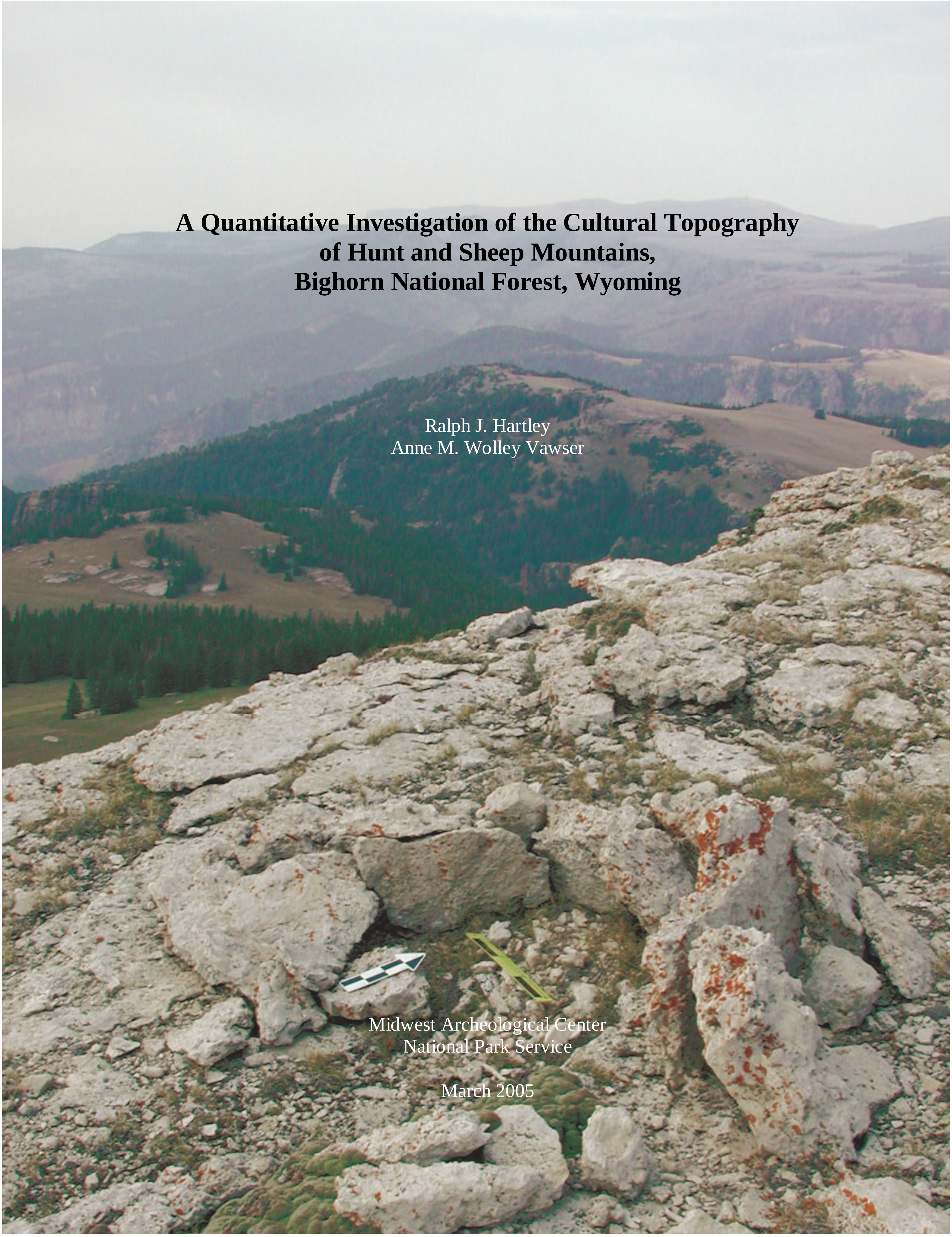

A Quantitative Investigation of the Cultural Topography of Hunt and Sheep Mountains, Bighorn National Forest, Wyoming

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Introduction

The use of high altitude environments in western North America and by pre-contact and historic Native American groups has been a theme in archaeological investigations especially since the advent and demands of cultural resource management on federally managed land. The terrain of Hunt and Sheep mountains (2800-3100 m) in the Bighorn National Forest of northern Wyoming is a topographically bounded environment that has avoided intrusive or destructive archaeological investigations (Figure 1). In August 2003, the tops of these two mountains were surveyed for above ground features of human construction or alteration. The existence of material remains of pre-contact, historic, as well as 20th–century Native American activities on these mountains has been known for decades. These areas were assigned site designations 48BH1516/48SH676 (Sheep) and 48BH1995 (Hunt) in the1990s by U.S. Forest Service personnel. Low level aerial photography of Hunt and Sheep mountains flown in September of 2000 at approximately 2500 ft. above ground surface, revealed the extent of the remains of numerous undocumented above ground rock structures and alignments. The proximity of these mountains to the Medicine Wheel (48BH302) and their topographical situation in the greater surrounding landscape lends significance to these material remains for northwestern Plains Indian individuals, groups, and concomitantly federal land management (Campbell and Foor 2004).

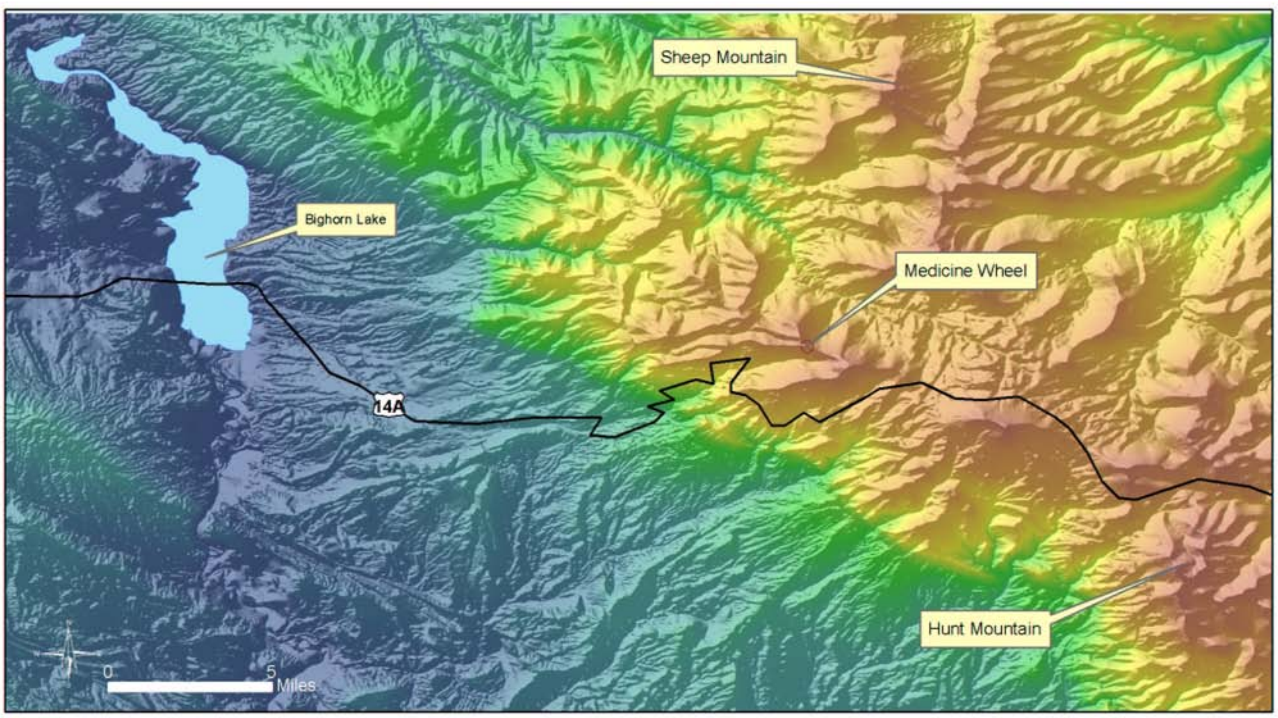

Figure 1. Topography surrounding Sheep and Hunt Mountains, Bighorn National Forest.

Hunt and Sheep mountains are examples of cultural topographies that are subject to dynamics, from a materialist perspective, that form the “attachment” attributed to these places by indigenous peoples for centuries. The interconnections among socio-cultural and architectural-geographical components of a setting continue to be a subject of behavioral research. Established settings, construed as a category of “perceived social facts,” emerge and maintain social impact due to being collectively recognized (Stokals and Shumaker 1981). Recognition that the socio-cultural meanings associated with a place are often perceived as a binding agent between individuals or groups and a particular environment is pertinent to observations of surface material on Hunt and Sheep mountains. The life history of a place in these settings can yield a *landmark* where particular activities or interactions occurred (Zedeno 2000:106; Sundstrom 2003; Whitridge 2004; Stewart, Keith, and Scottie 2004). The distinctiveness of such a place may be due to not only physical features but to personal or emotional "attachment" felt toward the place. The environments examined in this study exemplify landscapes that, in the words of McGlade (1999:459), should be characterized "as a dynamic arena in which interpretation and reinterpretation are seen as vital parts of the creation of cultural knowledge."

The observations of human-made features while on Hunt and Sheep mountains in 2003, as well as those made at a desk are, as Kosso (1991:625) points out, "theoretically influenced claims about local and specific situations, closely linked to perception." Furthermore, McGlade (1995:113) emphasizes that meaning assigned to human-made features observed in an archaeological context "resides in a perceptive relativistic and observer-dependent domain," insight that should not be ignored in studies of cultural topography. It is acknowledged that the categorization of our observations on these mountains for use as analytic units may not be shared by others *seeing* the same physical landscape, an issue of measurement not unfamiliar in social science (Golledge and Stimpson 1997: 400-405).

The conundrum confronting a description of the cultural topography of Hunt and Sheep mountains from the materialistic metaphysic that underlies archaeology is that the reality of the phenomena of interest is characterized by a continual process of human induced change. Moreover, the complexities inherent in the formation of the evolving natural landscape is beyond the bounds of the examination presented here but potentially addressable by way of intensive investigation into those formation processes that are recognized to be potentially influential in human use of places through time. In the attempt here to explore the structure of these assigned units in space we, in effect, hold time constant. For this reason, among others, these "crippled analytical units" make interpretation of past lifeways on these mountains an exercise in fictional story-telling (Wandsnider 1998a: 22; 1998b:101).

Examining socially constructed space as reflected in cumulative material features on these two mountains necessitates a variety of approaches when attempting to posit generalizations about variation in the life history of places that functioned in social behavior. It is acknowledged that perception of or assigned significance to the topographical features in these environments is highly vulnerable to variation in individuals and groups. And deriving meaningful patterns in an archaeological record formed by the interaction of cultural and natural processes is inherently a subjective enterprise. The objective mode of the data-led inquiry taken in this study allows for the pursuit of three overarching goals: (I) to assess variation in clusters of circles of stone as a function of the number and sizes of stone circles; (II) to assess, using quantitative analyses of viewshed, variation in the placement of structural features of rock on these mountain landscapes; (III) to frame direction for research that has the potential to build on the exploratory analyses described in this study.

Approach

Field observations of architectural remains on Hunt and Sheep mountains were recorded as three fundamental categories: circles of stone or rock; low level rock structures or small alignments; and stacked rock cairns (Figure 2). Different approaches and procedures were taken in examining the data derived from the information collected.

(a)

(b)

(c)

Figure 2. Examples of architectural remains recorded on Sheep and Hunt Mountains; (a) Stone Circle, (b) Rock Structure, (c) Rock Cairn.

I. Stone Circles –

Thousands of stone circles are documented in the plains and mountain environments of North America. A total of 87 were mapped on Hunt (n= 72) and Sheep (n= 15) mountains for this study. Ethnohistoric and ethnographic accounts suggest that prior to efficient means of making wooden pegs Native Americans used rock, and sometimes logs, to anchor tent coverings.[1] Clusters of circles of large but portable stone are assumed to reflect tent camps.

Five clusters of stone circles were mapped on Sheep and Hunt mountains (Figures 3 and 4). For the purposes of this study we consider these clusters (A – E) as "camp locales", the topographical setting at which episodes of camping occurred. We assume that it was highly probable that these five places were used for temporary camps intermittently through time (cf. Adams 2002). The stone circles in these camp locales may be the remains of untold episodes of tent camping, forming what Schlanger (1992) has termed a "persistent place" on the landscape. The validity of camp locales as a "formal unit" of analysis is, therefore, definitely lacking (Wandsnider 1998b:94). Nevertheless, for the purposes of examining variation in the past use of settings of presumed residence on these mountains the spatial content of clusters of stone circles permits means of exploratory analysis.

Circles of stone were defined by their arrangement on the ground surface, a sometimes subjective field task given the geomorphology of the Bighorn Mountains at high altitude. Many stone circles were, however, well delineated. All stone circles were mapped using a Trimble Pathfinder Power Pro GPS unit. Locations of any observable concentrations of surface stone both within the circles and outside of the circles were also recorded. An interior vs. exterior set of rock were discerned at forty-one percent of the stone circles documented on Hunt and Sheep mountains.

The diameter of the eighty-seven stone circles varied widely. A search of ethnographic and ethnohistoric literature of the Northern Plains brought Quigg and Brumley (1984:17-20, 30) to suggest that size of tents varied due to function, the number of inhabitants when used as a residence, the socio-economic status of the inhabitants, and available transport options. Concentrations of tents used during any one camp episode may reflect kin groups or band proximity (cf. Binford 1991; Whitelaw 1991:151-165). These sources indicate that the layout of a camp was highly situational. Topography and the resource structure surrounding the site setting is acknowledged to often dictate the arrangement of tents (Reher 1983; Quigg and Brumley 1984:18-20; Banks and Snortland 1995). Cross-cultural information suggests, however, that distance between units of residence or camp activities has the potential to inhibit or facilitate interaction between individuals or groups. The ethnographic and ethnohistoric sources for this region suggest that larger tents were more likely to have served as familial residences or for ceremonies whereas nearby smaller tents were likely used for women's domestic activities, small family units or lone individuals.

A common unit of measure for stone circles by archaeologists is diameter (e.g. Finnigan 1982; Winham 1982; Davis 1983; Quigg and Brumley 1984:84; Brumley and Dau 1988:329-331; Hanna 1991). Both the inside of the circle and the exterior limit of rock are often measured. A rationale for the interior vs. exterior measure is that the more interior rock reflects that used for a tent lining. Quigg and Brumley (1984:40) note that the interior diameter of the circle is most representative of the living or activity area of the tent given ethnographic and ethnohistoric descriptions. For the purpose of this study we use the area of the interior, as derived in Arc-GIS (v.8.3), of stone circles in square meters for analyses.[2] This measure is considered a conservative estimate of the living or activity space within a tent.

The total population of stone circles was divided into quintiles to establish size classes I – V (Table 1). This categorical data permits the description of the relationships between camp locales and stone circle size classes. Furthermore, it provides a means by which to evaluate the extent to which the spatial distribution of larger stone circles conditions the observed location of smaller circles at each camp locale.

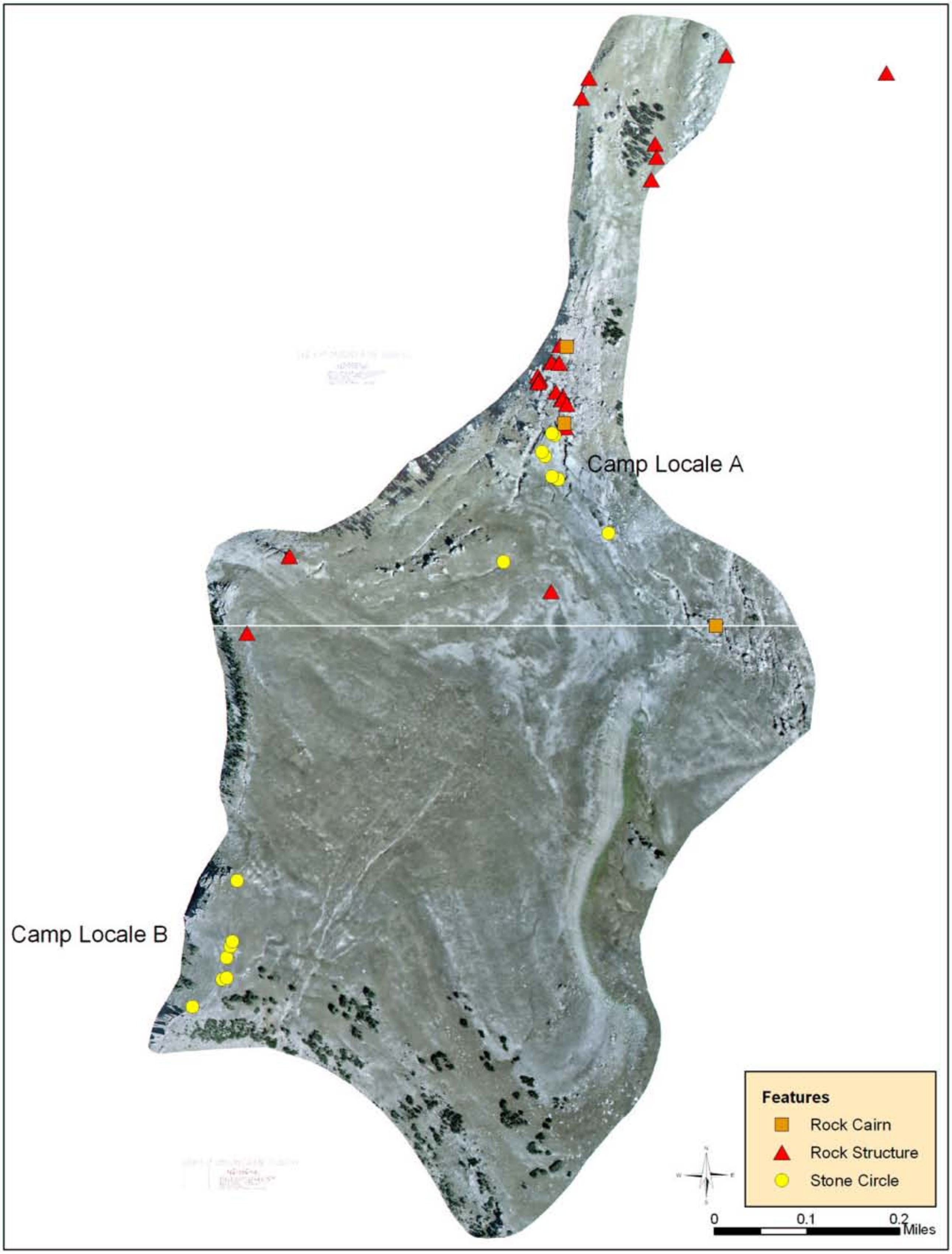

Figure 3. Archeological features and camp locales, Sheep Mountain.

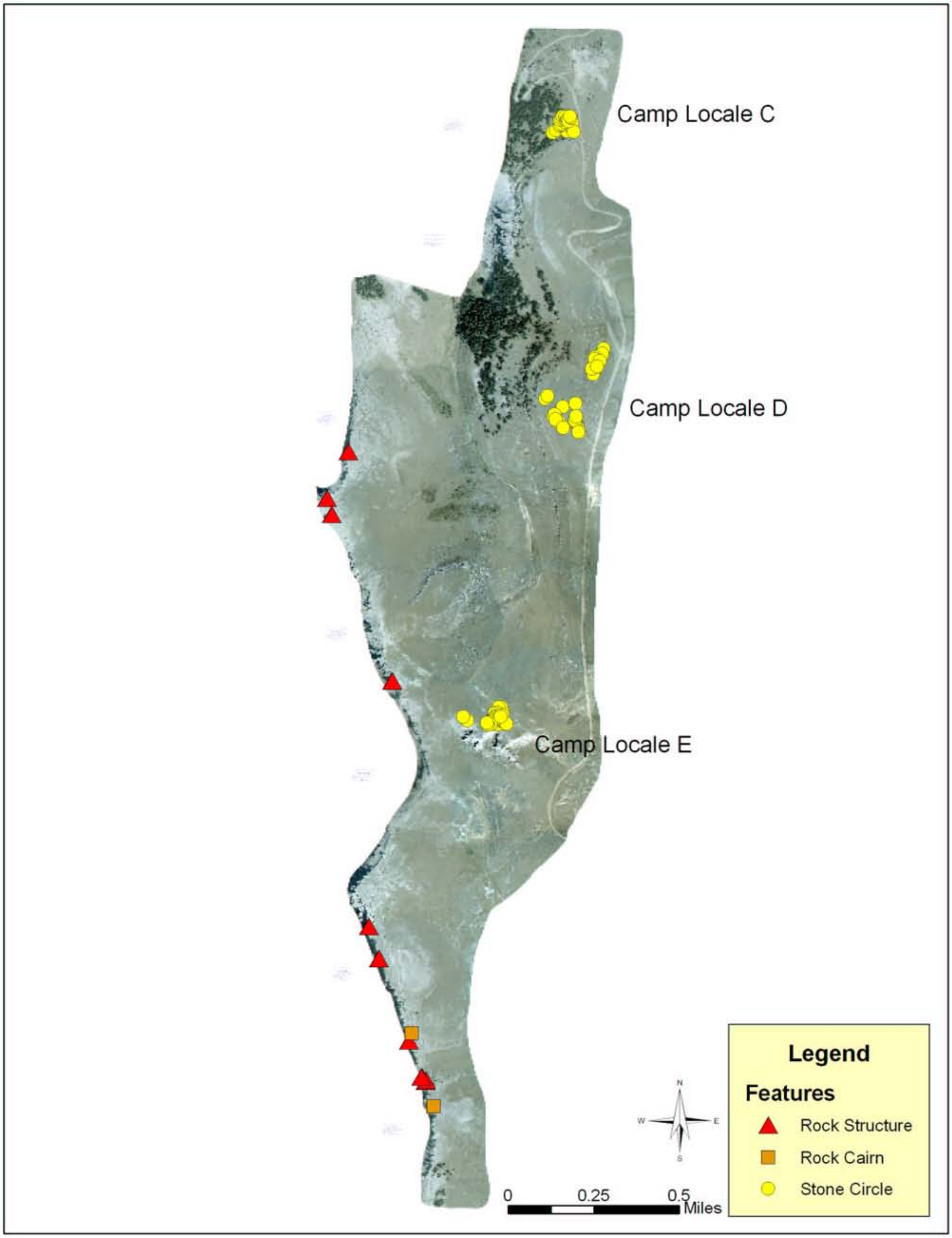

Figure 4. Archeological features and camp locales, Hunt Mountain.

Table 1. Size Classes for Stone Circles on Hunt and Sheep Mountains.

Size Class	Area (m^2)
I	6.5 – 12.10
II	12.11 - 15.20
III	15.21 - 18.40
IV	18.41 - 21.25
V	21.26 - 38.00

II. Rock Structures –

Rock structures and alignments other than circles were observed on both Hunt and Sheep mountains. Structural enclosures of rock, commonly considered the place of Native American "vision quests" were observed consisting of both stacked and unstacked rock alignments (Figure 5). Twenty-two of these features were documented on Sheep mountain and eleven on Hunt mountain. Primarily a solitary male activity, vision seekers often constructed a semi-circular or U-shaped rock enclosure in which to reside for extended periods of time. [3] Efforts to transcend the material world in search of power and enlightenment may have required several consecutive days and nights of physical deprivation at the place (Lowie 1922; Benedict 1922; Dugan 1985; Hultkrantz 1987:51-56; Irwin 1994). Enclosures were often oriented to or have an expansive view of the rising or setting of the sun or a sacred peak. Lowie (1922:332), describing a typical vision seeking experience among the Crow, writes "The faster was virtually naked, using a buffalo skin for a blanket at night. According to Flat-head-woman, he would lie on his back with legs stretched out, the arms extended at the sides and facing east all night; his bedding was framed by rocks on both sides." The situational positioning of these enclosures on high mountains, however, often enabled the occupier a panoramic view. Evaluating consistency in the orientation and extent of all enclosures considered places of vision quests is conducted here as a means of examining one dimension of variability in the presumed use of these places.

Narrowly stacked rock, considered cairns (Sheep, n = 3; Hunt, n = 5) were also noted on both mountains (see Figure 2).[4] Rock stacked high enough to be seen from some distance can serve as a landmark for which function is highly situational (e.g. Caldwell and Carlson 1954; Malouf 1962; Jett 1986). In addition to use by Native Americans the erection of cairns by herders, as survey markers, and for mining claims, is known throughout the intermountain west. Landmarks are often distinctive, its recall being dependent on its contrast to the surroundings. The human formation of cognitive maps may be highly dependent on hierarchically structured landmarks serving as cues in an environment (Kaplan and Kaplan 1982: 45-47, 57-59; Kitchin and Blades 2003: 35-40, 42-43). Some cairns constructed by pre-contact and historic Native Americans in the northern Plains and Rocky Mountains are believed to have been associated with trails as well as places of vision quests, burials, pilgrimages, or villages (Adams 1978: 13-14, 16, 60-64; Loendorf and Brownell 1980; Winham 1982; Platt 1992; Reeves 2003: 363-365; Sundstrom 2003: 270-271).

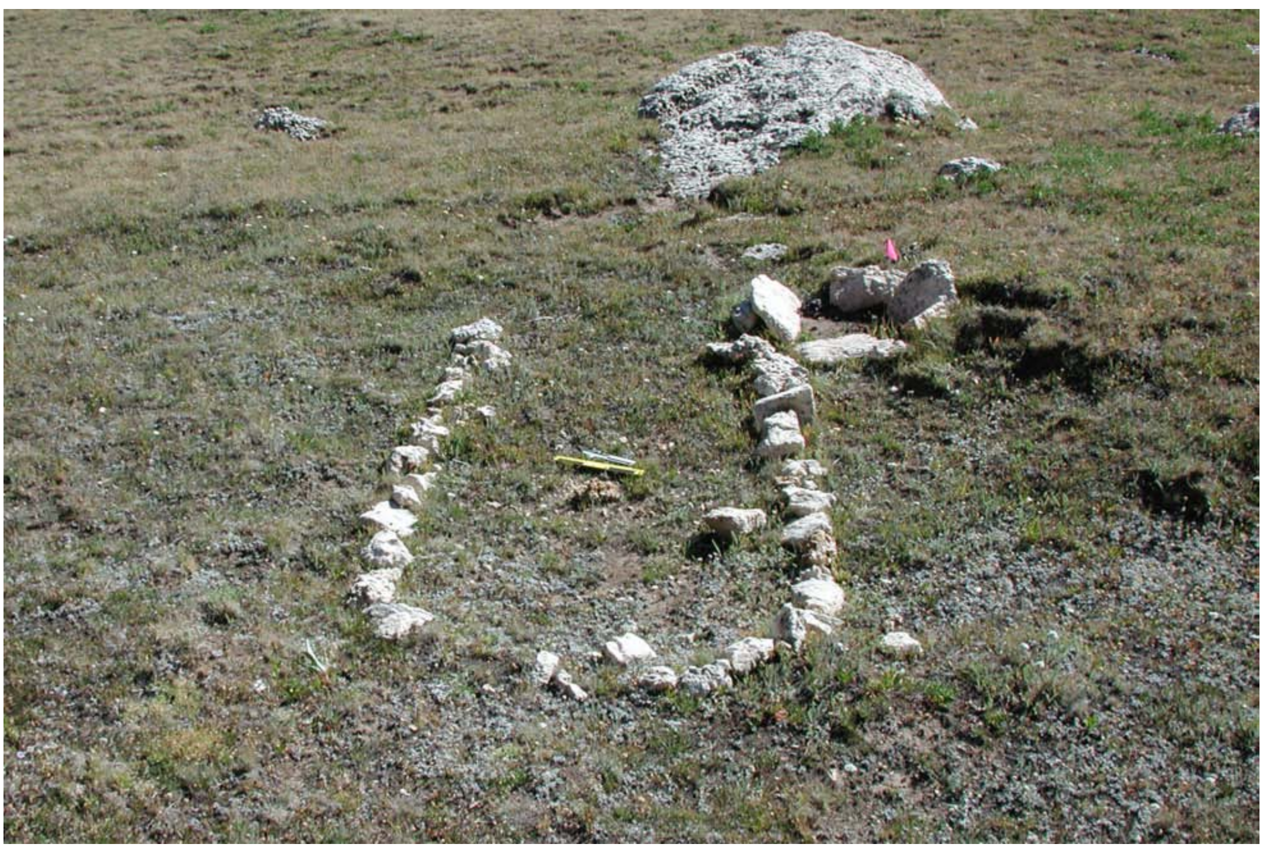

Figure 5. Rock Structures, commonly considered places of a vision quest were observed consisting of both stacked (top in red oval) and un-stacked rock (bottom).

Analysis and Results

I. Stone Circles –

Correspondence analysis, as an exploratory procedure (SPSS 11.5), was selected in order to describe relationships between the distribution of sizes of stone circles [SIZE CLASS] and camp locales [CAMPS]. [5] Evaluation of full input data suggests substantive variation in the data set when total inertia is .298 (X^2 = 25.95, *df* = 16, *p* = .05) (Table 2). Figure 6 shows the plot of the correspondence analysis (CA) of the two variables using the symmetrical normalization method. The first two dimensions of the correspondence table explain 95.4% of the 29.8% of the variation explained by the model. Camp locale B contributes the greatest inertia (variance) to Dimension 1, whereas the largest of the stone circles, Size Class V, accounts for by far the greatest inertia of the column points in both Dimensions 1 and 2. The lower left quadrant is defined by Camp Locales C and E, both highly concentrated sets of stone circles on Hunt Mountain. Although one must keep in mind that the inter-category distances on the map display are not measures of association, some generalizations can be made nevertheless. That is, the three Camp Locales on Hunt Mountain are more similar in terms of the distribution of stone circle sizes than those on Sheep Mountain.

Table 2. Correspondence Diagnostics for SIZE CLASS and CAMPS.

	Quantity[a]	Mass[b]	Inertia[c]	Dimen.1[d]	Dimen.2[d]
A	.918	.092	.068	.493	.425
B	.985	.080	.134	.985	.000
C	.996	.241	.047	.275	.721
D	.856	.264	.039	.049	.806
E	.967	.322	.010	.068	.899
I	1.0	.195	.092	.244	.755
II	.835	.195	.029	.467	.368
III	.742	.207	.031	.241	.500
IV	.871	.195	.007	.088	.783
V	1.0	.207	.139	.988	.012

[a] A proportion of variance statistic indicating how well a point is represented by the first two dimensions.

[b] Marginal proportion of the variable used to weight the point profile when computing point distance.

[c] A variance measure of the distance from the average weighted by its mass.

[d] Proportion of inertia accounted for by each axis as a squared correlation.

Similarities and differences in camp locales were further examined by establishing the mean of each size class distribution within each of the five camp locales. Figure 7 shows the difference in stone circle size distribution between Camp Locales A and B on Sheep Mountain relative to those on Hunt Mountain. Greater uniformity in both stone circle size classes and distribution are indicated on Hunt Mountain.

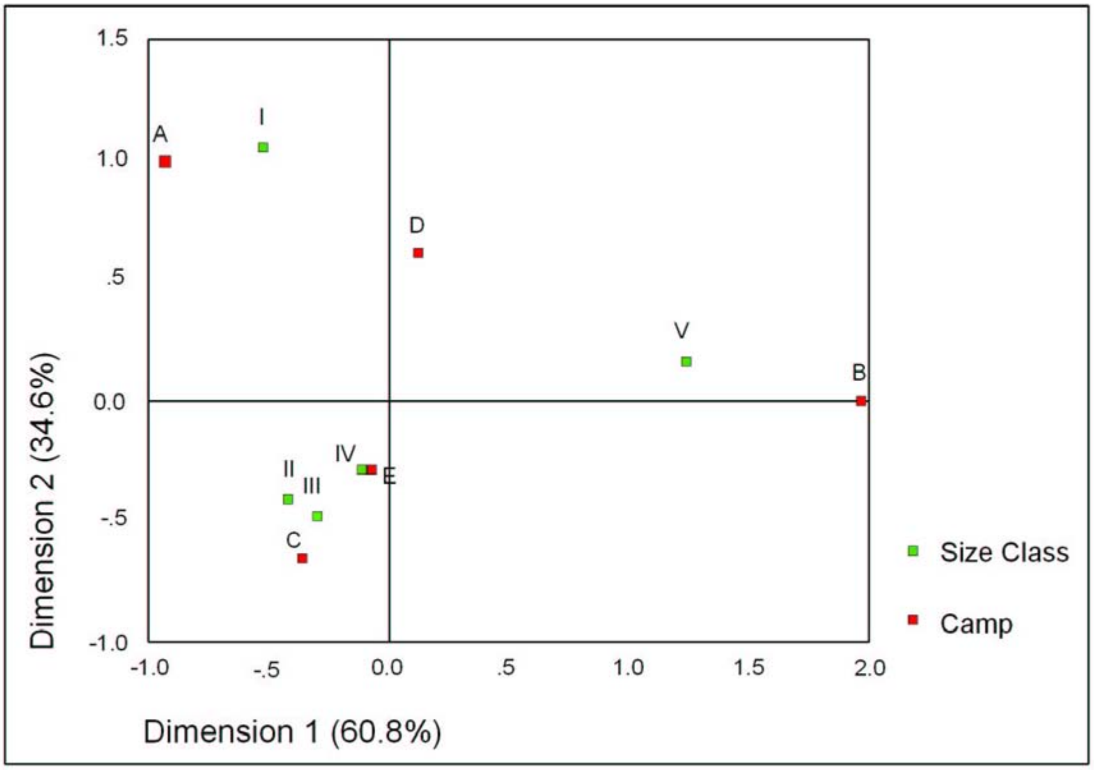

Figure 6. Correspondence analysis of sizes of stone circles with camp locales (1st and 2nd axis).

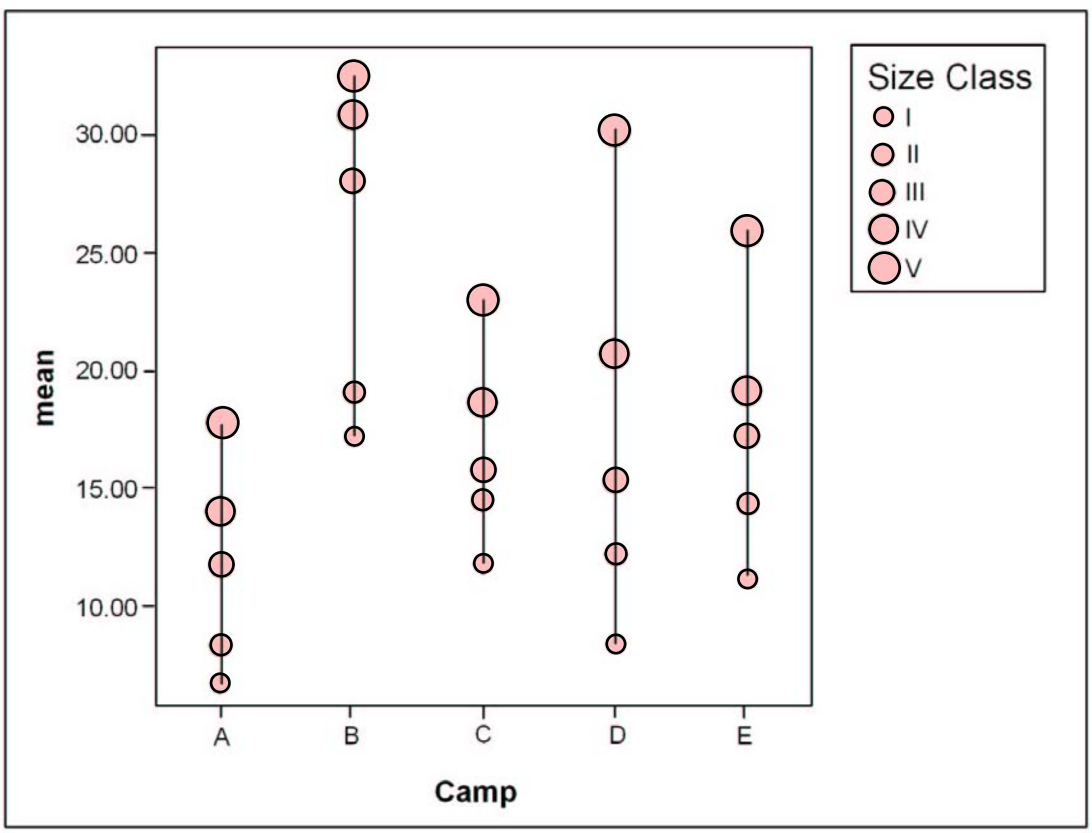

Figure 7. Distribution of mean Stone Circle Size Classes at each Camp Locale.

Spatial relations between stone circle units at each camp locale were explored using tessellation models. [6] The spatial extent of each camp locale was apportioned into spaces, such that each Class V (largest) stone circle functioned as nuclei by which tessellation procedures forming polygons were constructed (Figure 8 through 12). Each polygon is conceptualized as a space oriented to a particular large stone circle with the position of other smaller stone circles designated as nearer to a given Class V stone circle than any other. These boundaries allow us to visualize the proximity of smaller to that of larger stone circles as well as the arrangement of Class V stone circles throughout a camp locale. The aerial photographs on which the camp locales are depicted provide proximity information to topographic features.

Table 3 consists of measures for all polygons in each camp locale for which Size Class I-IV stone circles are in proximity to the Class V stone circle node of that polygon. Camp locales A and C each contain one polygon in which no smaller stone circles were observed in proximity to the Class V stone circle node.

Table 3. Mean Proximity (meters) of Class V Stone Circles to Smaller Stone Circles by Camp Locale.

CAMP LOCALE	I	II	III	IV
A	-	36.5	56	28
B	-	30	8.5	-
C	13.5	17.5	25	21.25
D	69	54.8	52.5	45.8
E	16.5	17.5	14.75	14.33

Five stone circles from the overall population were deleted from this summary table; three Size Class I stone circles one each from Camp Locales A, B, and E and two Class IV stone circles one each from Camp Locales B and E. These stone circles were not included here due to their extreme distance (ca.100m) from a Class V stone circle node. The scale of the Camp Locale D map, relative to all others, accounts for the greater distance between many of the stone circles in that area. What may be of interest here is the distance between two clusters of stone circles, north and south, irrespective of polygon boundaries. A more intensive examination of the spatial content of this area would include isolating these clusters as separate camp locales.

The assumption that the stone circles at these camp locales reveal the remains of several camping episodes through generations contributes greatly to the “noise” in proximity patterning between class sizes of documented stone circles. Nevertheless Camp Locale C on Hunt Mountain depicts an arrangement where, for the most part, the smaller the stone circle, the closer it is to a large stone circle. Although no overall pattern is readily apparent at the other four camp locales, at least one small stone circle is positioned adjacent to many of the Class V stone circle nodes. Further revealed by the maps of camp locales is the proximity of clusters of stone circles to variably deep crevices, especially at Camp Locales D, E and A. The north cluster of Camp Locale D stands out as a prototype for locating tents in the summer season near what may have been a source of water by way of pockets of snow in the deep crevices (cf. Kehoe 1960:436; Dooley 2004:108).

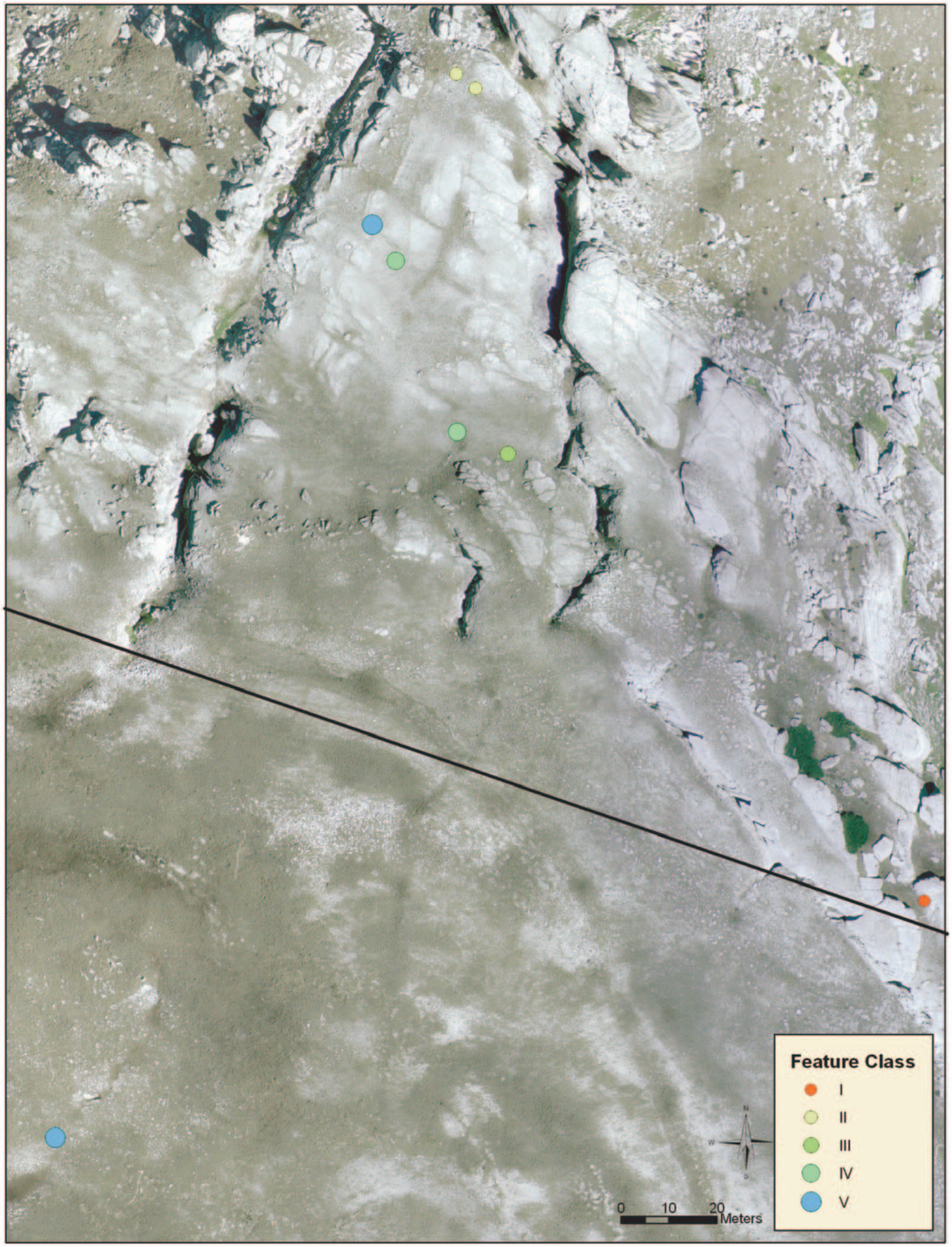

Figure 8. Camp Locale A showing distribution of stone circles and polygon boundaries.

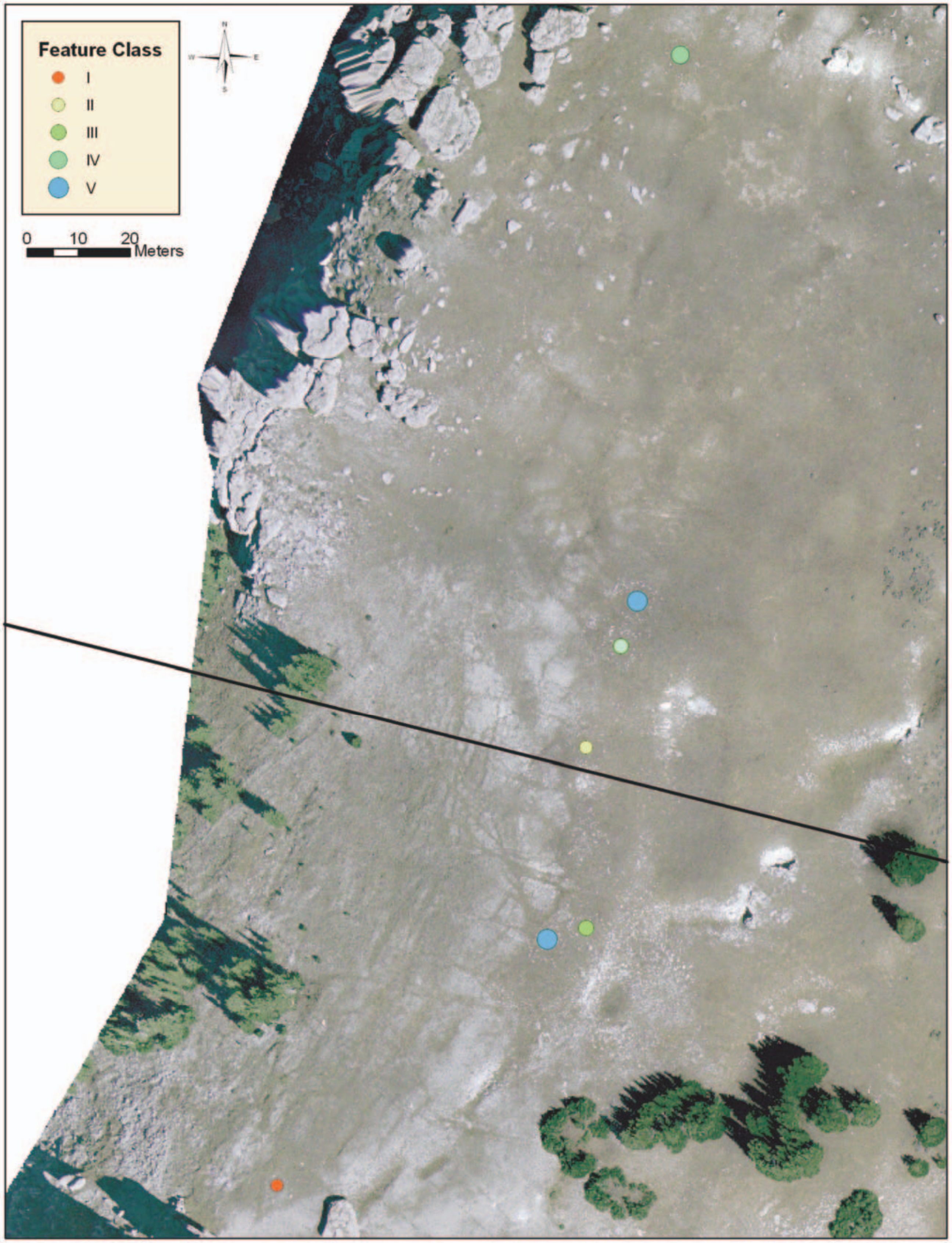

Figure 9. Camp Locale B showing distribution of stone circles and polygon boundaries.

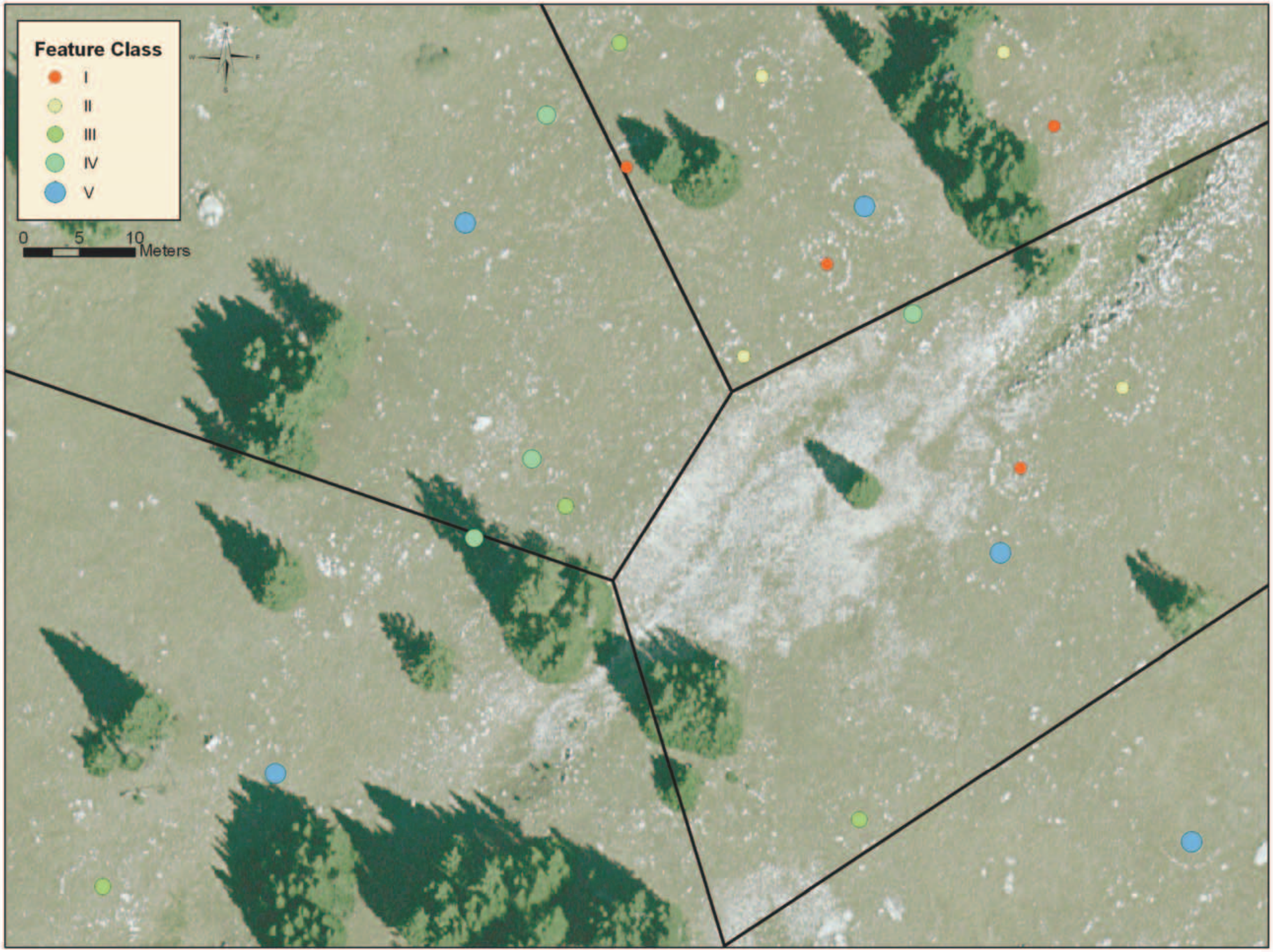

Figure 10. Camp Locale C showing distribution of stone circles and polygon boundaries.

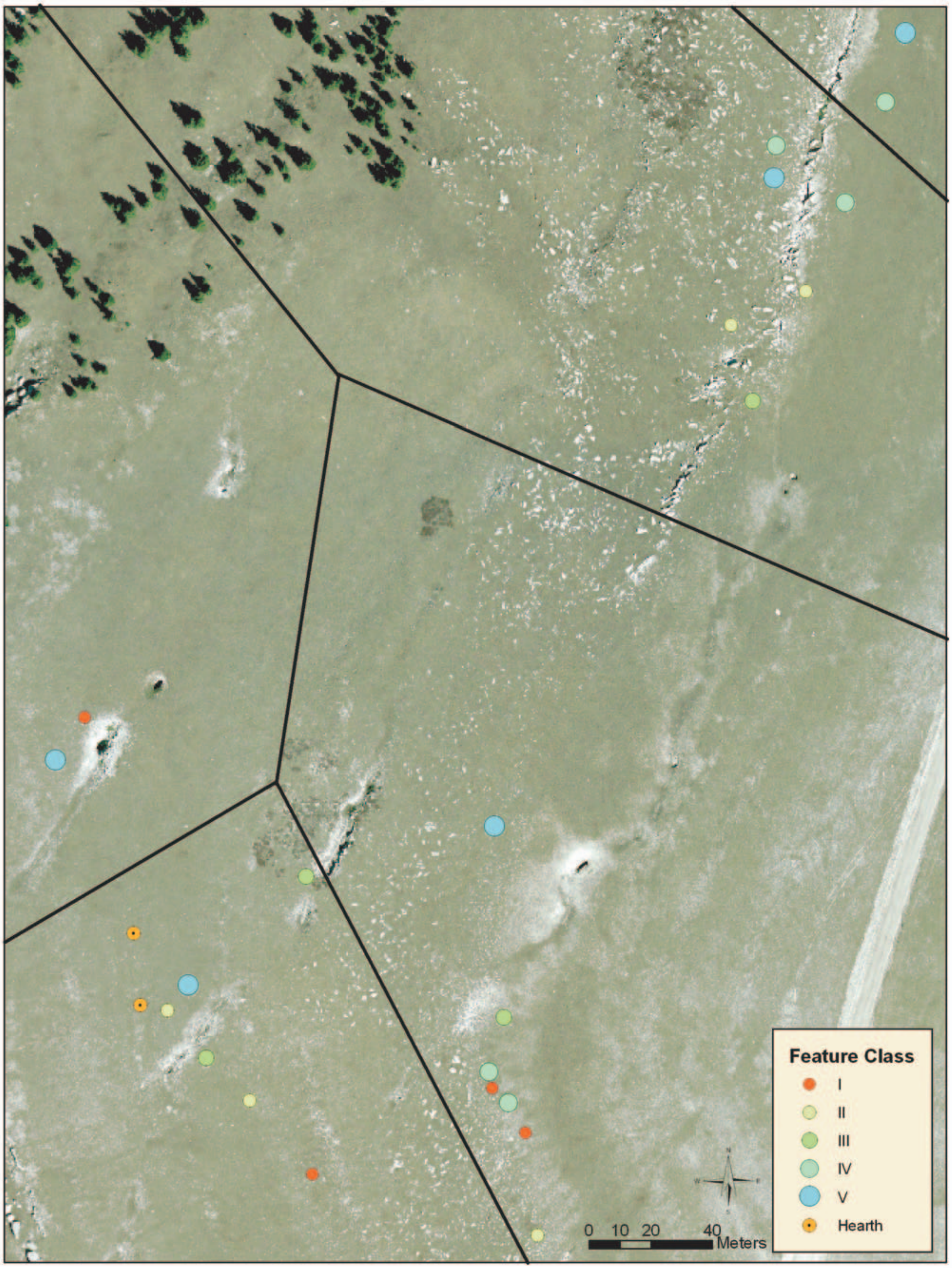

Figure 11. Camp Locale D showing distribution of stone circles and polygon boundaries.

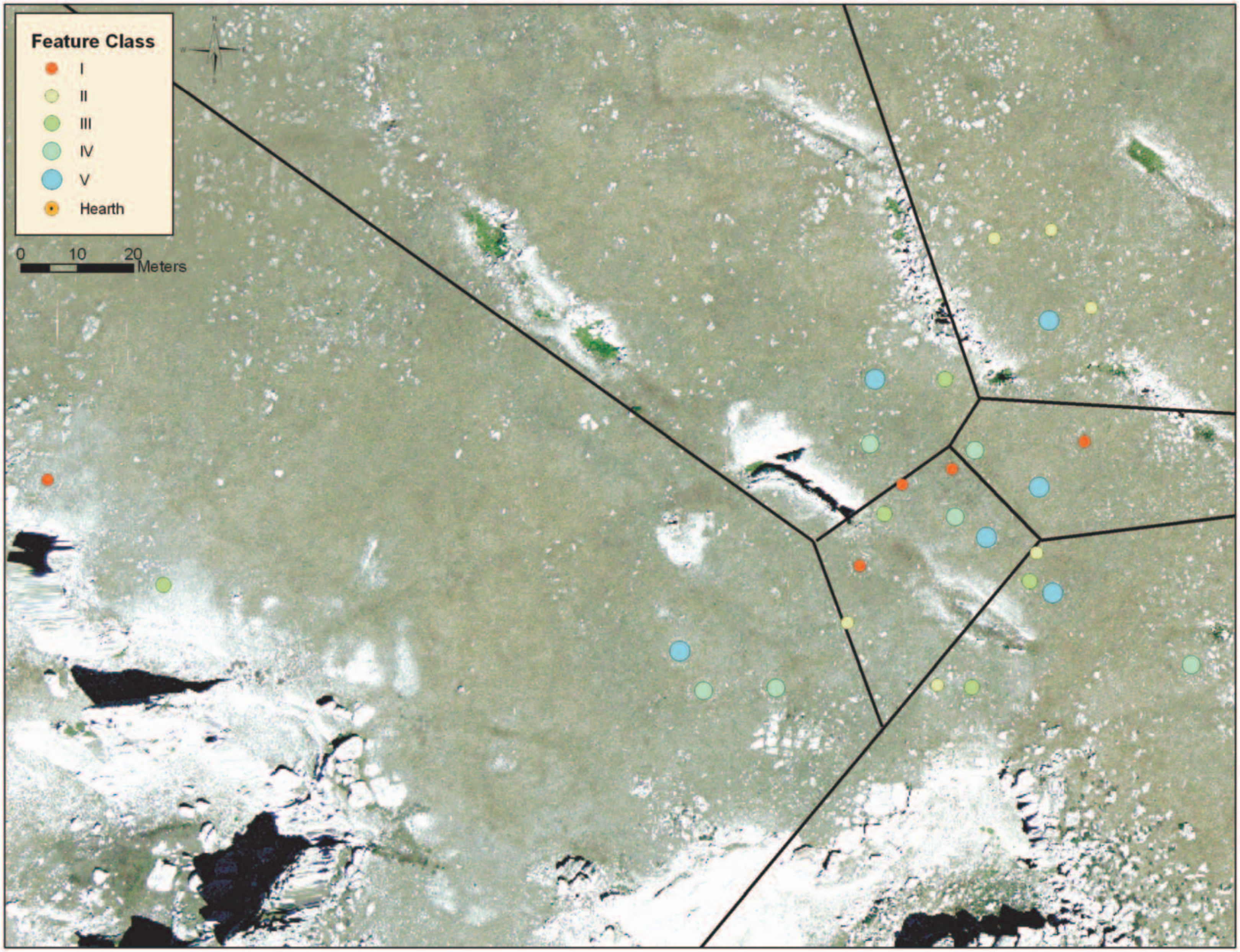

Figure 12. Camp Locale E showing distribution of stone circles and polygon boundaries.

II. Rock Structures –

Wheatley and Gillings (2000) have argued that quantifying directionality is a means by which to elaborate on and differentiate viewshed. Assessing variability in directional line-of-sight and field-of-view (viewshed) from rock structures and alignments considered places used by vision seekers was conducted using GIS-based applications (Arc-GIS v.8.3). The projected viewshed from each of the places of presumed vision quest was decomposed into eight directional zones (Figure 13). The area of visibility for each zone extended to 4.828 km (3 miles) and was quantified in square meters. Vertical height from which view is calculated is one meter. Elevational view from this point is 90 degrees (45 degrees from 0 or horizontal), permitting the inclusion of the area below the position of the structures on mountain tops.

A comparison of the places used by vision seekers on Hunt and Sheep Mountains suggests that an easterly view was available to vision seekers on Sheep Mountain (Figure 14). The placement of structures on Hunt Mountain permitted a more westerly view (Figure 15). The difference in natural topography of these two mountain tops contributes to this difference to some extent. However, decision-making of the vision seekers in locating their structures accounts for the variance when the summarized viewshed is quantified. Figure 16 shows the variation in directional view between structures on the two mountains. What appear to be somewhat recently constructed places of vision quests on Sheep Mountain contributes greatly to the summarized easterly view available from structures on this mountain (Figure 17).

Directions for the Future

The static nature of the observations examined spatially on Hunt and Sheep mountains permits only conjectural reasoning about the distribution and use of human-made features. Exploratory procedures with the categorical data and visualization constructed here do not permit *formal* inductive inferences to be made about the decision-making that resulted in these places being chosen for occupation or otherwise used in the past (Fotheringham et al. 2000: 185-188; cf. Taylor 1977:149; Binford 1990:120; Goodchild 1996:245). We can, however, propose some questions resulting from the apparent similarities and differences in these features and locations that can be pursued with a goal of establishing empirical models that attempt to illustrate the complexity of relationships in the use of these places through time. Constructing a model of the past is, as Binford (2001:482) has emphasized, vastly different and more difficult than searching for an explanation of variability in the archaeological record.

(1) Five concentrations of stone circles are identified on Hunt and Sheep mountains. Assuming stone circles are the remains of tent camping, based on ethnographic and ethnohistoric accounts as well as pattern recognition in the archaeological record, do these five settings conform to those environmental and topographic variables outlined by Kehoe (1960), Reher (1983), Quigg and Brumley (1984), Banks and Snortland (1995) and Dooley (2004) that are believed to have influenced decision-making in camp placement? If not, how do they vary from Native American informant accounts and/or the generalizations constructed by archaeologists? What were the conditions characteristic of Hunt Mountain that made it more amenable to camping activities relative to those of Sheep Mountain?

(2) Although past archaeological excavation of stone circles have yielded highly variable but generally sparse artifactual material, surface observations in 2003 resulted in eleven stone circles with artifacts (lithics and/or ceramics) within the circle and cultural material observed adjacent to 14 stone circles. Rock concentrations were observed within the center of 23 stone circles of various

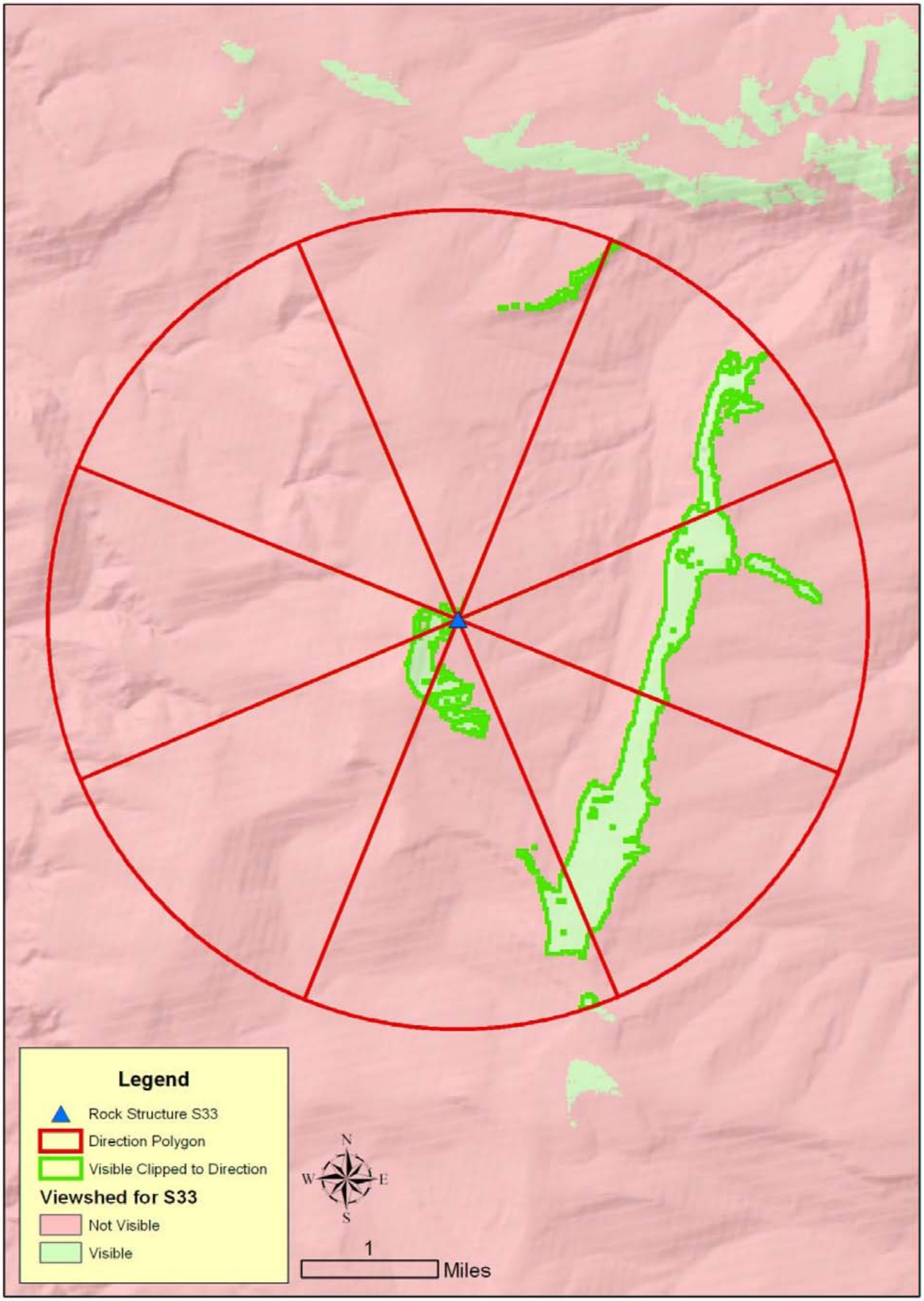

Figure 13. Example of a Rock Structure on Sheep Mountain for which the area of visibility from that place was measured in eight directional zones.

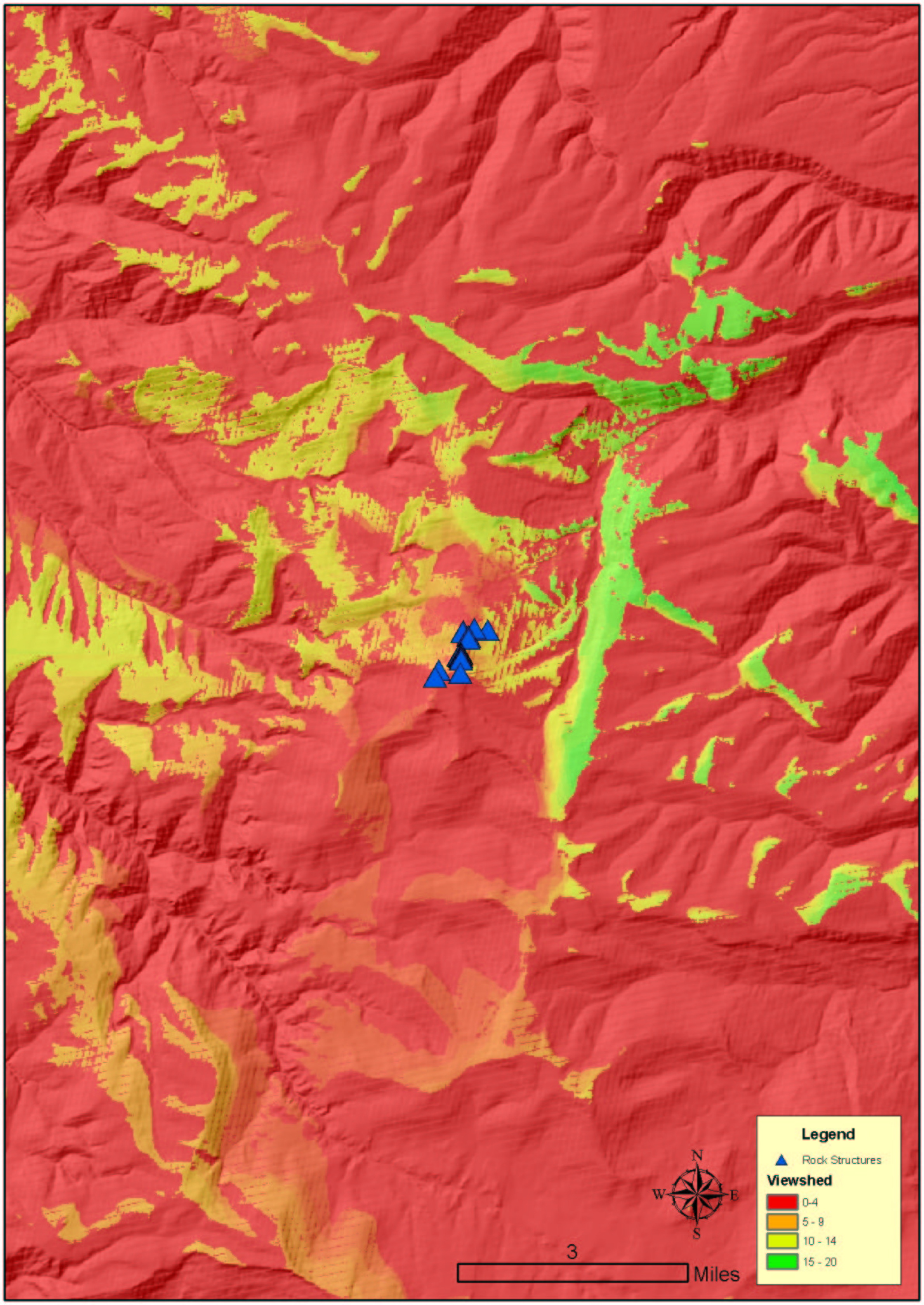

Figure 14. A composite of viewsheds from documented places of vision quests on Sheep Mountain. Color values indicate the commonality of view from these rock structures.

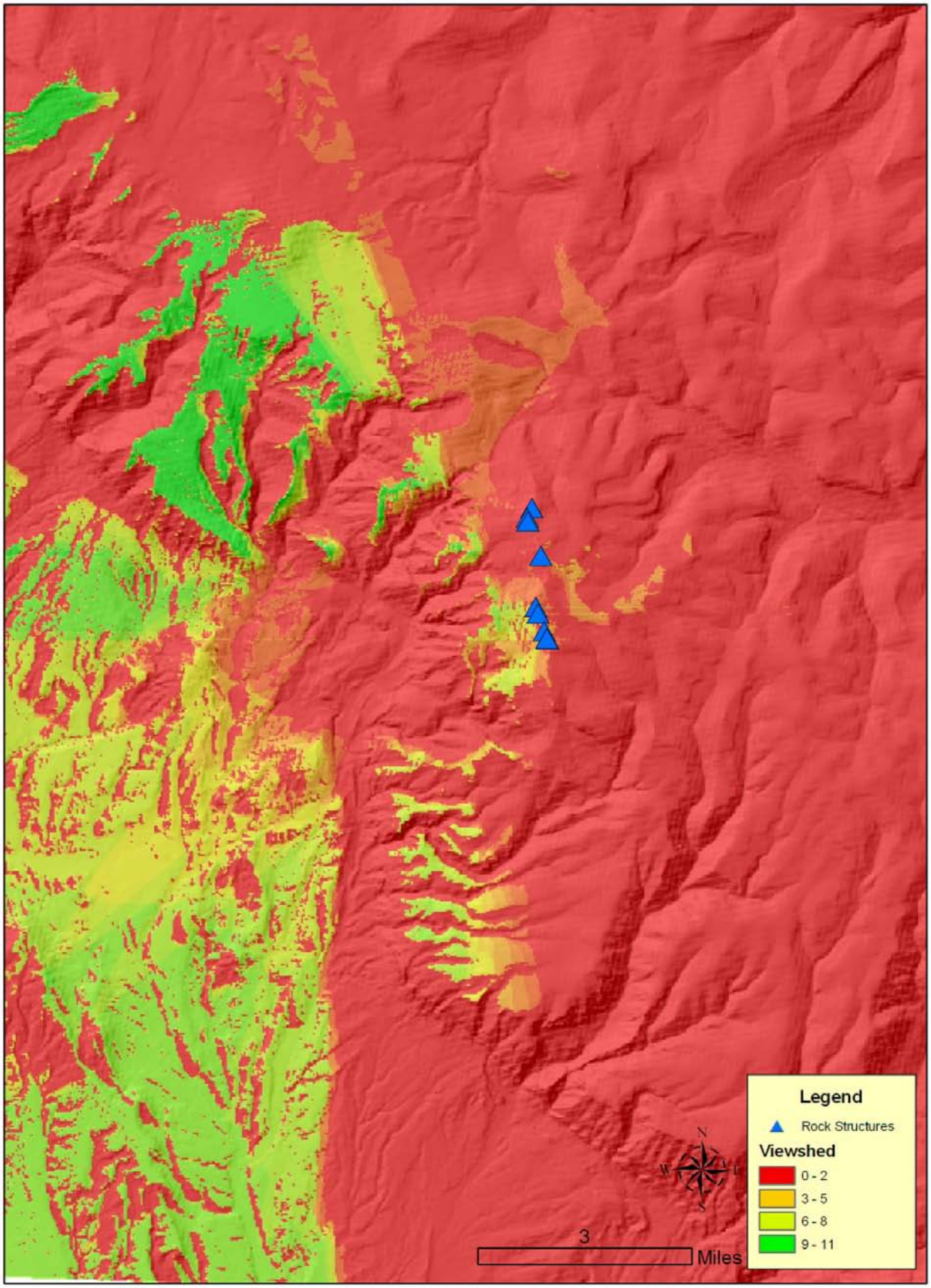

Figure 15. A composite of viewsheds from documented places of vision quests on Hunt Mountain. Color values indicate the commonality of view from these rock structures.

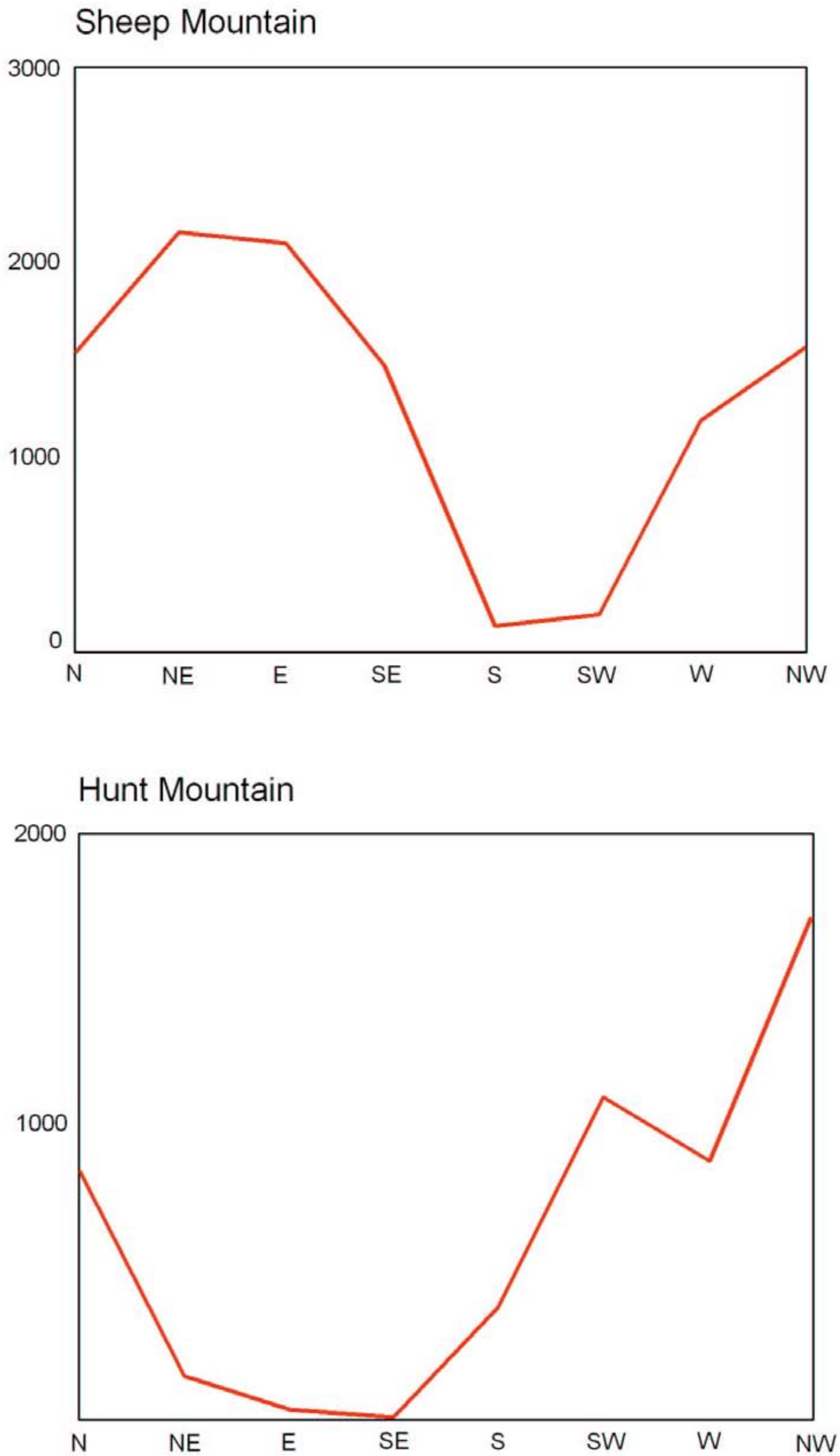

Figure 16. Variation in area of view (m^2) between places of vision quests on Sheep and Hunt Mountains.

Figure 17. What appears to be a recently constructed, northeast facing, place of vision quest on Sheep Mountain. Note the remains of a cloth wrapped hoop in the foreground.

sizes on Hunt Mountain and six on Sheep Mountain. Does intensive archaeological excavation reveal these features to be the remains of rock lined hearths as suggested by Winham (1982), Adams (2002) and others? If so, are rock- lined hearths placed within stone circles of any defined size range relative to other stone circles in a camp locale? Do artifact assemblages recovered during excavation vary between those stone circles with defined hearths and those that do not reveal the remains of fire hearths?

(3) Despite the warnings of Cribb (1991:371) that archaeologists should avoid attempts to evaluate relationships between the location of individual tents, if the stone circles in the five camp locales are the remains of episodes of variably sized tent camps, do those stone circles lying far outside Camp Locales A, B and E reveal, upon excavation, similarities or differences in structural morphology or artifactual remains relative to stone circles of similar size in the nearest camp locale?

(4) The two outlying stone circles in the vicinity of Camp Locale E are situated very near the rim and approximately 30 meters apart. Upon excavation how do these stone circles vary in terms of structural morphology and artifactual remains?

(5) Ethnographic and ethnohistoric sources suggesting preference for sunrise or sunset view by vision seekers is supported by the analyses of presumed places of vision quests on these two mountain tops. These sources also suggest that, in the past, these places were often re-used, resulting in what Reeves (2003:236) calls archaeologically “composite structures”. Did repeated use

of structures by vision seekers result in a morphology of rock stacking and alignment that differs from that of contemporary places of vision quests? Are recently constructed places of vision quests less or more likely to be locations previously used?

(6) Bifacially worked lithic tools and projectile points, although sparse, are observed primarily in the vicinity of camps. Does intensive archaeological excavation at structural enclosures of stacked rock reveal evidence of these places being used as hunting blinds at some time in the past (cf. Bettinger 1991)?

(7) Archaeological excavations at cairns or rock piles have, in the past, resulted in material suggesting diverse activities at these places. Does intensive archaeological excavation and analysis at places of cairn construction on Hunt and Sheep mountains reveal the use of these locations to be other than landmarks?

End Notes

[1] Use of the term "tipi ring" to describe a circle of stones in this study is avoided following Brasser (1982:313) because the implication of function narrows its utility as a unit of analysis.

[2] Interpretations of the absence of stone in a portion of a circle as observed on the surface range from being a "doorway" for the tent to "rock robbing", the re-use of stone from a previous camping episode, i.e." scavenging". Likewise, clusters or "loading" of stone in the morphology of a circle are sometimes interpreted as reflecting the orientation of the tent to the prevailing winds during a particular season (e.g. Calder 1979; Adams 1978; 2002; Winham 1982; Finnigan 1983; Quigg and Brumley 1984; Brumley and Dau 1988; Hanna 1991).

[3] Adult women were also known to seek and have vision experiences in some Native American Plains groups (Lowie 1922:332; Irwin 1994:80-81).

[4] In some cases identifying cairns is a highly subjective decision. Collapsed narrowly stacked rock enclosures, once used by vision seekers, may appear to be eroded "cairns" and documented as such (Reeves 2003:363-365; Sundstrom 2003:271).

[5] Correspondence analysis (CA) serves to explore the relational structure of rows and columns of a contingency table. The method, increasingly used in archaeology, allows for the factoring of categorical variables and displaying them in a space that maps their geometric association in two dimensions (Blasius 1994; Baxter 1994; Cool and Baxter 1995; Shennan 1997).

[6] This procedure uses an algorithm of Voronoi tessellation that divides a plane into polygons, in this study one for each Class V stone circle. A mosaic of tiles imposed over the area of interest is formed, commonly known as Dirichlet tiles, Thiessen or Voronoi polygons (Upton and Fingleton 1985:96-104; Haining 1990:20, 101-110; Halls et al. 2001).

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