The paucity of Paleoindian projectile points

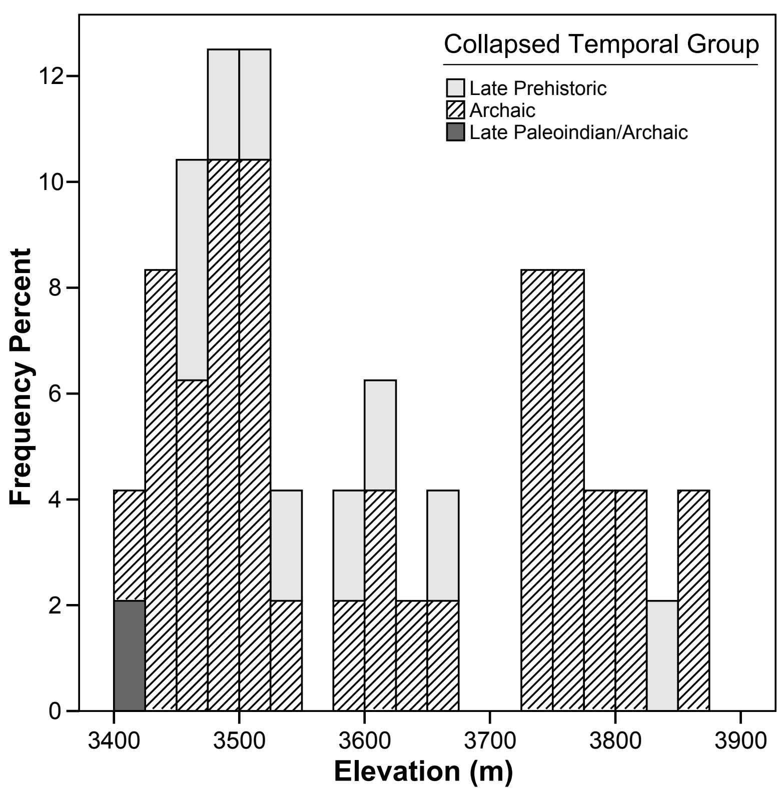

Figure 4.7. Elevation distribution of dated sites.

indicates only sporadic use of alpine environments in the San Juans prior to 9000 cal B.P. The diversity of stemmed, side-notched, and corner-notched dart points in the sample could point to use of the high country throughout the Archaic. However, projectile point data are insufficiently fine-grained to determine whether such use was roughly continuous or whether occupation during certain periods was more extensive or intensive. Native peoples' use of alpine environments in the San Juans appears to have declined significantly after about 2000 cal B.P.

The frequent and widespread occurrence of obsidian artifacts made from Valles Caldera stone indicates that native groups using the San Juan high country maintained strong connections to the northern Southwest. Recovered artifacts include cores and flaking debris as well as finished tools. These patterns together suggest that many of the people occupying sites above timberline in the San Juans wintered to the south, perhaps along the upper tributaries of the San Juan River. However, the marked diversity of the raw materials present on many sites, including a variety of cherts, orthoquartzites, rhyolites, and basalts, suggests either that a broad trade network linked groups living around the perimeter of the San Juans or that groups from different regions came together in the high country. The fact that the Uncompahgre Cirque assemblage includes artifacts made from raw materials quarried in widely separated areas both north and south of the San Juans lends support to the latter interpretation.

Sites above timberline reflect a variety of activities. Hunting is well represented, with nearly one-quarter of the resources consisting of isolated projectile points or projectile points associated with flaking debris. However, site assemblages representing a broad spectrum of tasks other than hunting are more common. Activities likely represented by these items include hide working, animal butchery, plant processing, lithic raw material procurement, and stone tool manufacturing and maintenance. This functional diversity points to a generalized, rather than focal, land use strategy. It also suggests that sites above timberline in the San Juans represent short-term residential foraging camps, rather than special-use localities occupied by dedicated task groups.

Most San Juan high country sites are small and this has implications for site re-use, occupation duration, and group size. Though additional focused research is needed to better understand site occupation histories, particularly in view of the fact that many resources date to the middle Holocene and may largely be buried, the small size of most sites suggests that they represent brief occupations by isolated bands. It also suggests that few sites were re-occupied. This, in turn, bolsters the conclusion drawn from assemblage diversity data that high country land use strategies were generalized, rather than focal.

The major exceptions to this pattern are two notably large quarry workshops (Uncompahgre Cirque and 5ML302) located near productive chert sources. Artifacts on these sites are seven or eight times more abundant than on the third largest site in the sample. Their assemblages are 70 or 80 times larger than the mean site assemblage. Coupled with evidence for a brief occupation at Uncompahgre Cirque, this suggests that these large sites represent seasonal aggregation localities. Site 5ML302 may have been used for a longer period, given the diversity of dart point types documented there. However, morphological diversity in itself is an inadequate guide to occupation history, owing to the wide range of styles that occur on many sites in the Southern Rockies. Both of these large quarry workshops are ringed by a halo of smaller sites, possibly reflecting repeated visits to the quarry over a longer period. This variation in site size may also point to temporal variability in the intensity of chert exploitation. A similar pattern may characterize site clusters around other toolstone sources, such as the Mosca Creek quarry or the Cochetopa Hills quarries (Black 2000; Jodry 1999a)

No game drive systems comparable to those documented in alpine settings in the Front Range or the Sawatch Range are present in the San Juan dataset (Benedict 1996; Hutchinson 1990; Southwell 1995). The OAHP sample does include 11 stone features located on nine sites or isolated finds. However, just one of these features exhibits the attributes and landform position typical of hunting blinds documented elsewhere. (The enclosure at 5HN151 may also exhibit these attributes, but it was inadvertently excluded from the OAHP sample.) The majority of the cairns in the dataset are isolated features, not elements of larger game-drive systems. Rock walls comparable to those on the Front Range have not been observed anywhere in the San Juan high country, with the possible exception of the currently undocumented alignment at 5ML302. In fact, Southwell (1995) lists just one game-drive system in southwest Colorado, located west of the San Juans at an elevation of just 2,017 m.

Though the site sample is limited, the apparent absence of large game-drive systems in the San Juan high country stands in marked contrast to the situation on the Front Range, where constructed walls, cairn lines, and hunting blinds are both common and conspicuous (Cassells 1995). Instead, hunting features in the San Juan high country consist exclusively of isolated blinds, likely operated by small residential bands or task groups. The use of individual blinds rather than communal game drives is a broad trend throughout western Colorado (Southwell 1995).

The fact that large-scale constructed features were not important to animal procurement strategies in the San Juans may simply be a function of the region's topography, which lacks the broad, gently sloping high ridges simultaneously attractive to large migrating herds and suitable for the concealment of hunters. Whatever the reason, the lack of communal game drives likely reduced incentives for people to return regularly to particular landscape features or zones, further reinforcing a generalized land use strategy. The lack of communal game drives also likely diminished certain kinds of opportunities for macro-band aggregation and the concomitant exchange of information, material goods, and spouses. More importantly, though, the absence of communal game drives suggests that high-country land use was not primarily focused on procuring storable foods for provisioning winter camps at lower elevations.

Comparison with other High-Altitude Land Use Patterns

The pattern of high country land use in the San Juans contrasts sharply with patterns observed in other high-altitude areas of the western U.S. The presence of numerous multi-component communal game drives in Colorado's Front Range testifies to a long-term, focal land-use system centered on large mammal procurement. Aggregated macro-bands repeatedly visited these features to obtain meat for storage and later consumption. The oldest sites above timberline in the Front Range are associated with parallel-oblique-flaked lanceolate points likely pre-dating 8000 B.P. (Benedict 1992, 5005). The youngest game drives may have been used as recently as the A.D. 1500s or 1600s (Cassells 1995). Many drive systems were repeatedly re-aligned or augmented. Benedict (1992) points to a suite of climatic, biologic, topographic, and geographic factors that made the Front Range especially attractive to this type of enduring, intensive use. By comparison, smaller groups occupied the San Juan high country extensively rather than intensively. In further contrast to the long record of occupation in the Front Range, alpine land use in the San Juan Mountains occurred primarily during the Archaic.

The high Uintas of northeastern Utah illustrate another pattern (Madsen et al. 2000). Like those in the San Juans, sites above timberline in the Uintas are relatively small. However, they are unevenly distributed across the landscape and primarily reflect animal procurement, rather than a broad suite of activities. These factors suggest that they represent short-term occupations by logistically organized hunters working out of lower-elevation base camps, rather than small-band residential sites as is the case in the San Juans.

Logistic organization also characterized the use of alpine environments in eastern California's White Mountains prior to about 1350 B.P. (Bettinger 1991; Zeanah 2000). After that time, however, settlement shifted from specialized large-game hunting camps to season-long residential bases. The bands occupying these village localities exploited a comparatively wide range of alpine resources. Their investments in substantial structures, storage features, and site furniture testify to the intensity with which they used these central-place foraging settlements. These factors may also point to repeated re-occupation of strategically positioned sites. A similar pattern of intensive Late Prehistoric use has been documented in Wyoming's Wind River Mountains (Koenig 2010).

Bettinger (1991) and Zeanah (2000) argue that intensive residential use of high-elevation environments in the Great Basin was a consequence of demographic packing in surrounding lower-elevation areas. By comparison, occupation of the San Juan high country appears to have declined as population was increasing in the river valleys both north and south of the mountains after 2500 B.P. Use of the high San Juans at about 1000 B.P., when regional population was greatest, appears to have been only sporadic.

It is not surprising that the alpine archaeological record varies among these high-elevation areas, given the unique physiography, climate, and local resource structure—both above and below timberline—that characterizes each region. The fact that native peoples used tundra ecosystems in different ways highlights the need to develop local frameworks for conceiving and investigating those uses (Zeanah 2000).

5

Summary and Recommendations

In 2010, Paleocultural Research Group and the Grand Mesa, Uncompahgre, and Gunnison National Forests jointly carried out an archaeological assessment of the Uncompahgre Cirque site (5HN1098), an extensive quarry workshop located high on the east flank of Uncompahgre Peak. Funding for the project was provided by the Forest Service and History Colorado's State Historical Fund.

The site consists of a dense scatter of flaking debris and chipped stone tools covering 1.15 ha (2.8 ac) of a sloping bedrock bench at an altitude of 3,840 m (figure 5.1). Artifacts are scattered throughout this area but are visible primarily in four concentrations. The 2010 field investigation focused on the largest and densest of the four, designated Locus 1. Work in Locus 1 included small-scale hand excavation, intensive surface mapping, and targeted surface collection. The research team also surveyed a small portion of the valley adjacent to Uncompahgre Cirque. Subsequent laboratory analyses of recovered artifacts included minimum analytical nodule analysis of surface-collected debris aggregates; individual flake analysis and mass analysis of excavated flaking debris; technological analysis of stone tools; and elemental composition and hydration analysis of obsidian artifacts.

Multiple lines of evidence—including radiocarbon dates, obsidian hydration rim thicknesses, and stratigraphic data—together indicate that the site was occupied briefly between about 5900 and 5700 calendar years ago. All four radiocarbon dates from the site are statistically equivalent, yielding a weighted mean age of 5038±19 ^{14}C yr B.P. This mean age spans at two standard deviations the period from 3944 cal B.C. to 3776 cal B.C., or a total of 168 calendar years. Hydration rim thickness distributions point to a brief occupation or short series of brief occupations within this period. Stratigraphic data bolster the conclusion that the occupation at Uncompahgre Cirque was brief. Artifacts primarily occur in a single zone spanning the Ab and Bwb horizons of a prominent buried soil. Larger, heavier artifacts are lower in the profile, suggesting only limited vertical movement due to frost heaving or other periglacial processes. The presence of well-defined chipped stone features primarily representing the

Figure 5.1. Uncompahgre Cirque site, with excavation taking place in Locus 1.

reduction of individual raw material nodules testifies to the remarkable integrity of the site's cultural deposits and, indirectly, to the brevity of the occupation.

Uncompahgre Cirque's stratigraphic position also has paleoenvironmental implications. The site was occupied during a period of large-scale aeolian deposition that must have begun shortly before 6000 cal B.P. Deposition continued after the occupation, followed by what likely was a lengthy period of surface stability and soil formation. Only limited sediment accumulation took place during the late Holocene. Because the contact between the underlying till and the loess cap represents an unconformity, the early Holocene record is not preserved at Uncompahgre Cirque. However, the fact that the climate of the San Juans was warmer and wetter after about 8000 B.P. (9000 cal B.P.) suggests that erosion, or high-frequency cycles of erosion and deposition, primarily shaped the local landscape during the early Holocene.

The principal activity at Uncompahgre Cirque was reduction of chert nodules initially quarried on the high, narrow ridge immediately north of the site. Blanks prepared for off-site transport and use included large flakes and both early- and late-stage bifaces. Multi-directional cores may also have been carried away for use elsewhere. In addtion, flint knappers at Uncompahgre Cirque manufactured a variety of tools for on-site use in hide processing, woodworking, animal butchery, or other tasks. These tools includes expedient flake tools as well as patterned end scrapers and bifaces. Some of the tools produced from local stone for on-site use were made from heat-treated flakes or nodules.

A notable feature of the workshop is the presence of cores, tools, and flaking debris made from imported raw materials, including obsidian from northern New Mexico and quartzite, chert, and possibly other materials likely from the Gunnison basin and central Colorado. The fact that these imported raw materials derive from widely separated source areas, both north and south of the San Juans, suggests that multiple groups from different regions came together to use the chert quarry at Uncompahgre Cirque. Imported stone arrived as both finished tools and as cores or large flakes, and was used at Uncompahgre Cirque in much the same way as the local chert. Initial core reduction of imported stone is indicated by the presence of large, unused flakes bearing cortex. Exhausted cores of obsidian, rhyolite, and chalcedony also occur in the collection, as do smaller flakes of imported stone indicative of tool manufacturing or maintenance. These latter items include thinning flakes produced during the late stages of biface manufacture as well as flakes produced by soft-hammer percussion and pressure flaking during tool rejuvenation.

Like Uncompahgre Cirque, the vast majority of all sites above timberline in the San Juans were occupied during the Archaic. Most alpine site assemblages there include a diverse array of chipped stone raw materials, as does the Uncompahgre Cirque site. Functional diversity is also a feature of many high-elevation sites in the San Juans. Reduction of quarried nodules for off-site use clearly was the primary activity at Uncompahgre Cirque, but the assemblage also includes scrapers, bifaces, and flake tools indicating that a variety of other tasks were undertaken concurrently. This functional diversity—even on a site such as Uncompahgre Cirque that primarily was dedicated to a single, focused activity—bolsters the view that most sites above timberline represent short-term residential camps occupied by men, women, and children, rather than special-use localities occupied by logistical task groups.

The principal difference between Uncompahgre Cirque and most other alpine sites in the San Juans is the much larger size of its assemblage. The brevity of the occupation at Uncompahgre Cirque, coupled with the diversity of its imported toolstone assemblage, suggest that it represents a multi-band aggregation locality. Site 5ML302, another notably large site located adjacent to a toolstone source, may also represent an aggregation locality. If so, toolstone may have played similar economic and social functions in the San Juans that large animal herds played in the Front Range. In both cases, small bands from a wide region converged during the late summer or early fall to communally exploit a key resource.

Recommendations for Future Work

Uncompahgre Cirque Site

The numerous animal trails cutting through the turf bank north of Uncompahgre Cirque testify to the impact livestock grazing has had on the site in the past. These trails expose the loess cap to wind and water erosion and so become deeper and broader over time. However, the current grazing schedule puts sheep on the site just one or two days each year. Within Locus 1, natural aeolian deflation is now the single most significant factor affecting cultural deposits. The effects of this can be seen in the size and density of the three chipped stone concentrations documented in 2010. All three features originally were entrained in the lower portion of the turf bank and now that they are exposed on the eroded till surface their enduring, well-defined boundaries indicate that only limited lateral movement of artifacts has taken place. Continued monitoring of the extent of the remaining turf bank is important, especially because the rate of on-going wind erosion is not known. To be most effective, monitoring activities should be based on photographs regularly taken from established stations. The locations of the 2010 excavation units, which are now marked by low, piled-rock cairns, could be used for this purpose.

Casual artifact collecting by recreational users has been documented in the past and likely is continuing. However, anti-vandalism signage posted on-site would only draw additional attention to the site and would mar the spectacular views that bring people to the area. An interpretive sign installed at the Nellie Creek trailhead parking lot that describes past American Indian use of the area and reminds users to leave cultural resources undisturbed would help protect Uncompahgre Cirque and other resources adjacent to the Uncompahgre Peak trail.

Circumstantial evidence collected during the 2010 field investigation strongly suggests that intact hearth features remain at Uncompahgre Cirque. If regular monitoring identifies newly exposed hearths or other features, then targeted data recovery efforts should be undertaken immediately to document them and sample their content. Little currently is known about the morphology or function of high-elevation hearth features. Evidence from Uncompahgre Cirque points to on-site heat treatment of quarried stone, but precisely how this was accomplished or the extent to which it was practiced is not known. In addition, charred seeds and plant parts contained within hearth fill may provide critical dietary data. Data on the spatial relationships among artifact concentrations and hearth features would answer questions about site structure and taphonomy.

San Juan Mountains

A better understanding of the archaeological record above timberline in the San Juans, and its relationships to the broader archaeological landscape, depends on targeted field research undertaken in conjunction with the development of systematic settlement and subsistence models.

Far and away the most important next step is to obtain additional excavation data. Such data currently are available for just three high-elevation sites, including Uncompahgre Cirque and the Piedra Pass sites (5ML45 and 5ML46). Critically important are high-quality radiocarbon dates. There is a growing consensus among researchers working in the broader region that the details of projectile point morphology offer only the most general chronological framework (Reed and Metcalf 1999; Stiger 2001). Many point styles were produced over long periods of time and many well-dated components incorporate multiple styles. Moreover, the styles to which archaeologists assign particular specimens likely have as much to do with their training (and to local histories of archaeological research) as they do with actual cultural relationships. An working chronology of alpine land use must therefore be based on radiocarbon dates.

A key chronological question is whether the structure of San Juan high-country land use differed before and after 3000 B.P. Before that time, native peoples regularly occupied winter residences immediately north of the mountains, but winter residences south of the mountains were located at much lower elevations far to the south in the San Juan River basin. After 3000 B.P., winter residences mostly disappeared from the Gunnison basin, but became more common in the Dolores and Animas river valleys, closer to the San Juans' southern foothills.

Routine use of obsidian hydration analysis eventually will provide additional chronological data. However, more data on hydration rates of specimens from well-controlled and precisely dated subsurface contexts are needed to maximize this method's utility. Excavation projects also are important for obtaining data on past diets. Samples of charred seeds and plant parts constitute the most readily obtainable dataset, owing to the poor preservation of animal bones above timberline. Pollen analysis, fatty-acid analysis of burned rocks, or other methods may also provide important data.

Results from the Uncompahgre Cirque assessment indicate that excavation above treeline is likely to yield high-resolution datasets. The periglacial processes that are responsible for modifying site stratigraphy and artifact distributions in many alpine settings appear to have had only limited effects at Uncompahgre Cirque (Benedict 1978), likely due to the absence of groundwater flowing through the loess cap. In addition, pocket gophers—whose burrowing churns cultural deposits located at and below timberline—are not present at Uncompahgre Cirque owing to the site's altitude (Bechberger 2010). Together, the absence of gopher burrowing, frost heaving and sorting, and solifluction, has preserved largely intact the mid-Holocene paleosol at Uncompahgre Cirque, along with a robust record of Archaic occupation. Similar conditions likely occur at other sites in the San Juan high country.

Surface inventories designed to address specific research questions also will be important for understanding the San Juans' alpine archaeological record. Three strategies might be used to guide this work. One is to target a particular drainage basin, such as the upper reaches of Pole Creek, that encompasses a significant area above timberline. A stratified random sampling procedure, keyed to elevation, topography, aspect, vegetation, or other factors, could then be used to select survey blocks within this basin. Integrated geomorphological investigations are critical to this work. The small survey carried out adjacent to Uncompahgre Cirque shows clearly that mid-Holocene sites, which constitute the bulk of the resources above timberline, frequently are buried. Inventory data gathered in this way would provide a systematic basis for evaluating settlement and subsistence models. For example, one might use these data to test the hypothesis that native peoples targeted resources or locations lying primarily between 3,700 and 3,800 m.

A second strategy is to develop a GIS model that predicts the locations of hunting features and then intensively survey the areas with the greatest predicted probabilities. Such a model could be derived from factors such as slope and landform, the locations of water sources, and the direction of the summer or early fall prevailing winds. A key question for the San Juans is whether communal kill features ever were an element of the settlement and subsistence system, and, if so, during which periods. The current sites dataset suggests that large game-drive systems were not used in the San Juan high country; however, systematically evaluating that hypothesis is crucial for a better understanding the nature of alpine land use.

Stone tool raw material sources clearly were focal points for high-elevation occupation in the San Juans. A third strategy for identifying survey areas is therefore to carry out geological research designed to gain a better understanding of the formation processes and contexts of known quarry localities and then use that understanding to predict the locations of other, previously undocumented quarries. One potentially productive target location is the area around Cataract Lake in the central San Juans, where a cluster of resources, including two notably large sites (5HN552 and 5HN554), already has been recorded.

Key to designing and interpreting the results of this intensive site- and area-focused fieldwork is a research framework derived from optimal foraging theory (Kelly 1995; Reed 2009; Reed and Metcalf 1999). A fundamental question for the San Juans is whether the most common site category—a small scatter of flaking debris associated with chipped stone cutting and scraping tools made from a variety of raw materials—represents a special-use location occupied by a dedicated task group, a short-term foraging camp occupied by a small band, or a combination of these two modes, possibly partitioned by age, position on the landscape, region, or cultural affiliation. The existing dataset suggests that many alpine sites represent short-term, small-band residential camps. This hypothesis can be evaluated in part by modeling the resource structure of the San Juan high country, including animal and plant species composition, patch distribution and density, the locations and sizes of resource "dead zones," and transport distances to lower-elevation residential bases. Such a model could identify areas within the San Juans where different mobility strategies might be expected (Madsen et al. 2000) or shifts over time in the strategies pursued in particular places (Zeanah 2000). Reed (2009) develops this sort of model for the Northern Colorado River basin, but the power of such an approach lies in the specificity with which it conceives the local resource landscape (Zeanah 2000).

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Appendix A

Data Coding Formats

Table A.1. Chipped stone flaking debris mass analysis variables and attributes.

Name	Description
CN	**Catalog Number**
Size	**Size Grade (1, 2, 3, or 4)**
Material	**Raw Material Type**
1	chert
2	chalcedony
3	quartzite
4	tuff
5	basalt
6	silicified wood
7	obsidian
9	unknown (not used)
Origin	**Raw Material Source Zone**
1	local
2	imported
Desilicified	**Weathering Presence**
0	absent
1	present
Cortex	**Cortical Surface Presence**
0	absent
1	present
Count	**Count of flakes with common coding**
Weight	**Combined weight for this data case, to 0.1 g**

Table A.2. Surface feature and excavated flaking debris individual flake analysis variables and attributes.

Name	Description
CN	**Catalog Number**
Size	**Size Grade (1, 2, 3, or 4)**
Material	**Raw Material Type**
1	chert
2	chalcedony
3	quartzite
4	tuff
5	basalt
6	silicified wood
7	obsidian
9	unknown (not used)
Origin	**Raw Material Source Zone**
1	local
2	imported

Table A.2. Surface feature and excavated flaking debris individual flake analysis variables and attributes (continued).

Name	Description
SRT Class	**Sullivan and Rozen Debitage Class**
1	complete flake
2	broken flake
3	flake fragment
4	debris
PlatType	**Platform Type**
1	cortical
2	simple
3	complex
4	crushed
PlatPrep	**Platform Preparation**
1	none
2	faceted
3	dorsally reduced
4	ground
9	unknown
COR	**Cortex Presence (recorded for excavated specimens only)**
0	absent
1	present
Type	**Flake Type (recorded for excavated specimens only)**
1	shatter/angular debris
2	bipolar
3	biface thinning
5	simple
6	complex
99	indeterminate
Weight	**Specimen weight, to 0.1 g**
Length	**Specimen length, to 0.1 mm; recorded only for specimens coded as SRT Class 1**
Width	**Specimen width, to 0.1 mm; recorded only for specimens coded as SRT Class 1**

Table A.3. Minimum analytical nodule analysis (MANA) variables and attributes.

Name	Description
CN	**Catalog Number**
Nodule	**Nodule Number**

Table A.3. Minimum analytical nodule analysis (MANA) variables and attributes (continued).

Name	Description
Size	**Size Grade (1, 2, 3, or 4)**
Material	**Raw Material Type**
1	chert
2	chalcedony
3	quartzite
4	tuff
5	basalt
6	silicified wood
7	obsidian
9	unknown (not used)
Origin	**Raw Material Source Zone**
1	local
2	imported
Tool	**Tool Presence**
0	tool not present in nodule
1	tool present in nodule
Type	**Nodule Type**
1	multiple item, no tools
2	multiple item, with tools
3	single item, not tool
4	single item, tool
Class2	**Nodule Composition**
1	flakes and cores only
2	flakes and tools
3	tools only
Thermal	**Thermal Alteration**
0	no evidence of burning or heat treatment
2	burned or heat treated
9	unknown
Count	**Count of flakes with common coding**
Weight	**Combined weight for this data case, to 0.1 g**

Table A.4. Stone tool analysis variables and attributes.

Name	Description
CN	**Catalog number**
Size	**Size grade (1, 2, 3, or 4)**
Seq	**Sequence number within level lot**
Case	**Case number for multiple records on a single specimen**
Material	**Raw material type**
1	chert
2	chalcedony
3	quartzite
4	tuff
5	basalt
6	silicified wood
7	obsidian
9	unknown (not used)

Table A.4. Stone tool analysis variables and attributes (continued).

Name	Description
Origin	**Raw material source zone**
1	local
2	imported
Tech	**Technological class**
0	absent
1	present
Comp	**Completeness**
0	absent
1	present
Burn	**Burning**
0	absent
1	present
Weight	**Specimen weight, to 0.1 g**

Table A.5. San Juan Mountains sites variables and attributes.

Name	Description
ID	**Smithsonian Site Number**
Type	**OAHP Site Type**
1	Open camp
2	Open lithic
3	Open architecture
4	Isolated find/feature
Association	**Association Group**
1	Flakes only
2	Flakes and tools, ground stone, or pottery
4	Stone tool only
5	Flakes and projectile point(s)
6	Flakes and core(s)
7	Feature only
8	Projectile point(s) only
Temp	**Temporal Period**
1	Archaic
2	Middle Archaic/Late Archaic
3	Late Archaic
4	Late Paleoindian/Archaic
5	Late Prehistoric
6	Late Archaic/Late Prehistoric
7	Early Archaic/Middle Archaic
9	Unknown
Criteria	**Dating Criteria**
1	Projectile point morphology
2	Pottery present
3	Radiocarbon date
4	Pottery and projectile point morphology
Obsidian	**Obsidian Presence**
0	Not present
1	Present

Table A.5. San Juan Mountains sites variables and attributes (continued).

Name	Description
9	Not recorded
Ground Stone	**Ground Stone Presence**
1	Present
blank	Not present
Pottery	**Pottery Presence**
1	Present
blank	Not present
Feature	**Feature Class**
1	Cairns
2	Stone enclosures