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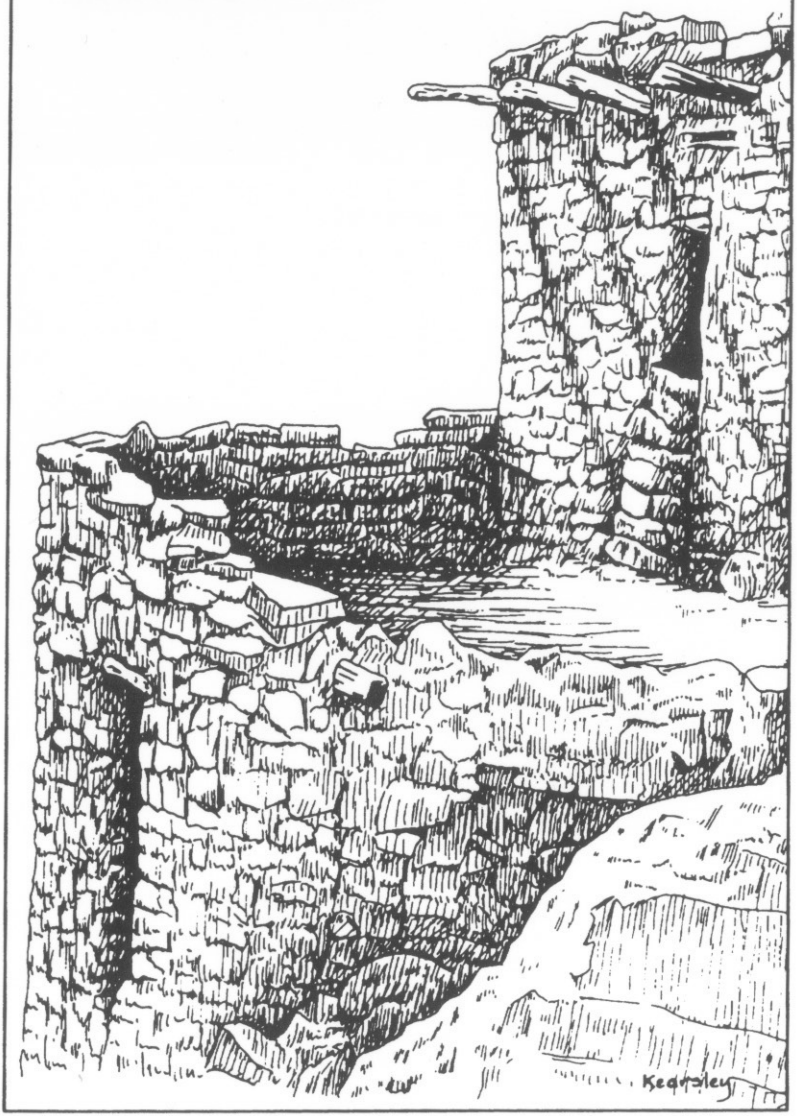

Changes in the Organization of Technology and Labor among Archaic and Ancestral Pueblo Peoples in the Vicinity of the Coombs Site, South-Central Utah

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Abstract. Archeologists have proposed alternative explanations (decreased mobility, risk avoidance, adoption of agriculture, sexual division of labor) to account for the shift from formal (bifacial) technology to expedient (core) technology. We examine these alternatives through an analysis of lithic artifacts and site settings documented through an archeological survey of Black Ledge—a mesa immediately adjacent to the Coombs site, the largest ancestral pueblo village in south-central Utah. We contrast the sites associated with more mobile hunter-gatherers during the Late Archaic, to the equally ephemeral sites created largely by women as they harvested, processed, and transported wild resources for use in their Late Formative village at Coombs.

Key words: archeology, Utah, Coombs site, Black Ledge, lithic artifacts, Late Archaic, Late Formative

Throughout North America archeologists have perceived a change in chipped-stone from formal (bifacial) technology to expedient (core) technology. They have variously attributed this technological change to decreased mobility, the adoption of agriculture, the availability and quality of raw materials, risk avoidance, and sexual division of labor. We further this discussion by contributing an analysis of data obtained from our recent archeological survey near the Coombs site (42Ga34)—the largest pueblo existing in south-central Utah between 1150 and 1200 AD. We contrast the organization of lithic technology at Late Archaic

sites—much older than Coombs—with what we observed at Late Formative sites—contemporary with Coombs. Our analysis is by no means complete, but outlines a program of additional research in the region.

BACKGROUND TO COOMBS

Noel Morse (1931) investigated the Coombs site for Harvard University. He recognized that the site had puebloan affiliation based on ceramics and architecture. As part of the Glen Canyon project, the University of Utah excavated architectural features within the Coombs site during the summers of 1958 and 1959 (Lister 1959, Lister et al. 1960, Lister and Lister 1961). Since the site became Anasazi State Park in 1960, small-scale excavations, primarily between 1970 and 1991, have added to the collections.

Based on their analysis of the ceramics and architecture, Lister and Lister (1961) linked Coombs Village to the Kayenta Anasazi. They believed that Coombs was rapidly colonized and settled by Kayenta immigrants because the entire settlement seemed to be constructed according to a master plan and no evidence was found for the existence of ancestral villages either below this settlement or in the immediate vicinity (Lister and Lister 1961). The Kayenta-style jacal and masonry rooms were arranged in two unit pueblos—one L-shaped and the other U-shaped. About 100 rooms once existed in the two adjacent units. Over two-thirds of these rooms were used for storage. The ten pitstructures and a ramada are believed to be contemporary with the unit pueblos. Based on the internal architecture, the pitstructures are believed to have been constructed and used for habitation, rather than as kivas. The absence or rarity of kivas and prevalence of storage rooms has also be noted at Virgin Anasazi settlements to the west (Lyneis 1995, 1996).

Tree-ring, radiocarbon and ceramic dates place the most likely age estimate for Coombs between 1150 and 1200 AD (Bannister et al. 1969, Prince et al. 1998). At the time Coombs was established by Kayenta colonists from the south, the eastern-most Virgin Anasazi settlements were being abandoned (Lyneis 1996). Even though Coombs was the largest village in the region, it still probably included no more than 200 people, presuming that the 30-40 habitation rooms and pitstructures were all contemporary. The isolated position and size of Coombs very likely contributed to the brief (50 year), unsustainable occupation of the village.

Coombs was not isolated from more distant communities. The presence of trade wares from many portions of the ancestral pueblo world

(e.g., Mesa Verde, Kayenta, Chaco, and Virgin) and Fremont, as well as locally-made pottery in the Kayenta style (Morgenstein and Latady 1998) probably indicated attempts by Coombs villagers to foster long-distance alliances through exchanges of ceramics and artifacts of exotic materials (marine shells from the Pacific and turquoise from a single, but unknown source; Prince et al. 1998).

Based on the size and planned layout, Lister and Lister (1961) proposed that Coombs was inhabited year-round. In contrast, Jennings (1966) and Lipe (1970) proposed that many villages were occupied on a seasonal basis. Lipe (1970) argued that large upland villages, like Coombs, only represented winter occupations. Small parties left their upland villages in the spring, and then traveled to the low, hot, and well-watered lowland canyons along the Colorado River where they planted and tended their crops. Part of their harvest was transported back to upland (winter) villages, while the remainder was stored in the canyons to provide food and seed for the following year. Given the kinds and diversity of architecture at Coombs, as well as the finding of numerous short-term logistical settlements in our survey of a nearby mesa (Black Ledge), we also propose that Coombs was inhabited year-round.

The Listers (1961) concluded that the occupants of Coombs were primarily farmers because they found numerous examples of corn and squash, relatively few wild plant remains (e.g., pinyon, indian rice grass and chenopodium), stone hoes (tchamahias), trough metates, and two-handed manos. Trough metates and larger, two-handed, manos are generally presumed to have been used to mill cultigens, while slab metates and smaller manos are presumed to have been used with wild plants and pigment (Hard 1990, Mauldin 1993, Nelson and Lippmeier 1993, Schlanger 1991).

Coombs was located near West Deer Creek. Other perennial streams flow south off the Aquarius Plateau enabling villagers to engage in more intensive, but predictable, irrigation-based horticulture. The first Mormon settlers discovered ancient ditches in the vicinity of the by-then-abandoned Coombs site that might represent the remains of a former irrigation system.

A palynological study of the village and a packrat midden from an adjacent mesa provides additional evidence for the existence of agricultural fields (Prince et al. 1998), and adds support to claims for year-round occupation. The reduced coverage of pinyon-juniper woodlands continued after the abandonment of Coombs in about 1200 AD, until about 1650 AD. This persistence of cleared/disturbed vegetation, after the abandonment of Coombs, was attributed to the efforts of Numic

peoples, although very little evidence of Numic or Late Prehistoric occupations has been found in the surrounding area (see Madsen and Rhode 1994 for elaboration on the Numic spread and Late Prehistoric).

The residents of Coombs also hunted large and small animals. Among the larger faunal remains bighorn sheep predominate, followed by fewer mule deer and even less frequent pronghorn. Cottontail and jackrabbit bones dominate the smaller mammal remains. The remains of a few dogs have been found.

We are uncertain where the villagers hunted game animals, whether they concentrated on agricultural fields or on more distant uplands and less inhabited places. We suspect that deer and rabbits were obtained from the fields, while the more human-sensitive sheep were hunted in remote locations, such as the mesa tops.

Earlier sites associated with Archaic hunter-gatherers (8000-3000 BP) and incipient horticulturalists (3000-1500 BP) are known from other portions of the Colorado Plateau (Geib 1996, Janetski 1993, Parry and Smiley 1990). Many of the early sites are either buried or destroyed by erosion. The people who created these sites lived at low population densities and organized their lives towards high mobility to exploit seasonal resources as they became available. As reliance upon farming increased and mobility declined during the Formative, ancestral puebloan peoples made greater use of local raw materials (Parry and Smiley 1990) and relied more on expedient (flake) tools made from cores. In contrast, for reasons explored below, bifaces are more common in Archaic sites (Parry and Kelly 1987, Kelly 1988, 1992).

Organization of Lithic Technology

Archeologists have repeatedly noted the shift over time from formal bifaces to informal cores in lithic assemblages from many areas of North America, especially where sources of raw materials were spatially restricted. They offer several explanations for this shift: (1) decreased mobility (Kelly 1988, Kelly and Todd 1988, Parry and Kelly 1987); (2) risk avoidance (Torrence 1989); and, (3) increased horticultural production (Abbott et al. 1996).

(1) Mobility

Parry and Kelly (1987, Kelly 1992) propose that mobile people produce and use bifaces because they need long-lasting, flexible, and reliable tools to carry and use in places where raw materials are lacking. Bifaces served both as tools and as cores from which to strike flakes that could also be used as tools (Kelly 1988). They were often made from better, but more locally restricted, materials to insure their reliability and extend their use-life.

Parry and Kelly (1987) argue that the change from bifacial to expedient core technology coincided with sedentism. By living in one place, people could stockpile materials and recycle older artifacts. Because sedentary people use their tools mostly at their residential sites, there is little spatial incongruity between raw material and tool use.

As Sassaman (1992) notes, expedient core technology has been observed among mobile hunter gatherers who also used formal bifacial technology in places with a super-abundance of raw materials. Biface technology was restricted to anticipated needs and expedient to immediate needs. Sassaman (1992) also points out that where people continued to make logistical trips—traveling from sedentary villages—to hunt game, we might expect a continuation in biface production and use, both as cores and as weapons. Instead of presuming that the entire group moves together (residential mobility), it is probably more useful to consider differences in tool movement arising from sexual division of labor.

(2) Risk Avoidance

Torrence (1989) proposes that greater risk is associated with hunting than with gathering because prey animal are mobile and less predictable. Hunting tools should consist of complex, formal (bifacial) tools designed for reliable, long-lasting use. They should be easily repaired. Incorporating these technological features averts the risk and uncertainty of hunting by minimizing the chance of technological failure. The timing and severity of risk are less among gatherers, encouraging them to use simple, short-term, expedient tools made on flakes from cores. Torrence proposes that the shift from biface to core technologies coincides with the transition to food production or horticulture.

As Sassaman (1992) indicates, instead of seeing the two technologies as replacing one another, we should more often expect both hunting and gathering to operate simultaneously with a sexual division of labor, involving both formal (bifaces) and expedient (core) technologies. The co-occurrence of formal and expedient technologies would depend upon the organization of land-use, duration of occupation, site reoccupation, and the availability of raw materials. Hunting continued, and even intensified in the vicinity of more sedentary horticultural villages, but as Sassaman notes (1992), by then bifaces, and especially smaller projectile or arrow points, were made on flakes. Expedient core technology converged and incorporated aspects of bifacial technology.

(3) Agriculture

Abbott et al. (1996) reject the other two alternatives, as well as Sassaman's, because they involve behavioral variables. Instead, they argue for a Darwinian selectionist approach. The change in replicative success of the technologies (the decline in the relative frequency of biface technology and increase in flake technologies over time) might be the product of stochastic processes, selection, or sorting. After eliminating stochastic and sorting, they argue for selection due to the clear directionality of change. Because selective agents by definition are environmental, they conclude by proposing two possibilities: (1) 'flake technology is proximately the product of reduced mobility...and reduced mobility the product of selective agents favoring increased maize production...'; and, (2) '...if flake technology is associated... with the mechanics of agricultural production, increases in the proportion of flake technology in the record may be a product of subsistence shift toward increased agricultural production, because of the increased importance of technology associated with agriculture, and perhaps because of the decreased importance of technology associated with hunting.'

The exact ways in which flake technology is linked to agricultural production remains unclear, and unspecified. We return to this problem later.

ANOTHER ALTERNATIVE

Sassaman (1992) demonstrates that the bifacial technologies did not always stand in opposition to those based on cores. Furthermore, the shift that archeologists have perceived is attributable to the greater attention archeologists award to hafted bifaces (projectile points) during the preceramic (Archaic) and ceramics during the Formative for the determination of temporal placement and cultural identity. The archeologists' research methods make bifaces more visible in Archaic sites, and cores more visible in more recent, Formative sites. As Sassaman (1992) says among both Archaic hunter-gatherers and Formative farmers, hunters and gatherers we might expect the manufacture, distribution, and consumption of stone tools to both shape and reflect the division of labor by sex. We should not presume that men were exclusively the stone tool makers and users (Gero 1991), in that both men and women influenced each others decisions about lithic technology. Because the presumed shift from bifacial to core technologies coincides with the advent of pottery and increased reliance upon horticulture, it may be attributable to changes in sexual division of labor.

Again following Sassaman (1992), 'bifacial and expedient core technologies varied from being independent to being interdependent.' Away from sources, bifaces served both as tools and as cores for flakes. Women would have been dependent on men for flakes, if we assume that men were the makers and users of bifaces.

With increased population density and sedentism during the Formative, access to good and distant raw material sources probably declined. The adoption of the bow and arrow enabled people to use smaller projectile points, readily made by bifacing flakes. Expedient core technology wastes less material and can be accomplished with poorer quality material than biface technology.

Similar demands on women's time and energy, to those outlined by Sassaman (1992) for the Woodland period in Eastern North America, shaped the lives of women in the American Southwest. Puebloan peoples practiced a mixed economy, involving horticulture, hunting of wild game, and gathering of wild plants. Based on various cross-cultural studies and ethnographic analogies, Crown and Wills (1995) propose that Puebloan women were responsible for much of the everyday agricultural labor, food processing and preparation, house cleaning and clothing laundry, the manufacture of clothing, mats, baskets, leather products, and pottery, primary child care, and collection of firewood and water. With even a portion of these demands, Pueblo women would have faced a time and energy crisis.

In response to the crisis, Puebloan women sought out local raw materials—encountered during other tasks—to manufacture their own stone tools. To minimize their time investment, they manufactured tools from flakes struck from expedient cores. Such cores could be made with materials too small, or too poor in quality for bifacial technology. Women scavenged and recycled lithic refuse from other, and often more ancient, sites. With unmodified and slightly modified flakes, women could accomplish many of the tasks outlined above. Grinding stones, used for processing plant foods away from the village, were cached near the places where the plants grew in anticipation of future use. As Sassaman (1992) suggests, both women and men probably produced expedient cores at residential places, with some of the flakes being bifaced to produce arrow points. He also proposes that formal bifaces remained in male domain, but now to create artifacts for use in ceremonies and rituals, perhaps representing a form of male resistance in response to their loss of control over lithic production.

Many studies of lithic technology in the American Southwest have focused on the more substantial residential settlements. In contrast, our

study examines more ephemeral artifact scatters and camps located on a mesa near the Coombs site. We intend to compare the ways more mobile Archaic hunter-gatherers manufactured and used chipped-stone tools, to the more recent sites associated with the Coomb site. We also examine how changes in the sexual division of labor structured lithic technology.

THE BLACK LEDGE SURVEY

Black Ledge is a large mesa located just east of Boulder, UT and the Coombs site (Fig. 1). We surveyed 900 acres of private land that has been subdivided for residential housing.

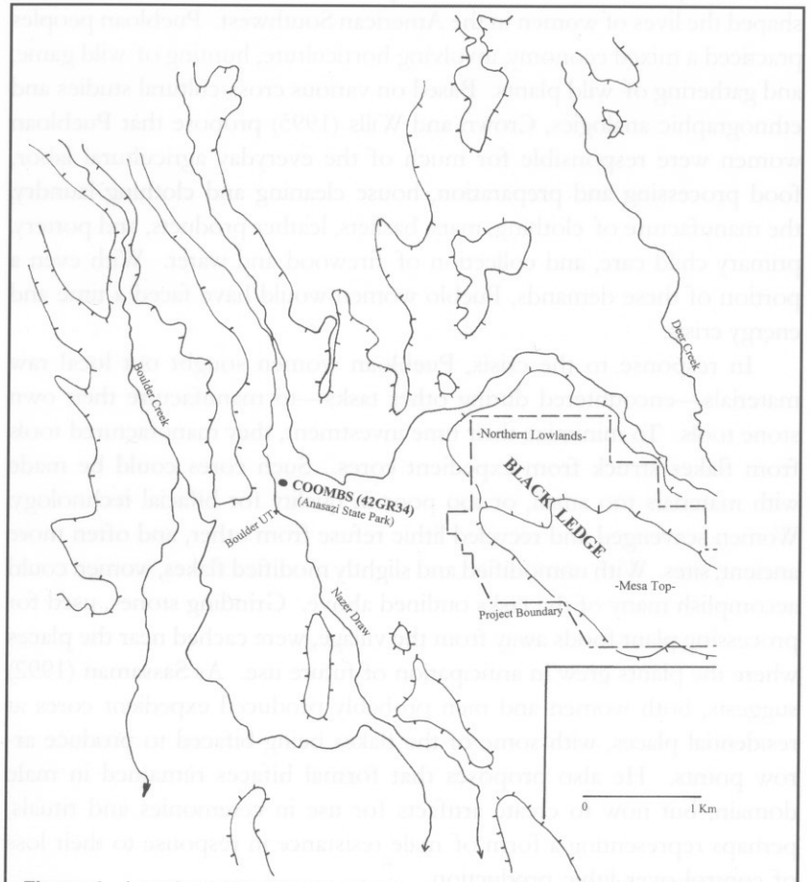

Figure 1. Location of the Black Ledge survey project near Boulder, Utah and the Coombs site.

The authors and Celeste Clegg led three 3-4 person groups of student volunteers. A maximum of 30 m spacing was maintained between survey members while walking survey transects. Isolated artifacts and archeological sites (defined as localities exhibiting evidence for multiple activities with considerable accumulations of artifacts) were plotted on 7.5' USGS topographic maps and flagged as they were located. Later we returned to the sites to record them on IMACS forms and to complete infield tabulations of artifacts.

Thirty-six prehistoric sites were located during our survey. They occur in two major settings: on the lowlands to the north of the mesa (21 sites) and atop the mesa (15 sites). The sites on the northern lowlands tend to be smaller and more concentrated than the ones located on the mesa top. The only natural water sources occurring today are depressions in the Navajo sandstone where water collects after summer thundershowers and spring snowmelt. Sites cluster around these bedrock water holes and along a ephemeral wash in the northern lowlands. In the same setting we observed many pieces of ground stone, numerous cores, and several cultural features (hearths and other pit-features). Some of the features were exposed in backhoe trenches excavated by the landowner. Time diagnostic artifacts were limited to a few arrow points and several black-on-white potsherds. We suspected that most of the sites in the northern lowlands are contemporary with Coombs, and represent short-term (one-day and over-night) trips to procure and process wild plant resources that were either stored for later use or transported back to the village.

On the mesa top we recorded more extensive and discrete sites than in the northern lowlands. No cultural features were observed, although subsurface hearths are suspected given the existence of discolored aeolian sands at several sites. Ground stone and cores were scarce, and most time diagnostic artifacts date from the Late Archaic (mostly Elko dart points)—predating the Coombs site. A Desert side-notched arrow point found at one site provides the only evidence for occupations post-dating Coombs. The prevalence of projectile points, combined with the location of several of the sites on overlooks (from which game animals would have been visible) suggests that many of the mesa-top sites were associated with hunting activities. The shattered remains of a single Tusayan Corrugated Coombs variety jar was recorded as an isolated find. No other sites occurred nearby. This jar would be contemporaneous with the occupation of Coombs.

No archeological sites were located on the southernmost portion of the mesa. While the southern tip of the mesa is now slickrock, areas to

the north are still covered with dense pinyon-juniper so that it seems unlikely that site destruction through erosion can be used to explain the absence of sites in the south.

ANALYSIS OF SURVEY DATA

Ancient peoples made considerable use of Black Ledge for hunting and plant gathering, including processing; however, no evidence exists for farming on or immediately adjacent to the mesa. We did not find any unit pueblos, farming implements, trough metates, two-hand manos, field houses, or agricultural features (check dams, ditches, fields, etc.). All of the sites appear to have been created as short-term camps and places where limited activities were accomplished.

The key questions is whether many of these sites were contemporary with the Coombs site. The scarcity of time diagnostic artifacts, especially projectile points and ceramics, in part due to prior artifact collection by persons unknown, make this question somewhat difficult to address. However, as we demonstrate below, the settings of Archaic and Formative sites appear to have been distinct.

Upon examining the few (17 out of 37) sites with diagnostic artifacts we found that Archaic sites were located significantly further from Coombs than Formative sites, contemporary with the village (Fig. 2; Table 1). Archaic sites are also concentrated at higher-elevations, on the mesa

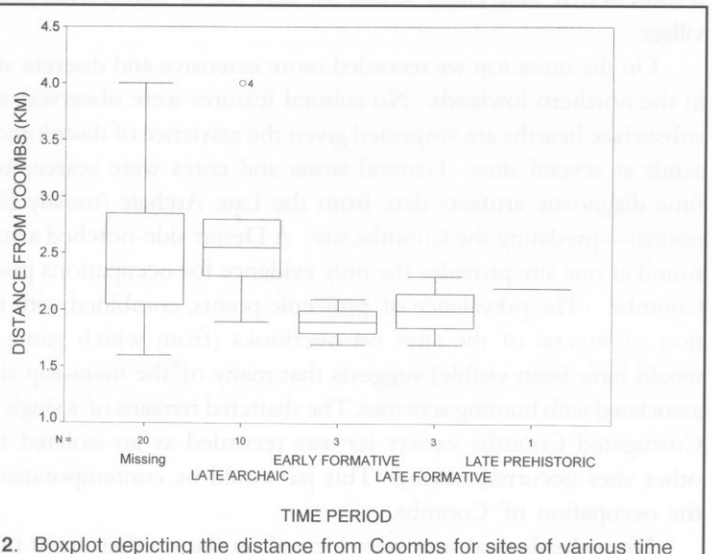

Figure 2. Boxplot depicting the distance from Coombs for sites of various time periods.

Table 1. Comparison between Late Archaic and Formative sites according to their distance (in km) from the Coombs site.

Time Period	Mean	S.d.	n
Late Archaic	2.63	0.55	10
Formative	1.99	0.23	7

$t = 3.28$
d.f. = 13
$P = 0.006$

top, while the Formative sites occur at lower-elevations, mostly on the northern lowlands (Fig. 3; Table 2). Closer examination of the 17 sites with diagnostic artifacts revealed that nearly all of the Archaic sites are located above 6800' and over 2.3 km from the Coombs site, and Formative sites occurred at lower elevations, closer to the village.

After applying this classification scheme to assign presumed ages to the remaining (20) sites, we evaluated the age estimates by examining the prevalence of cores in relation to bifaces. As in previous studies that have focused on the organization of technology, bifaces predominate more frequently at presumed Archaic sites, and cores at presumed Formative sites (Table 3). Notice that far more of the 'misclassified' ages are

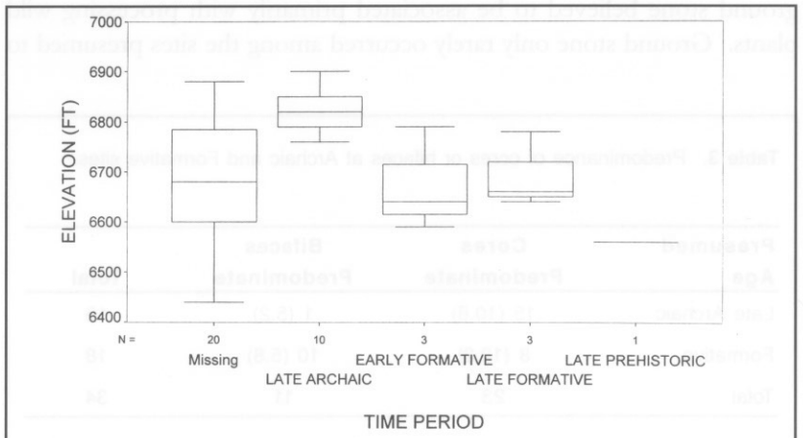

Figure 3. Boxplot depicting the elevation of sites on Black Ledge from various time periods.

Table 2. Comparison of elevation (in feet) between Late Archaic and Formative sites.

Time Period	Mean	S.d.	n
Late Archaic	6825	44	10
Formative	6666	88	7

$t = 4.40$
d.f. = 8
$P = 0.002$

among sites presumed to date from the Formative (at 8 presumed Formative sites bifaces outnumber cores).

This pattern can be attributed to recycling of older bifaces during the later Formative. Recycling probably also accounts for the scarcity of Archaic sites at lower elevations and closer to the Coombs site. Other Archaic sites, yet to be discovered, may have existed in the fields and beneath the town of Boulder, but they have yet to be recorded. They were probably impacted to an even greater extent through later recycling of lithic materials by Formative villagers.

Most of the presumed Formative sites are concentrated at lower elevations on the northern lowlands. At these sites we observed numerous examples of one-hand manos and slab or basin metates—forms of ground stone believed to be associated primarily with processing wild plants. Ground stone only rarely occurred among the sites presumed to

Table 3. Predominance of cores or bifaces at Archaic and Formative sites.

Presumed Age	Cores Predominate	Bifaces Predominate	Total
Late Archaic	15 (10.8)	1 (5.2)	16
Formative	8 (12.2)	10 (5.8)	18
Total	23	11	34

$\chi^2 = 9.41$
d.f. = 1
$P = 0.002$
( ) = Expected

date from the Late Archaic, and were strongly associated with presumed Formative sites where cores also predominate (Table 4).

DISCUSSION

The relatively few examples of Archaic sites at Black Ledge are concentrated on the mesa top. The assemblages and settings of these sites suggest that they were very short-term camps associated with hunting activities. Both the contents and settings are redundant, and almost certainly the Archaic sites only represent a small fraction of the annual or seasonal round over which their creators moved. Mobility and the absence of abundant, high-quality raw materials, probably contributed to the predominance of formal (bifacial) technology at the Archaic sites. Artifacts that archeologists have often associated with women's work (scrapers for processing hides and plant fiber, ground stone for mealing seeds, and flake tools) rarely occur within the Archaic sites. Their absence and the existence of a sexual division of labor probably contributed to the brief nature of the utilization of Black Ledge during the Archaic.

Based on our analysis, we propose that most of the sites on the northern lowlands date from the Formative and were created while wild plant resources were harvested and processed, before they were transported (< 1 mile) back to the village at Coombs. Ground stone, cores, and flakes occur in great abundance on the lowland sites. Whether these sites can be attributed to the efforts of task-groups of women is debatable, but would agree with the ethnographic and cross-cultural studies reviewed by Crown and Wills (1995) that include firewood and plant collection, and food processing among the tasks accomplished by women in villages with mixed economies. The prevalence of core-based tech-

Table 4. Association of Ground Stone with Formative sites.

	Ground Stone (manos/metates)		
Time Period	Absent	Present	Total
Late Archaic	15 (12.4)	2 (4.6)	17
Formative	12 (14.6)	8 (5.4)	20
Total	27	10	37

$\chi^2 = 3.71$
d.f. = 1
$P = 0.05$

nology, using poorer-grade, local raw materials and recycled bifaces, to produce flakes and flake tools supports our proposal that much of the archeological record on the northern lowlands can be attributed to the activities of women faced with considerable constraints on their time and energy. Given the prevalence of short-term camps and logistical use-areas on Black Ledge, we suggest that Coombs must have been occupied year-round.

On the other hand, our presumed age estimates for both the mesa top and lowland sites may be in error. Some of the lowland sites may represent the activities of women during the Archaic, who insisted upon making and using their own tools from local materials, while men and perhaps women also hunted on the nearby mesa tops. Archaic sites may not have been so spatially separated from Formative sites, as we presume from our analysis. Given the limited range of the assemblages and features at all of the sites, we suggest that it is unlikely that these ephemeral settlements can be attributed to adaptive diversity, or in this case—hunter-gatherers living in proximity to farmers (see Simms 1986, Upham 1984, 1988, 1992, 1994, Young 1994 for elaborations upon this alternative).

By testing the features (hearths, ash stains, slab-lined cists, and pits) at sites in both settings we should be able to obtain radiocarbon samples—to resolve chronological questions, bulk soil samples for pollen and flotation analysis—to resolve questions about the utilization of plant resources, faunal remains—to address questions about hunting activities, and tool and debitage samples for microwear and technological studies (See Geib 1996 for an additional example of the advantages of investigating features). Ceramics will be sourced and compared with those from Coombs.

Conclusions

Our survey of a mesa within close proximity to the Coombs site—the largest pueblo village during the 12th century AD in the area—addresses changes in the organization of technology and sexual division of labor between the much earlier, Late Archaic, and the Late Formative—contemporary with Coombs. Our analysis of the survey data from Black Ledge indicates that indigenous peoples used this area, and most of the sites appear to be contemporary with and attributable to short-term visits by the residents of Coombs. This information indicates that the villagers supplemented their agricultural production through seasonal procurement of plants and animals in the surrounding uplands. The presence of these logistical camps and localities argues for the year-round occupation of Coombs Village, rather than seasonal transhumance to lowland agricultural villages at Glen Canyon. We also propose that many of these sites were created by women using a core technology and local stone that they encountered while harvesting and processing wild plants and gathering firewood, clay (for pottery), and other materials on the northern lowlands, near their village.

Earlier sites, dating from the Archaic, are concentrated at higher elevations, further away from Coombs Village (mostly on top of the mesa). Because projectile points are more prevalent at these sites than at later ones and because some are situated on overlooks, these Archaic sites may be associated with hunting activities. Ground stone is also rarer at the Archaic sites.

Through preliminary analysis of our survey data we have documented the same shift in the organization of lithic technology (from bifaces to cores) observed at many other places around the world. Further research will be directed at evaluating the various alternative explanations for this shift

Acknowledgments

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