Journal of California and Great Basin Anthropology | Vol. 34, No. 2 (2014) | pp. 181–210

Prehistoric Bighorn Sheep Procurement Tactics in the Colorado Desert: A Hypothesis for a Stone-Feature Complex in Yaqui Pass, Anza-Borrego Desert State Park, California

JOAN S. SCHNEIDER
California State Parks, Colorado Desert District (Retired),
6595 Hawarden Drive, Riverside, CA 92506

ROBERT S. BEGOLE*
Colorado Desert Archaeology Society,
200 Palm Canyon Drive, Borrego Springs, CA 92004
(*deceased)

MARK JORGENSEN
California State Parks, Colorado Desert District (Retired),
6595 Hawarden Drive, Riverside, CA 92506

ESTHER S. RUBIN
Center for Reproduction of Endangered Species, Zoological Society of San Diego,
P.O. Box 120551, San Diego, CA 992112
Arizona Game and Fish Department,
5000 West Carefree Highway, Phoenix, AZ 85086 (current address)

L. LOUISE JEE
California State Parks, Colorado Desert District,
6595 Hawarden Drive, Riverside, CA 92506

*Lines of rock cairns have been recorded in several areas in Anza-Borrego Desert State Park. The stone-cairn line features are sometimes associated with stone walls, either natural or built, which may represent hunting blinds. The stone features are within or adjacent to areas known to be regularly used by groups of bighorn sheep (*Ovis canadensis*). Here, we argue that the lines of rock cairns and associated structures form complexes that were both built and used by indigenous people for procuring bighorn sheep. Several lines of evidence support this hypothesis, including behavioral characteristics of bighorn sheep, locations where stone-feature complexes have been recorded, ethnographic accounts, biological observations, and data from radio-collared bighorn sheep in Anza-Borrego Desert State Park.*

Rock cairns arranged in lines and regularly spaced have been recorded in several areas of Anza-Borrego Desert State Park (ABDSP) and elsewhere in the region. The function of these linear features has remained an enigma. Here, we focus on one feature complex in Yaqui Pass,[1] and consider ethnographic, archaeological, historical, and wildlife conservation data to support our hypothesis that this, as well as other similar stone-feature complexes, were used in prehistoric times to procure bighorn sheep.

ENVIRONMENTAL CONTEXT

ABDSP encompasses 650,000 acres in southern California, lying between the eastern slopes of the Peninsular Ranges to the west, the Salton Sea to the east,

the peaks of the Santa Rosa Mountains to the north, and the Mexican border to the south (Fig. 1). Most of the lands within ABDSP are considered part of the Colorado Desert, that portion of the greater Sonoran Desert lying west of the Colorado River and being relatively low in elevation. ABDSP, however, contains extremes in elevation and many microclimates as its lands rise from the desert floor where elevations are below sea level in the Salton Trough to mountain peaks of greater than 5,000 feet (1,500 meters) in elevation. ABDSP lies mostly within the rain shadow of the Peninsular Ranges; precipitation occurs in the form of summer monsoons traveling north from the Gulf of Mexico and as occasional winter storms that manage to climb over the mountains from the west. Water sources are mostly springs, seasonal drainages, and tinajas (natural water catchments); a perennial stream flows within Coyote Canyon in the northern portion of the Park. Vegetation varies with elevation and microclime; a desert scrub plant community (creosote, mesquites, agave, ocotillo, cacti, and grasses and abundant wildflowers in season) are at low elevations; occasional palm oases exist where springs are available; and, as one ascends the mountain slopes, many other plant species are added to the variety (e.g., sugar bush, oaks, jojoba, *Prunus* spp., sages, etc.). Geology is mostly granitic, but meta-sedimentary and meta-volcanic outcrops also contribute to the landscape. Extremes in temperature, a characteristic of desert areas, make water sources especially important in the summer months when temperatures commonly soar above the 100 (F) degree mark. It is not unusual to see the mountains surrounding ABDSP capped with snow in the winter months.

ABDSP has long been known to harbor a population of native bighorn sheep. The steep-sided canyons, rocky outcrops, and types of vegetation are ideal bighorn sheep habitat, and the now-reduced (from historic and prehistoric levels) bighorn sheep population is closely monitored by wildlife conservation biologists on an annual basis. ABDSP takes measures to encourage protection of the bighorn sheep populations by providing artificial water sources to augment natural water availability and by managing recreational activities in certain areas during lambing season and during the hot summer months when visitors might prevent bighorn sheep from approaching some water sources.

CULTURAL CONTEXT

The archaeological record in ABDSP is overwhelmingly associated with late prehistory, that period of time (i.e., between about 1,500 years ago and A.D. 1774) when the indigenous inhabitants have continuity with the present-day native peoples of the region, the Cahuilla and Kumeyaay. We have access to the first written accounts of the region's inhabitants in 1774 when the contact era begins (Bolton 1930; Coues 1900). The only definitive evidence from an archaeological site in ABDSP that goes back further in time (to somewhat earlier than 4,000 years ago, according to radiocarbon dates and other evidence) is Indian Hill Rockshelter (McDonald 1992; Wilke et al. 1986) in the southern part of the Park. Other sites in the Colorado Desert region, however, recently found and studied, date to somewhat earlier times and fall within the Archaic Period. Dates from these earlier sites have been collated and the use of the term "Archaic" discussed by Bruce Love and Mariam Dadul (2002), as well as by John Eddy (2007). At this time, it is evident that prehistoric settlement of the Colorado Desert is well-represented during times preceding the Late Prehistoric period, and that the archaeological record for earlier times will become more robust with future investigations within both ABDSP and the entire Colorado Desert region.

In ABDSP and adjoining portions of the Colorado Desert, the Late Prehistoric is characterized by the presence of ceramics, small projectile points, and certain bead styles; the Archaic is characterized by the absence of ceramics, larger and heavier projectile points, and other types of beads and ornaments. Each time period, however, has other diagnostic features that help to place them in chronological context; these would include, for example, artifacts of obsidian from different sources, technological differences in artifact manufacture, and differing methods for the disposal of the dead. To summarize, there is very strong evidence for widespread Late Prehistoric peoples using the region; adequate information for people during the Middle or Archaic Period, but likely in fewer numbers; and inadequate evidence about people being in the ABDSP region in earlier times, although there are no reasons why they should not have been present.

ABDSP and the adjoining portion of the Colorado Desert was home to two indigenous groups at the time of

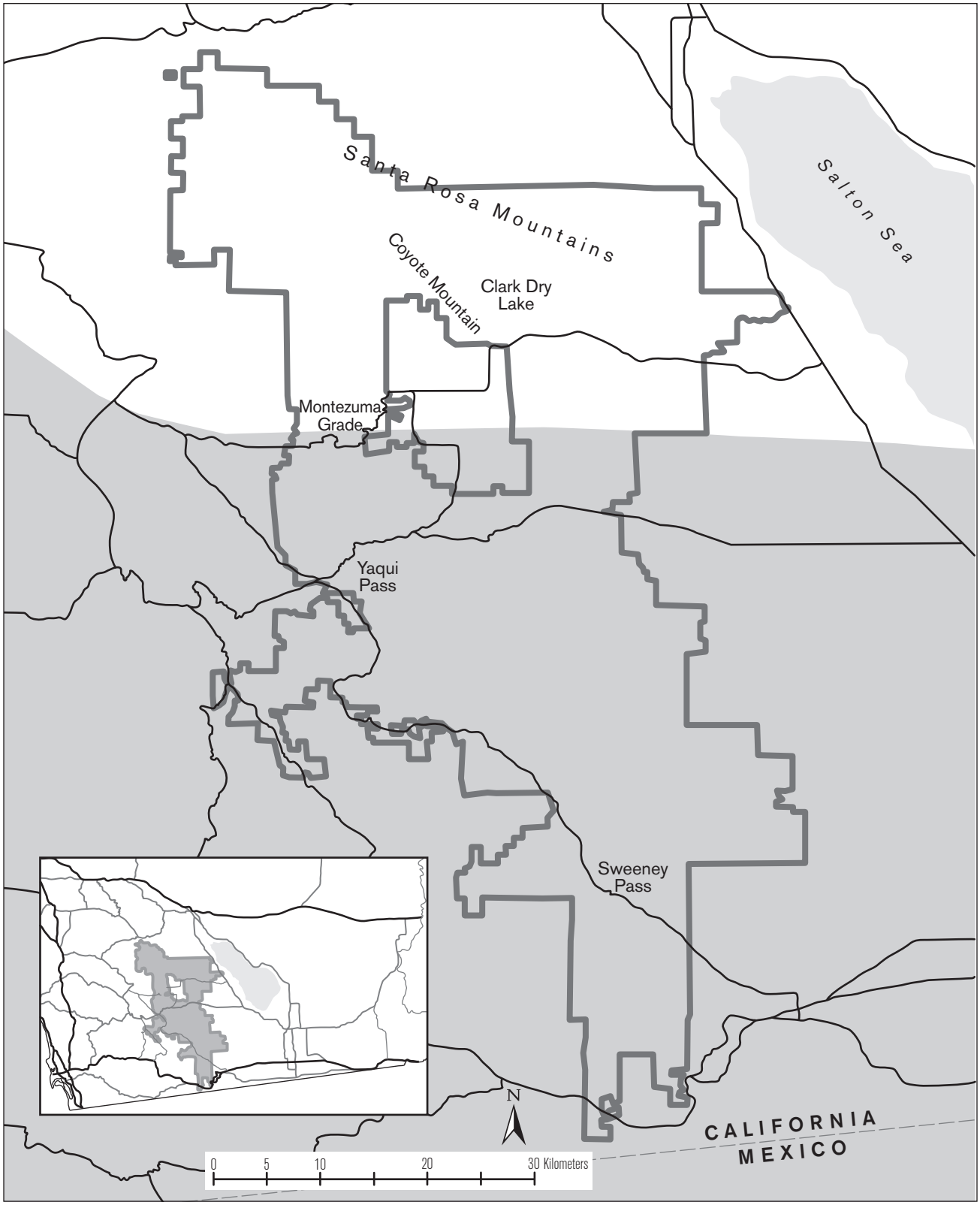

Figure 1. Location of Anza-Borrego Desert State Park in southern California and places referred to in the text. Light-colored northern portion of ABDSP map indicates Cahuilla ancestral lands. Darker-colored southern portion of the map indicates Kumeyaay ancestral lands.

the first European contact: the Cahuilla in the northern portion, and the Kumeyaay[2] in the southern portion (see Fig. 1). The Cahuilla, for the most part, were not heavily influenced by the missions established by the Spanish in what is now southern California. They spoke (and speak) a Takic language, and are often divided into geographical groups: Mountain Cahuilla (Santa Rosa Mountains); Pass Cahuilla (those living in the Banning Pass area); and Desert Cahuilla (those living in the northern portion of the Salton Trough). Today, those living on reservation lands in the region are of many different groups, and often an individual may trace his or her ancestry to more than one indigenous group. Many Kumeyaay groups, on the other hand, were heavily influenced by the missions. They spoke (and speak) a Yuman language. Their territorial ranges included the Pacific coast, the Peninsular Ranges, the interior desert, and the northern part of Baja California.

Although the Cahuilla and Kumeyaay were separated by spoken language, the groups that lived in the Colorado Desert area had very similar lifestyles that were adaptations to the arid environment. Many ethnographic sources of information are available for both the Cahuilla and Kumeyaay (e.g,. Bean 1972; Bean and Saubel 1972; Gifford 1918, 1931; Kroeber 1925; Luomala 1978; Shipek 1970; Spier 1923; Wilke 1978). The social organizations of both the Kumeyaay and the Cahuilla were complex, though not in terms of hierarchy, but in other ways. There were bands, patrilineal groupings or clans, and "moieties" (a system whereby everyone belonged to one of two groups). For example, the Cahuilla were (and are) divided into Coyote and Wildcat moieties. This loose, multi-level social organization allowed extended family groups to survive well and adapt to both seasonal and other environmental changes, and promoted interchanges of marriage partners and the establishment of alliances. Groups would often coalesce and break apart and live here or there, depending on abundances of or lack of food or other resources. There was a great deal of visiting, trading within extensive networks, and a joining together for intermittent ceremonial occasions.

Traditionally, most Cahuilla and Kumeyaay lived in a semi-nomadic manner, hunting and gathering in varying environmental zones in patterned seasonal movements. Some Kumeyaay probably practiced agriculture in well-watered areas in the Colorado River and Imperial valleys. In historical and modern times, agriculture and ranching were added to the subsistence regimes of both Cahuilla and Kumeyaay. Hunting and gathering, as a way of life, provided an excellent diet. Although the groups surely knew about different forms of agriculture (since they interacted with agriculture-using peoples along the Colorado River), the abundance of resources in their territories provided all the necessities of life. Some manipulation of the landscape was practiced in the form of burning and the encouragement of plant growth through selective harvesting. Reliable plant foods included two species of mesquite, agave, wild fruits, cholla, prickly pear cactus, tule and cattail roots, acorns, pine nuts, and a variety of grasses and their seeds.

Animal foods included small game such as rabbits, hares, woodrats, lizards, snakes, grasshoppers, desert tortoise, and a variety of other smaller species. Birds, fish, and other species were taken when they were available. Larger game included bighorn sheep and deer.

ROCK-CAIRN LINES IN THE ARCHAEOLOGICAL RECORD OF ANZA-BORREGO DESERT STATE PARK AND OTHER NEARBY AREAS

Robert S. Begole, an avocational archaeologist who conducted most of the archaeological surveys in ABDSP during the 1970s and 1980s, recorded the stone features considered here. He filed site records and marked the locations of the cairn-line features on USGS topographic quadrangles (mostly 7.5" maps) using a symbol consisting of a line with cross-hatch marks. A review of all the USGS topographic quadrangles used by Begole and of his site records archived at ABDSP resulted in the identification of 13 locations where this type of symbol indicated lines of rock cairns (see Table 1). Begole noted on his site record sheets that lines of rock cairns were "fairly common in the general area of Borrego Valley, Yaqui Pass, Truckhaven Trail area, etc." (Begole 1980). Moreover, the rock cairn lines seemed concentrated in the Yaqui Pass area. Whether this was because Begole surveyed more intensely or frequently there, or whether this concentration represents a "real" concentration, when the Park is considered in its entirety, remain unanswered questions. Begole was greatly influenced by

Table 1

LOCATIONS OF RECORDED LINES OF ROCK CAIRNS IN ANZA-BORREGO DESERT STATE PARK

USGS 7.5' Quadrangle	Site Trinomial	Topography	Number of Cairns	Number of Lines	Reference	Other
Clark Lake	CA-SDI-9831	Hillside above drainage; north of Clark Lake. Elevation: 1240'	Unknown	Unknown ("many")	Begole 1983a	Cleared circles
Clark Lake	CA-SDI-9645	Rocky slope overlooking Coyote Creek outflow, near Pegleg Monument, base of St. Rosa Mts. Elevation: 800'-1000'	Unknown	8	Begole (unknown date); updated by CSP staff 2001	Several loci. All run from low-to-higher elevations. Abandoned jeep trail, residential sites. (No mention of cairn lines in site record update.)
Font's Point	CA-SDI-9723	Hillside above north side of Little Clark Lake; base of St. Rosa Mts. Elevation: 720'	Unknown	At least 6	Begole 1983b	Cairn lines form a kind of V-shaped or fan-shaped complex; Begole noted that the "very old" cairn lines cross "ancient" trails
Font's Point	CA-SDI-9724	Gently rising slope on a rocky terrace NE of Little Clark Lake. Elevation: 850'	Unknown	1	Begole 1983c	Associated rock-ringed cleared area, perhaps residential
Sweeney Pass	CA-SDI-1492	Gently rising slope along Carrizo Canyon Elevation: 920'–980'	>500	Ca. 14	Begole 1972	"Trail Shrine" where trails fork nearby. Habitation sites; many trails
Borrego Mountain SE	CA-SDI-4172	Gently sloping hillside near Fish Creek Wash Elevation: 440'	9+14+?	3	Begole 1977	Lines are >110'-long and are of different ages. Also 4 randomly- placed cairns. Trails cut across lines of cairns; 1981 notes say that many of the cairns were destroyed when rocks were removed to outline camping area nearby
Borrego Sink	CA-SDI-2633	Rocky low hillside on ridge, east side of Yaqui Pass. Elevation: 1650'	Unknown	3	Begole 1976b	5-8 small hunting blinds nearby on point of ridge; nearby are rock-ringed cleared areas, possible residential sites; cairns very old—not rebuilt
Borrego Sink	CA-SDI-2634	Near Yaqui Pass Primitive Campground, up trail to small pass overlooking San Felipe Creek. Elevation: 1900'	Unknown	1	Begole 1976c	Cairn line across a trail
Borrego Sink	CA-SDI-2635	On east side of Yaqui Pass, at middle of Pass. Elevation: 1760'-1840'	Unknown	Several lines	Begole 1976d	Several cairn lines cut across by a circular "nature trail" leaving from parking area to Primitive Campground. Several blinds in rocks west of trail. A few ceramic sherds are present as are possible residential features in rocks. (PCAS Quarterly 1976)
Borrego Sink	CA-SDI-2637	Rocky hillside on the east side and in the middle of Yaqui Pass. Elevation: 1760'	Unknown	4–5	Begole 1975a	3+ small hunting blinds In an area near an established visitor trail. Some cairns appear very old while others have been rebuilt. Likely impacted when the visitor trail was established.
Borrego Sink	CA-SDI-2635	Rocky hillside on ridge, west side of Yaqui Pass. Elevation: 1960'	5 in one line 26 in second line	2	Begole 1975b	8 lookout blinds
Borrego Sink	CA-SDI-2651	Same rocky hillside as SDI-2633 on east side of Yaqui Pass, but slightly higher in elevation on same landform	42	2	Begole 1974b	9 lookout blinds associated
Borrego Palm Canyon	CA-SDI-7593	Ridge overlooking Galleta Meadows (outflow of Henderson Canyon) to the south. Ascending a ridgeback	50+	1	Begole 1980	"Appear to be a dividing line up a ridgeback . . ." A lookout blind and mescal roasting pits nearby

the work of Malcolm J. Rogers, who conducted a good deal of his research in these desert regions. Perhaps for this reason, Begole's original interpretation of the cairn lines was that they perhaps served a ritual purpose or acted as territorial-boundary markers (Begole 1973, 1976a, 1981).

Archaeological studies carried out by Mark Q. Sutton and Philip J. Wilke (1988) in the Colorado Desert near La Quinta, California, included the investigation of a rock cairn complex with 424 cairns (CA-RIV-2823). Although the investigations did not draw definite conclusions, the project did document a huge cairn complex that included two cairn groups, one on each flank of a ridge, presenting a generalized V-shaped configuration on the rather flat area at the base of the ridge. It was suggested, furthermore, that the V-shaped configuration of hundreds of cairns may have originally included brush superstructures that would have acted as visual barriers, and therefore channeled bighorn sheep as they descended the ridge to drink at the edge of Lake Cahuilla. Due to the presence of the cairns, the bighorn sheep would be confined to a specific spot when they sought water; hunters would lay in wait at this spot to dispatch the animals. The Sutton-Wilke interpretation of the CA-RIV-2823 cairn complex as a game-diversion facility "does not exclude the possibility that these or other cairns may have served some other functions" (Sutton and Wilke 1988:18–19).

We tend to view the Sutton-Wilke interpretation of the cairn complex as problematic, primarily because it would have been very difficult to conceal hunters waiting at the lower elevation, when that area could easily be seen by the bighorn sheep descending from the higher vantage point of the ridge on their way to drink.

CAIRN LINES AND LARGE MAMMAL-HUNTING TACTICS IN THE GREAT BASIN

In the Great Basin, a number of investigators have studied archaeological remains purported to be used for hunting large mammals. Some consist of or contain lines or arrangements of rock cairns. Most of the complexes are thought to be associated with the communal hunting of pronghorn antelope (*Antilocapra americana*), and not bighorn sheep. Philip Wilke (1986) studied such a complex near Whiskey Flat in western Nevada; Brooke Arkush (1986, 1995) studied pronghorn drivelines and traps near Mono Lake in eastern California; and Robert Parr (1989) investigated a pronghorn-trap complex in western Nevada's Huntoon Valley.

Also within the Great Basin, Lorann Pendleton and David H. Thomas (1983) studied a substantial and lengthy stone drift fence and discussed the fauna that may have been intercepted by that feature: antelope, bighorn sheep, and deer. They made a case for this long stone fence being an aboriginal hunting feature dating back to the prehistoric era. Although they were not able to come to a definitive conclusion about the species of game taken using this facility, they thought that the species was most likely antelope, and less likely bighorn sheep. They disagreed with Julian Steward (1938), who believed that drift fences and drive lines in open range would not have been a practical tactical method for hunting bighorn sheep because of the typical behavior of bighorn sheep when they are alarmed (see below). However, we tend to agree with Steward in this matter, as well as with Patrick Lubinski (1999).

Lubinski (1999) suggested that traps and drivelines for hunting pronghorn antelope, common in the Great Basin and on the Great Plains, would not have been suitable for bighorn sheep. Pronghorn are not good vertical jumpers, while bighorn sheep are excellent climbers. Therefore, the simple low fences of many of the pronghorn drift fences would not have contained bighorn sheep. Lubinski divided hunting tactics into two general categories: those tactics requiring only a single hunter or small groups of people vs. tactics used for communal hunting (cf. Frison 1987). According to the Lubinski model, the function of the Yaqui Pass stone-feature complex would likely fall somewhere midway on a scale between the extremes of the single-hunter small-group type and the communal-hunt type tactical categories. While just a few hunters could have been successful, larger groups also could have been employed, perhaps with greater success.

Richard A. Brook (1980) explored the hunting practices of the indigenous people of the Saline Valley of eastern California. From a variety of sources—such as ethnologies and historical documents, as well as from archaeological records—Brook gathered data on known game trails, hunting blinds, and artiodactyla distributions for the Saline Valley area. Sixty rock features were

studied; most either overlooked or adjoined existing game trails (Brook 1980:62):

> Many of the stone features are positioned in ways that seem to maximize the use of natural landforms for purposes of concealment or as vantage points.... Stone features located on bluffs or prominent hills afford a commanding view of the lowland areas. These latter features appear designed to monitor movements in the flats, particularly where they overlook water sources.

In his paper, Brook suggested that the functional role of the stone constructions he observed in Saline Valley was bighorn sheep hunting; he viewed hunting pronghorn antelope as a secondary emphasis.

A more recent study of a hunting complex thought to have been used for hunting bighorn sheep was carried out in central Nevada (McGuire and Hatoff 1991). An array of 125 rock cairns, very much like the cairns in Yaqui Pass, are distributed across the landscape at a canyon outwash. Here, however, the lines of cairns are short and rather scattered. "(T)he rock features at the Mt. Augusta site may lack a functional unity, and instead reflect a series of temporally disjunctive constructions of linear net facilities" (McGuire and Hatoff 1991:196). The investigators hypothesized that the rock cairns were support structures for upright posts between which a large net was suspended. Bighorn sheep would have become enmeshed when they were driven into the net, become entangled, and would then have been dispatched, in a very similar manner to the way a rabbit drive was conducted.

The most recent report of features attributed to bighorn sheep hunting is from the Humboldt-Toiyabe National Forest (Scott et al. 2012:273–276). The authors' short note describes hunting blinds and a wood and stone "drift fence," with the hunters using the natural terrain to their advantage.

INVESTIGATIONS AT CA-SDI-2651, THE YAQUI PASS FEATURE COMPLEX

The Yaqui Pass stone-feature complex, the main focus of this paper, was originally recorded as CA-SDI-2651 and described by Robert Begole (1974a, 1974b). Begole listed 42 rock cairns and 9 "lookout blinds" at the northern entrance to Yaqui Pass. Yaqui Pass lies immediately to the south of the *bajada* that marks the borderline between the Pass and the Borrego Valley to the north (Fig. 2) within ABDSP. The feature complex is located on a north-facing rocky slope and runs generally north-south, on the eastern side of a drainage that parallels the present road through the Pass. The topography slopes downward to the north into the Borrego Valley from a higher elevation on hills to the south. In our view, the two rock-cairn lines and a series of small stone walls are related and integrated parts of a complex focused on the procurement of bighorn sheep in prehistoric times.

Description of the Rock-Cairn Lines

In 2002, Colorado Desert Archaeology Society (CDAS) volunteers updated the site record for CA-SDI-2651 using Global Positioning System (GPS) technology (Fig. 2). The GPS coordinates form the basis for Figure 3. One of the two rock-cairn lines contains 31 cairns; the other has 20 cairns, for a total of 51. A typical rock cairn making up the lines is composed of a low pile of weathered boulders and cobbles (Fig. 4). All the rock cairns making up the lines appear ancient; many of the cairns have collapsed and the rocks forming them are often weathered and disintegrating. GPS coordinates were also acquired for the stone walls described by Begole; in all, CDAS found 13, while Begole had described only nine (Fig. 3).

The westernmost of the two lines of rock cairns runs from the base toward the top of the slope for about 161 m. (0.10 mi.). In this line, the cairns (as mapped) are closer together near the base of the slope than towards the upper limits of the line (Fig. 3). The easternmost line of rock cairns is about 97 m. (0.06 mi.) long and appears to be the older of the two lines because of the higher frequency of fallen cairns and their more weathered appearance. Table 2 shows the distances between cairns in each of the lines. At the lower ends of the lines, the cairns are quite regularly spaced. Eliminating the more widely spaced last five cairns in the upper reaches of the western line, our general impression is that cairns are, on the average, about five meters apart. Both lines approximately parallel a natural, rocky-outcrop spine that runs along the westernmost aspect of the hill in a generally north-south direction. The cairn lines are further apart toward the base of the hill and converge toward the top of the slope, forming a V-shaped configuration (see Fig. 3). We are uncertain if both cairn lines were used at the same time, or if the lines were used at different times and form the V-shape only due

Figure 2. The western rock-cairn line. Each person is standing beside one of the rock cairns. View is from the bottom of the rocky slope (north) towards the top (south). Only part of the cairn line is visible; other cairns are further upslope and are not visible.

to our mapping data. Other cairn lines are present in the immediate vicinity (CA-SDI-2633, -2635) and were visited but not studied.

The cairns average a little over one meter in diameter, and many have plants such as brittle bush or cholla growing within them. The cairns are definitely cultural in nature: (1) they are composed of different rock types that are placed at varying orientations and do not represent a single weathering rock outcrop, (2) their spacing is quite regular; and (3) although they are located on a rocky slope, they are quite obviously different from the natural distribution of rocks on the slope. On the average, each cairn is composed of 18–19 local boulders, cobbles, and rocks (Figs. 4, 5). The sizes of the cobbles and small boulders range between 15 cm. and 40 cm. in diameter. Some cairns are formed around a large bedrock boulder that is naturally in place; thus, in these cases, the cairn builder(s) enhanced a natural geological feature; in other cases, the cairns are wholly constructed. At least half of the cairns have collapsed, with the percentage of collapsed cairns slightly higher in the eastern line and consistent with the observation that the eastern line of cairns exhibits a higher degree of rock weathering, likely due to its greater age. In view of the presence of the rocky outcrop along the westernmost aspect of the slope, acting as a barrier to the hill below, and the observed variation in the degree of weathering of cairns in the two lines, we tend toward the view that each line was used singly at

Figure 3. The area of the stone-feature complex in Yaqui Pass, based on GPS data. Background is aerial photograph.

Table 2

DISTANCES BETWEEN CAIRNS IN WESTERN AND EASTERN LINES

Cairn line	Number of cairns	Maximum distance between cairns (m.)	Minimum distance between cairns (m.)	Mean distance between cairns (m.)	Standard deviation (m.)
Western	31	22.06	0.44	5.72	5.16
Eastern	20	8.04	1.42	4.66	1.71

different times. Begole (1976a:12–15) observed that at this and other rock-cairn-line sites in the vicinity, some cairns had fallen and had been rebuilt in the past. It is not clear to us how this information was derived.

Description of the Rock Walls

While Begole recorded nine rock-wall structures in 1974, CDAS recorded 13 (Fig. 3). All of the rock-wall structures overlook the drainage to the west, as well as the road that today runs through Yaqui Pass (Fig. 3). While several of the stone-wall structures are entirely freestanding, most are natural bedrock outcrops that have been enhanced by adding rocks and filling in niches (Figs. 6, 7). The end-to-end lengths of the stone-wall structures range between 1.6 m. and 5.6 m. (mean = 3.4 m.); their greatest heights, measured on their eastern aspects, from

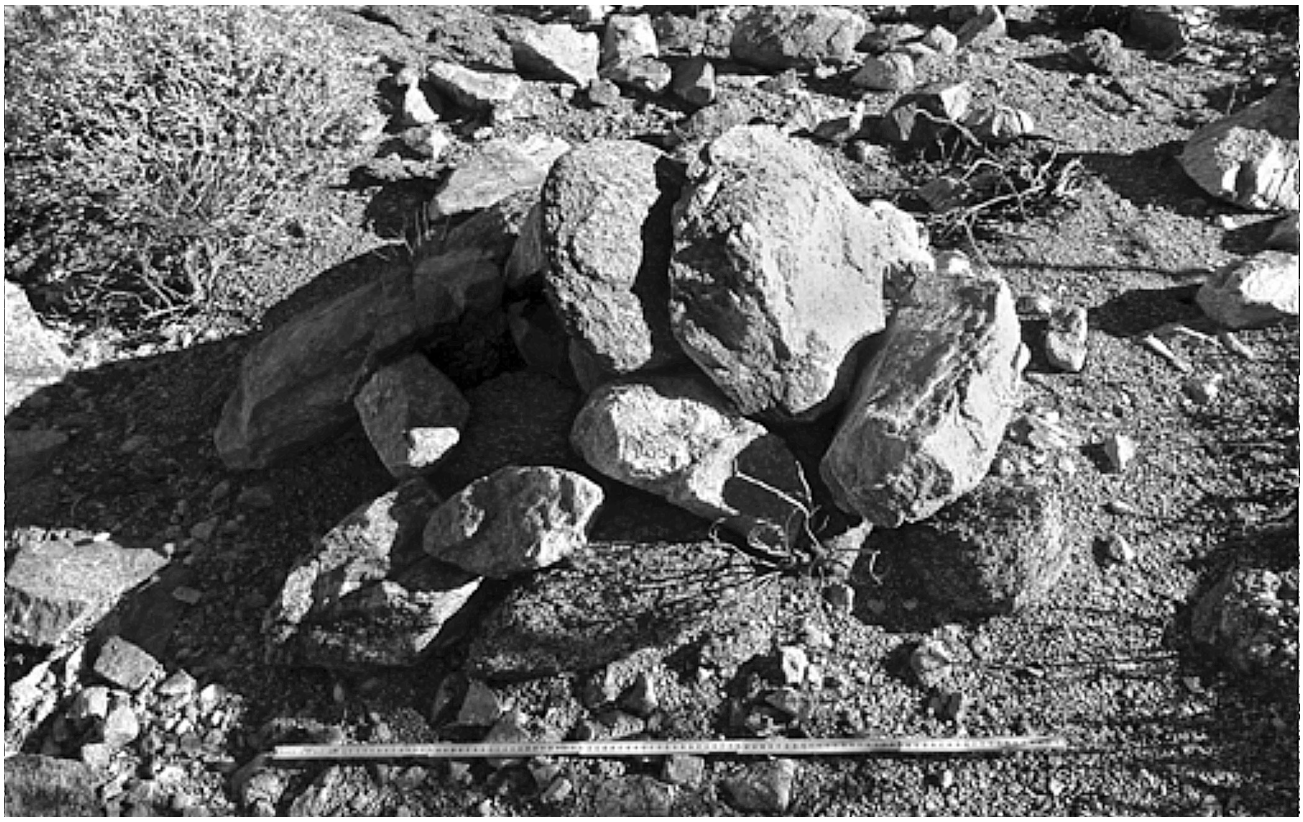

Figure 4a & 4b. Typical rock cairns within the western cairn line. Scale is in 10 cm. increments.

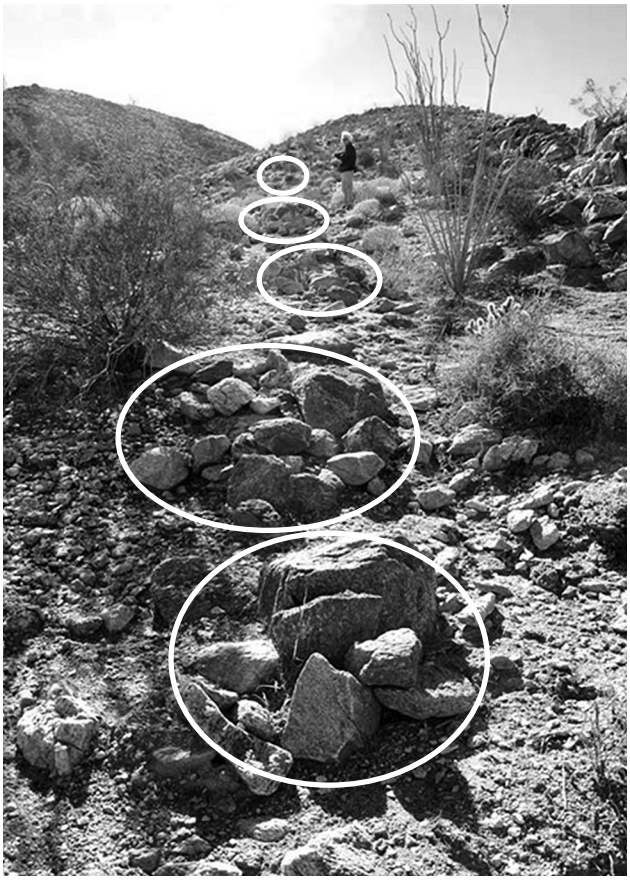

Figure 5. Partial view of the rock-cairn line; cairns are circled in white. To the right of the photograph is the rocky ridge at the western crest of the hill. View is approximately to south. Person high on hill for scale.

the ground surface to their vertical extent range from 0.5 m. to 1.5 m. (mean = 1.03 m.). Eight of the 13 structures (66%) are slightly curved, with the maximum (center) of the curve toward the west and the open ends of the curve toward the east and the rocky bedrock spine running along the westernmost aspect of the ridge. The maximum space within the curved features is 2.4 m. measured in east-west direction; the curvature of the majority of stone-wall structures is less extreme than the maximum curvature (mean depth = 1.8 m.). The orientation of the outer wall of the stone structures is westward and toward the drainage, with the inner aspects of the curved features opening toward the east. Every walled structure is at a slightly lower elevation than the apex of the rocky-spine outcrop along the ridge, and there is an excellent view of the eastern-facing hillside on the west side of the Pass (see Fig. 6), as well as of the drainage below (i.e., a view of the hillside opposite that on which the rock-cairn line/stone wall structures are located). A few quartzite and meta-volcanic flakes and cores were found within the area of the stone-feature complex, but could not be associated with particular features; no formal tools were observed. A small scatter of ceramic sherds was found higher on the hill, above the complex.

The placement of the rock-walled structures and the relationship between the rock-walled structures and the cairn lines present a number of questions. Begole (1976a:12–15) noted that the stone walls could not have been used for hunting because they were too high above the floor of the Pass. This may or may not be so. The rock-walled structures are definitely oriented toward the drainage and hillside to the west. If the structures were used to conceal a lookout person who was observing the movement of the bighorn sheep herd in the Pass, the structures would have been quite functional. If the structures concealed a hunter with his weapon(s), Begole may have been correct (that is, the walls were too far away from the drainage to have served as hunting blinds), unless bighorn sheep were encouraged to walk up the steep western side of the hill right past the structure that concealed the hunter. Modern data suggest that the range for accurate use of an atlatl is between 50 and 75 ft. (about 15–23 m.) and that of a Kumeyaay bow and arrow perhaps twice that distance (Campbell 1999:318–319). It does not seem feasible that the distance (about 75 m.) between the stone-walled structures and the drainage in the pass below would have permitted hunters hidden within the structures to shoot bighorn sheep with any accuracy unless the bighorn sheep passed much closer to the hunters. Although Begole suggested that both types of features (i.e., the cairns and the walls) might be the same age, he did not explicitly state this. He called attention to another instance of a combination of stone walls and lines of rock cairns, at a site (CA-SDI-2638) located in another small pass to the west of the Yaqui Pass feature complex. Given these circumstances, we may consider the rock-walled structures in at least three functional contexts: as lookout posts used in association with the cairn lines; as hunting blinds not directly associated chronologically or functionally with the cairn lines; or as a hunting-blind alternative or additional tactic associated with the use of the cairn lines.

Figure 6. Free-standing rock wall on the western side of the rocky ridge. This feature overlooks the drainage below and the eastern slope of a hill to the west.

Figure 7. Enhanced natural rock outcrop. View to the west. Note the rocks placed within the natural outcrop to fill in spaces. Note that this feature overlooks the drainage below and eastern slope of hill to the west.

Other Archaeological Features in the Vicinity

Several other archaeological sites have been recorded in the vicinity of CA-SDI-2651. CA-SDI-2649 contains at least 15 stone-outlined, cleared circular areas on a gentle slope on the west side of the road running through Yaqui Pass, about 1 km. south of the complex we describe here; this site is interpreted as a seasonal camp of the Late Prehistoric era, based on the presence of ceramics, diagnostic projectile point type, and an OSL date (Mahan 2012). At the summit (1,940 ft. AMSL) of the same series of hills where the subject complex is located on lower slopes, and on the east side of Yaqui Pass, is a World War II military outlook post containing stone circles, historic artifacts, and other items. Within Yaqui Pass (both on the eastern and western slopes of hills standing over the Pass) and elsewhere in ABDSP, are other rock-cairn lines and rock-wall structures; some were visited but have not been studied (Table 2).

DISCUSSION

Brook (1980:70) quoted an 1892 account of bighorn sheep hunting in Death Valley, written by New York Sun reporter John R. Spears:

> ...when they [bighorn sheep] are alarmed they fly to the top, and if there is a ridge there, follow it to the highest peak. Having observed this peculiarity, the Paiutes build blinds on the ridge top runway.... The blinds were in all cases semicircular walls of stone. ...[W]hen all preparations were complete, [the Indians] posted their best marksmen in the blinds while others chased the sheep up to the slaughter.

Here we explore the functional possibilities of the elements of the Yaqui Pass feature complex at CA-SDI-2651. We first discuss the rock-cairn lines and the manner in which they may have functioned. Second, we discuss the rock-walled structures, how they may have functioned, and the possibility that they are functionally related to the rock-cairn lines. We then present our hypothesis of how this feature complex (and likely others in ABDSP) was used prehistorically. Finally, we present ample archaeological data that bighorn sheep were successfully hunted and used mainly for subsistence, but also for tools, items of apparel, ornaments, and ceremonial purposes by both the Cahuilla and Kumeyaay, as well as other indigenous peoples of the region.

Exploring the Function and Meanings of the Rock-Cairn Lines

Exactly how the rock cairns were used remains problematical. Bighorn sheep tend to see and shy away from visual obstructions as they travel. The cairns in Yaqui Pass do not, by themselves, represent much in the way of visual obstruction. However, if bunches of brush such as ocotillo branches were held upright by rock cairns built around their bases, and/or if "dummies" (i.e., for humans) were constructed of brush and held upright by a pile of rocks, the bighorn sheep would see these constructions as visual obstructions and would be deterred from

attempting to breach this "fence." Moreover, should a few persons, shouting or otherwise making noise, be placed along the line of brush obstructions, this would also act to "channel" the sheep up the hill to where hunters would be lying in wait. Both the cairn lines described here run parallel to the rocky spine at the western crest of the hill. If the bighorn sheep were startled at the base of the slope, they could be contained between the two lines, if they were used contemporaneously, or between the rocky spine and one of the lines. In this manner, hunters could wait at the upper reaches of the slope and dispatch the bighorn sheep.

Another way the cairns might have been used is detailed by McGuire and Hatoff (1991) in their discussion of the Mt. Augusta feature complex in central Nevada. The authors observed that most rock cairns they studied contained fewer cobbles and boulders in their centers than on their perimeters. The center, then, was purported to be the place where an upright was inserted; the upright was a holder for a large net (but this might serve just as well to hold upright brush as visual barriers). The net-holding cairn hypothesis was supported by the fact that a large net had recently been discovered in an archaeological context in Wyoming (cf. Frison et al. 1986). The case for bighorn sheep net-entrapment, in our view, may be tenuous in the Yaqui Pass situation because the configuration of the rocky slope differs greatly from that of the Mt. Augusta complex. At Mt. Augusta, the cairn complex is composed of 125 large rock cairns scattered over about a 500 m. area of an outwash plain; some of the cairns are in clusters, some are in lineal arrangements of five to eight cairns, and some are isolated (McGuire and Hatoff 1991:97–98). The cairn intervals are generally between 10 m. and 15 m. Projectile points and casual flaked-stone tools were found in the vicinity of the cairns. The Mt. Augusta complex may be the result of many overlaid episodes of net-entrapment of bighorn sheep or other artiodactyla. The conclusion that bighorn sheep were the prey at the Mt. Augusta cairn complex was based on the large faunal assemblage at a nearby habitation site, most of which was identified as artiodactyla, and many elements were specifically identified as bighorn sheep (McGuire and Hatoff 1991:101–102). In the case of the Yaqui Pass cairn complex, the slope of the site is much more extreme, the rock cairns are smaller and do not have obvious center holes that might have supported posts strong enough to have supported a net to trap animals the size of bighorn sheep, and the lines are much longer than those at the Mt. Augusta cairn complex. Although stone projectile points were not found among the cairns on the slope (or within the rock-wall structures), the Late Prehistoric period weaponry of the Colorado Desert region did include the wide use of wooden projectile points (see Schneider and James 2003 for a review of the types of projectile points used).

A good deal of variability likely existed in the tactics used for bighorn sheep procurement; the methods used to take bighorn sheep might vary by cultural group, season, topography, the availability of people to participate in the hunt, and likely the seasonal behavior of the bighorn sheep themselves (McGuire and Hatoff 1991). The McGuire and Hatoff hypothesis for the group of cairn features that they described in central Nevada does not lead us to lean at all heavily on a similar interpretation for the Yaqui Pass complex. In addition to the differences between the cairn complexes stated above, other factors to be considered include the fact that there are a number of other possible hunting features (the rock-wall structures) associated with the Yaqui Pass rock-cairn lines, and there are additional data available that document the presence of bighorn sheep in Yaqui Pass and at other locations in ABDSP that have similar lines of rock cairns (see below).

Exploring the Function and Meanings of the Rock-walled Structures

We view the Yaqui Pass stone-wall structures as probably serving a similar function to those described by Brook (1980); that is, they were either used for observing the movements of bighorn sheep herds, or they were used to conceal hunters waiting to ambush large game. Brook noted that modern game trails have been used by game for long periods of time, extending back into prehistory. Based on several criteria, he posited that trails were located in the same areas today as they had been located since at least the beginning of the Holocene. He further observed that some rock-wall features (blinds) were located at a great distance from water sources, and that these were further from game trails than other rock features that did overlook water sources. On the basis of these locational data, Brook suggested that the uses of stone-wall features may have been varied: those at

a distance may have been observation posts, while the rock-wall features nearer water sources were actually used for ambush.

Brook also addressed the orientation of rock-wall features; the open sides faced away from game trails. He noted that "[t]he Indians would certainly have been very familiar with the habits of the animals they were hunting and would have located their hunting facilities accordingly" (Brook 1980:64). As we have discussed above, the rock-wall structures at Yaqui Pass likely functioned in one of two ways to ensure success in taking bighorn sheep; they either functioned as observation posts or provided concealment for hunters who ambushed bighorn sheep as they ran upslope. What remains problematical is the association of the rock-walled structures and the cairn lines. The rock-walled structures are to the west of the cairn lines and the rocky ridge at the spine of the hill; they are topographically lower than both. If they were used for observation only, this is understandable; if they were used to conceal hunters, it may be that they were either used simultaneously with the other tactic involving the cairn lines or they may have concealed hunters at entirely different times. If both tactical approaches were used synchronically, why was this so? Possibilities might include differing seasonal movements and behaviors of bighorn sheep, the number of hunters available, wind direction, or a combination of these factors. Other unknown factors might include two differing cultural groups exploiting the same location, each using traditional tactics or a succession of tactics, with one being an improvement over the other.

CONTEXT OF THE HYPOTHESIS

The technologies and tactics used in the past to hunt and capture artiodactyla left traces on landscapes throughout the world (e.g., for southern Levant, see Nadel et al. 2010). Each large mammalian species exhibits individual adaptive behaviors and inborn instincts; the various hunting tactics used by native peoples the world over represent an acquisition of traditional knowledge about each species and the transmission of that information through the generations.[3] Sometimes the tactics involved sophisticated weaponry and solitary or small groups of hunters that might result in the "taking" of a single individual prey; often, species behavior required more subtle techniques that entailed a deep knowledge of the environment and animal behaviors and involved highly organized groups of people that constructed temporary or permanent structures resulting in the "taking" of multiple prey. Often, the many types of active and passive methods and tactics used for "taking" animals leave archaeological correlates seen as modification of the landscape; such is the case with the Yaqui Pass cairn lines and rock-wall structures.

At least five expectations would tend to support our hypothesis that the feature complex, and especially the cairn-line features, at CA-SDI-2651 in Yaqui Pass functioned to optimize the exploitation of bighorn sheep. First, the ecology and behavioral patterns of bighorn sheep should be such that they could be channeled past hunters. Second, if bighorn sheep were regularly taken by local people, we should see bighorn sheep food remains or bone tools in residential sites in the region, as for example, at the nearby Mine Wash site (Christenson 1987). Third, in addition to their known historic presence, we should have documentation that bighorn sheep populations were present in the area of the complex at the time it was used. Fourth, we should see, overall, a correlation between known bighorn sheep populations and the presence of cairn-line complexes such as the one in Yaqui Pass. Fifth, we should see cultural symbolism reflecting the importance of these large game animals. Each of these subjects is discussed below.

HUNTING TACTICS OF INDIGENOUS PEOPLES

Very little information is available regarding the specific tactics that were used by local native peoples to hunt bighorn sheep. The following information and insights were gathered from early ethnographic sources. Philip Drucker (1937) did not identify bighorn sheep as a prey species in his Southern California Cultural Element Distribution (CED) study, although he did identify deer. However, according to his 1941 CED list for the Yuman and Piman peoples, Drucker reported bighorn sheep (i.e., mountain sheep) hunting among the Diegueño (i.e., Kumeyaay), as well as among some of their Yuman neighbors (Yavapai, Hualapai, Maricopa, and Pima) in the Lower Colorado River area who hunted bighorn sheep extensively (Drucker 1941:98). They stalked the animals and also drove them past hidden hunters.

In his classic late nineteenth century description of the mountains of California and the West, John Muir (1894:300–324) devoted an entire chapter to bighorn sheep and related species. He noted that Indians hunted mountain sheep "like a pack of wolves" (Muir 1894:320). On every mountain he visited were "small, nest-like enclosures built of stones" where Indians would wait while others "scoured the ridges below, knowing that the alarmed sheep would surely run to the summit, and when they could be made to approach with the wind they were shot at short range" (Muir 1894:320–321). Muir was referring to the fact that, when alarmed, bighorn sheep run uphill to rocky inaccessible crags. Furthermore, when the bighorn sheep could not sense the hunters (i.e., the wind was blowing toward the hunters), they could be shot at close range, unaware of the hunters that lay hidden behind the rocky enclosures.

Muir also described the giant wing traps and "corrals" that were constructed near game trails. These, Muir said, were used in a cooperative effort that required a large group of people. It is more likely that he was describing the tactics used to hunt antelope or deer, since the behavioral characteristics of these species differ from those of bighorn sheep (i.e., antelope and deer will run across open land, but bighorn sheep retreat to rocky prominences). Muir also described rows of constructed "dummy hunters" made of stone, located along ridge tops, which kept bighorn sheep from crossing the ridges. The "dummies" (brush-topped stone structures) would have people stationed between them, thus appearing to the game as a solid wall of hunters (Muir 1894:321–322).

Harold Driver (1937:61) wrote about Panamint Shoshone hunting methods that his indigenous consultants described to him; bighorn sheep were driven to hunters concealed by blinds at mountain-tops and along game trails. Furthermore, his indigenous consultants said that the methods that they employed for large-scale game drives for deer and antelope (i.e., traps, enclosures, and nets) were "...largely ineffective in hunting mountain sheep" (Brook 1980:74). Apparently, the hunting technique used for bighorn sheep did not require the large numbers of people that *were* necessary for antelope drives.

Although Julian Steward (1938:33–37) described, in great detail, pronghorn-hunting tactics, he barely mentioned bighorn sheep hunting tactics. He said that the mountain sheep lived high on rocky mountain tops and were hunted, often with the help of dogs.

Bengt Anell (1969) gathered information from many ethnographic sources and attempted to develop a classification of the methods used to hunt herd animals. Some of the variables that he considered included the type of terrain, the size of herds, the challenges and benefits of seasonality, the use of fire drives, the manufacture and use of nets, and other factors. Anell, however, did not include indigenous knowledge of animal behaviors, and he considered artiodactyla as a group and did not differentiate between the hunting of deer, antelope, or bighorn sheep. He did describe one hunting method of interest to us here: beating or scaring herd animals into a V-shaped trap. He described hunters waiting at the closed end of the V to dispatch the animals that ran by at close range. The lines of the V trap were enhanced to either scare or "fool" the animals into thinking there were more hunters present than were actually there. Anell described dummy hunters constructed from rock and brush (or combinations thereof), with streamers or other moveable objects posted on trees or upright posts supported by rocks.

Campbell Grant (1980:8) wrote that the most favored method for hunting bighorn sheep in the Great Basin "took advantage of the habit of bighorn sheep to head for high rocky points when alarmed." Hunters would wait at these places in blinds, while others drove bighorn sheep past their hiding places. Sometimes the blinds were above narrow, basalt gorges like those in Death Valley and in the Coso Range (the gorges acted the same way as lines of cairns: they channeled the animals past the hunters).

BIGHORN SHEEP BIOLOGY, ECOLOGY, AND BEHAVIORAL PATTERNS

In addition to the great deal of recent research that has resulted from studies of declining bighorn sheep populations (e.g., Buechner 1960; Carson 1941; Delaney 1989; McCutchen 1981; Weaver 1985; US Fish and Wildlife Service 1998, 2000), a project focused on long-term observations of bighorn sheep was conducted during the 1950s by a husband-wife team in Death Valley National Park (Welles and Welles 1961). Much of the following information is based on that study, on the classic work of Bruechner (1960), and on that of Simmons (1980).

Bighorn sheep populations were once very large and widely distributed in the Desert West. Buechner (1960) estimated that the number of desert bighorn sheep before contact probably was in the tens of thousands. Drastic declines occurred during the intensive contact period in the last half of the nineteenth century, when many factors associated with the impacts of human settlement of the West contributed to the decline (Kelly 1980; McCutchen 1981). Buechner (1960:15) stated that "despite the scarcity of early records, it seems safe to assume that sheep were plentiful in the desert mountains of southern California, where they exist today."

Behavior

Welles and Welles (1961) recorded many significant behavioral characteristics during their eight-year study of bighorn sheep in Death Valley. They observed and reported that groups often were led by a ewe (female); that rams live separately from the female groups, except during the annual rut (fall breeding season); that the climbing ability of bighorn sheep is phenomenal; and that bighorn sheep wariness of human contact is an acquired trait (Welles and Welles 1961:xii–ix).

Bighorn sheep live near perennial water sources, and the "average desert bighorn sheep probably spends its lifetime within a relatively small area" (Simmons 1980:130). The Welles study found that in Death Valley, an individual's lifetime range was within 32 km. (19 mi.) of its birthplace. Simmons reported that the daily range varied with the age and sex of the animals. During the summer months in the Santa Rosa Mountains of California, Simmons (1980) observed that adult ewes and juveniles stayed within 1.3 km. (0.8 mi.) of water holes, while rams ranged farther (up to 5 km. [3 mi.]). During the cooler months, bighorn sheep have been observed at greater distances from water and may spend extended periods in areas with no known surface water. In general, males have larger home ranges than females, but the size of the home range varies greatly among populations, depending on the accessibility of water and the quality of forage, the season, and the density of the bighorn sheep population.

Two types of bighorn sheep movement patterns have been described in the literature: seasonal drift and daily round. Seasonal drift is used to describe movement shifts within the home range (Goodman 1962; Simmons 1980). This is a somewhat regular seasonal movement, dependent on resource availability within the home range. Daily habitat use and movements might vary and are certainly not predictable or regularized, but a few general patterns or group habits can sometimes be recognized. Simmons (1980:37) described a typical daily round as waking at dawn, moving downhill in the early morning hours, resting in the late morning and early afternoon, and then feeding and drifting back uphill to bedding areas in the late afternoon and evening. Moreover, well-worn trails are usually used and these are dictated by ease of access and topography (Simmons 1980:140). Both types of movement patterns (seasonal and daily), as well as the location of well-worn bighorn sheep trails, were probably well known to the indigenous peoples of the Colorado Desert

For the above reasons—living close to a water source, keeping to a traditional home range, and following somewhat regular daily and seasonal routines—native people would have observed and understood that the patterns of bighorn sheep behavior could be exploited for capture purposes. Moreover, it would be energy efficient to employ a hunting strategy that might require a considerable initial energy investment, such as building rock features, since the tactic could be employed time and time again in an area known to be used regularly by bighorn sheep.

Anza-Borrego Desert State Park Bighorn Sheep Data

In the past, substantial investments of time, energy, and travel were necessary to directly observe this elusive species. In ABDSP, bighorn sheep counts, in which observers are stationed to observe bighorn sheep from distant locations, were (and still are) traditional means of obtaining demographic information about the bighorn sheep population. Advanced technology has added more accurate and efficient means of studying bighorn sheep movements and behaviors. In ABDSP, sheep have been tracked with Very High Frequency (VHF) radio collars and, in recent years, with Global Positioning System (GPS) collars; their movements have been recorded via telemetry and by satellite, respectively. GPS collars have been especially effective for monitoring, at frequent and regular intervals, the locations of collared animals. Rather than being dependent upon small numbers of casual sightings, or observations made after intense searching and tracking on foot, GPS collars can provide

a more detailed and complete picture of bighorn sheep movement patterns and habitat use.[4]

Unpublished data from ABDSP developed by the California Department of Fish and Wildlife indicate that between 2001 and 2003, when tracking occurred, there were bighorn sheep present in large numbers in the southern Santa Rosa Mountains near Coyote Peak and in the vicinity of Clark Lake. Other data acquired between 1994–1999 placed collared bighorn sheep in the southern part of ABDSP (California Department of Fish and Wildlife, unpublished data; also see Rubin 2000). These are all locations where lines of rock cairns have also been recorded (Fig. 8).

Using data collected from GPS-collared bighorn sheep, we have established that the location of the Yaqui Pass stone-feature complex is an area where bighorn sheep are frequently present (Fig. 9). The subpopulation of the ABDSP bighorn sheep population that uses the area in the vicinity of the Yaqui Pass stone-feature complex (and other complexes within Yaqui Pass) is known to biologists as the "South San Ysidro subpopulation," one of eight subpopulations in the Peninsular Ranges (Rubin et al. 1998). The home range of this population extends from about Montezuma Grade, west of Borrego Springs, south to Highway 78 (see Fig. 8). In 2002, the California Department of Fish and Wildlife estimated that there were 41 adults and yearlings in this subpopulation.

Archaeological Evidence of Bighorn Sheep Exploitation

It is assumed that bighorn sheep were hunted in the past for subsistence purposes. While the majority of animal dietary protein may have been supplied by smaller mammals and reptiles caught by both males and females using a variety of tactics, large mammals were occasionally taken and the hunt was often imbued with ceremonial, spiritual, and status values (e.g., see Fowler 1995; Yohe and Garfinkel 2012). Ethnographic sources confirm this. Katherine Siva Sauvel has stated that "The mountain sheep is the guardian spirit of the cloven-hooved animals. He rules over all things, over the antelopes, over all the deer, he watches and rules over them" (Sauvel and Elliott 2004:492). Cahuilla and Serrano oral traditions tell us that bighorn sheep were once people. The Bighorn Sheep Song relates that in a time of very scarce resources, some of the people volunteered to become bighorn sheep so that starvation by others would be averted. This explains why, before the hunt, the Bighorn Sheep Song is sung, and why, when a bighorn sheep is taken, a type of mourning ceremony follows (Kim Marcus, personal communication, December 2012; Sauvel and Elliott 2004:178, 1140–1141).

These traditional beliefs are important to bear in mind in the context of hunting strategies, especially when one considers the difficulty of catching bighorn sheep. If individual bighorn sheep were considered to be relatives sacrificing themselves for the good of the people, and there was a traditional emphasis on the conservation of resources (i.e., not taking more than was needed), this may have contributed to the likelihood that only a few bighorn sheep were killed in a single hunt.

Faunal remains in site assemblages do, however, provide us with definitive evidence that bighorn sheep (and/or other large mammals such as deer and antelope) were butchered and eaten, and their remains used to make bone tools, and perhaps ornaments and articles of clothing such as sandals. Archival research was conducted in regional information centers for the western portion of the Colorado Desert, including portions of Riverside, San Diego, and Imperial counties. Schneider visited the information centers, searched base maps, and reviewed all archaeological reports on excavations conducted in the study area[5] in an effort to find faunal data that would confirm the use of bighorn sheep by indigenous peoples (Table 3). The search for data was problematical for a number of reasons: (1) comparatively few research-oriented excavations have been carried out in the study area (see Schaefer 1994); (2) a lack of faunal expertise has resulted in only a rare identification of remains to the genus level; (3) highly fragmented and burned specimens[6] have made identification difficult; and (4) insufficient funding within cultural resource management project budgets often has not supported definitive faunal analyses.

In *Research Issues in San Diego Prehistory*, which Donald Laylander developed and edits for the San Diego Archaeological Center (http://sandiegoarchaeology.org/Laylander/Issues/), Laylander notes that although bighorn sheep seem to have been present in fair numbers in the eastern San Diego County mountains, there is sparse archaeological evidence for the animal being a major food source among the indigenous peoples of the area. He goes on to cite a few faunal analyses that did identify bighorn sheep within archaeological

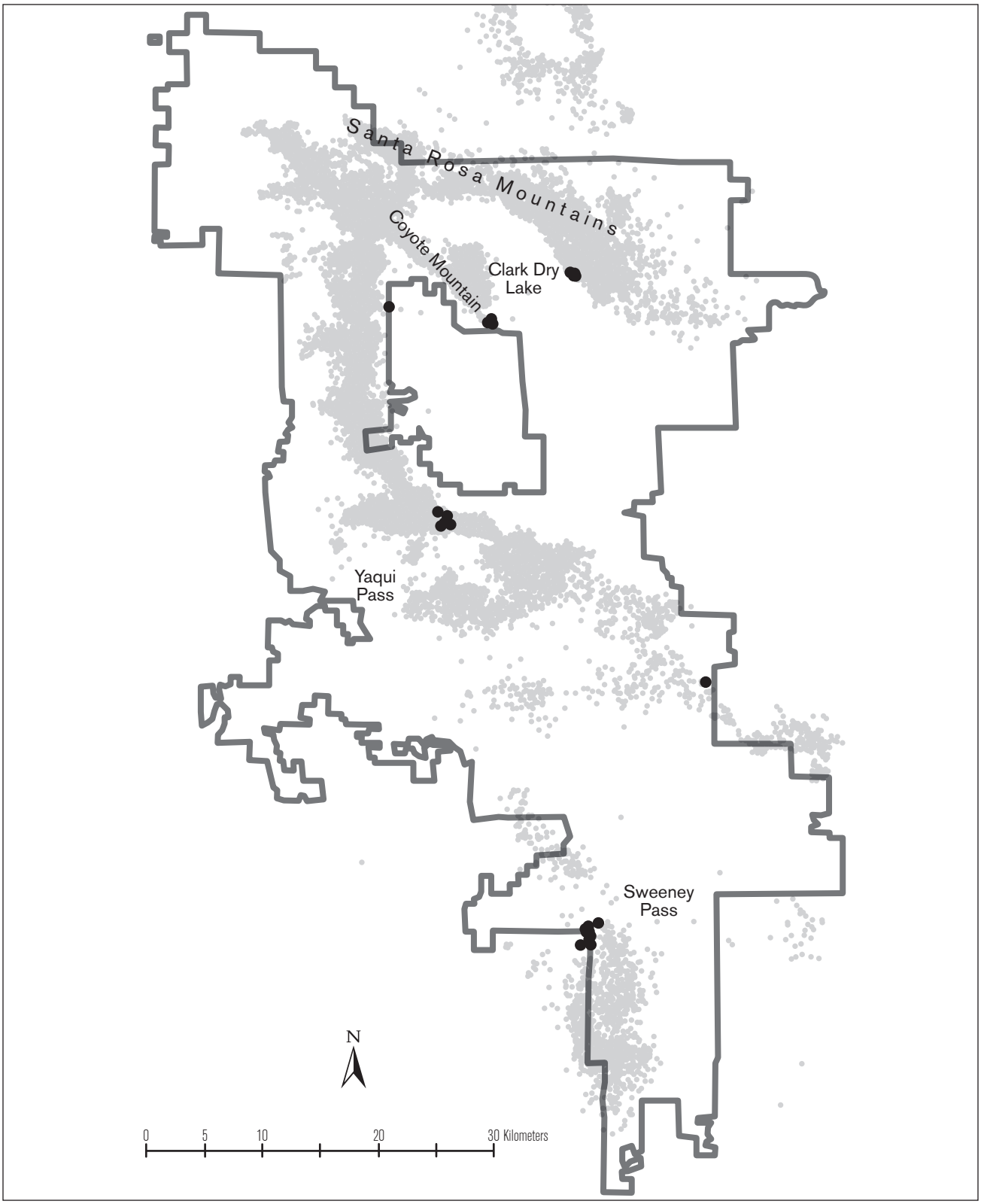

Figure 8. Co-occurrence of bighorn sheep populations (data from radio collars and satellite GPS) and known rock cairn lines in ABDSP. Grey areas represent recorded locations of bighorn sheep populations; black dots indicate locations of known cairn-line features. Dark lines indicate Park boundary.

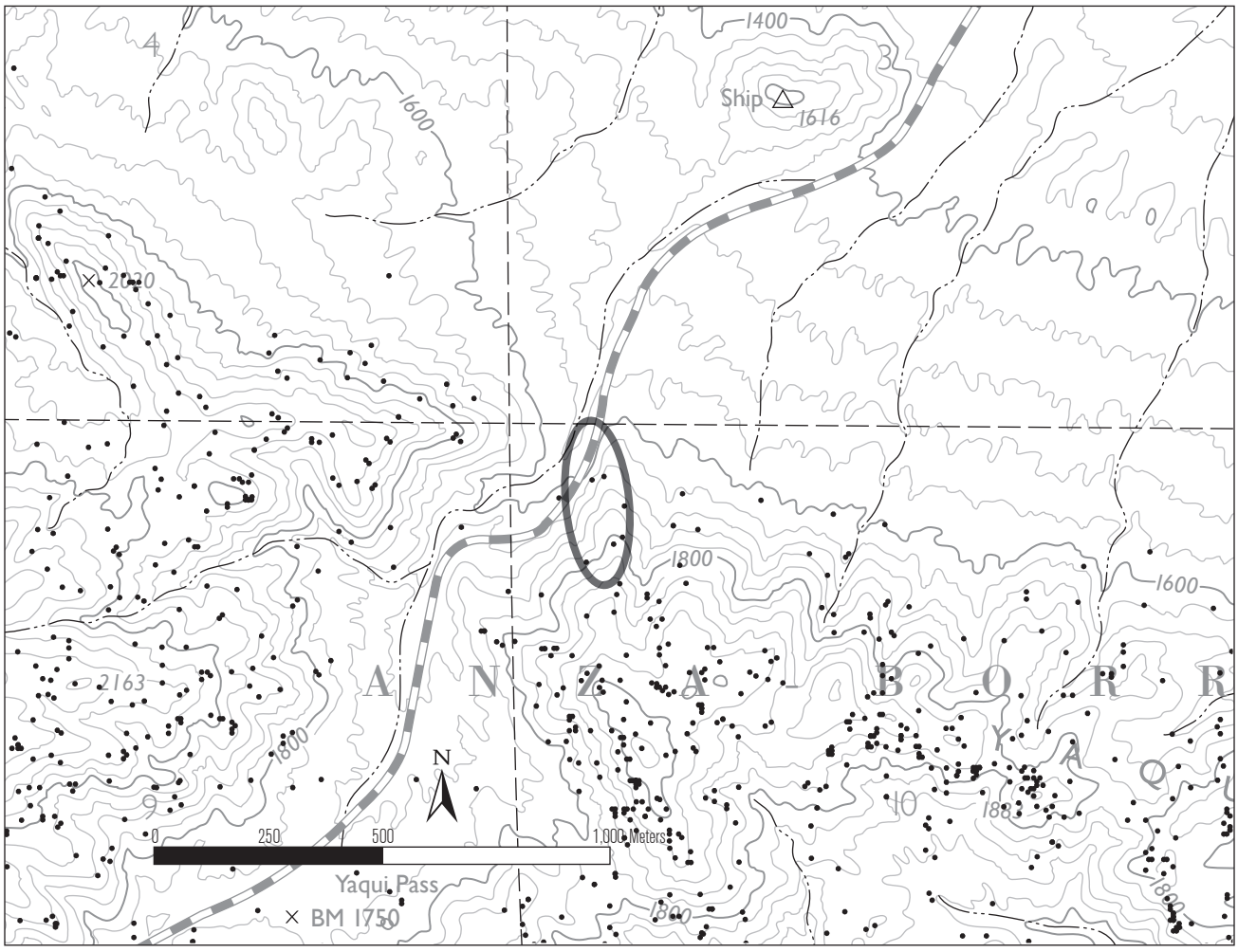

Figure 9. Bighorn sheep population in Yaqui Pass in 2001–2003. Each dot represents a single individual at a specific time. Note that no GPS locations were acquired on the *bajada* in the Borrego Valley—the northern limit of bighorn sheep range in this area. The oval is the location of the stone feature complex that is the subject of this paper.

assemblages. In the future, it might be beneficial to routinely test flaked and ground stone tools for animal protein and fat residues in order to develop a more robust record of bighorn sheep use. For example, residue analysis was carried out on artifacts from the Stahl Site and at sites in the Pinto Basin (northern Colorado Desert); bighorn sheep was identified at the Stahl Site and general artiodactyla, deer, and cat were identified at Pinto Basin sites (Schroth 1994:149, 195).

Even with limited archaeofaunal data available for the study region, we can draw some information from major faunal studies outside the immediate region. One such large faunal assemblage is from the Afton Canyon Site (CA-SBR-85) in the central Mojave Desert (Sutton and Yohe 1989). Excavation produced 499 bighorn sheep faunal elements in a faunal assemblage of 7,511 elements (about 6.5% of the entire faunal assemblage); 5,295 more non-identified large mammal elements were also present and likely represent additional bighorn sheep bone that could not be identified because of burning and fragmentation. These data confirm that human desert dwellers did hunt and eat bighorn sheep in prehistoric times.

In her analysis of faunal remains from a random-sample survey of Joshua Tree National Park (spanning both the Mojave and Colorado deserts), Anna Noah concluded that 17 of 24 sites with faunal remains had bighorn sheep elements (Noah 2000).

Bighorn sheep bone tools, hide footgear and clothing, and bone ornaments have also been identified in faunal

Table 3

ARCHAEOFAUNAL DATA FOR *OVIS CANADENSIS*, AND NON-SPECIES-IDENTIFIED LARGE MAMMALS/ARTIODACTYLA WESTERN PORTIONS OF THE COACHELLA AND IMPERIAL VALLEYS, CALIFORNIA

Site	USGS 7.5 Quadrangle	*Ovis* elements	Large Mammal/Artiodactyla Elements	Reference
CA-RIV 2827	La Quinta	9	15 (prob. Bighorn)	Sutton and Wilke 1986, 1988
CA-RIV-1179	La Quinta	20+; [6 modified] [14 non-modified]		Sutton and Wilke 1986, 1988
CA-RIV-150/H	La Quinta		3 artiodactyl; 3 charred	Jertberg and Rosenthal 1992; Dahdul 2003
CA-RIV-3682	La Quinta		3 artiodactyl	Yohe 1990
CA-RIV-2936	La Quinta	1 burned	1	Yohe 1990
CA-RIV-3680/-3681	La Quinta		1	Yohe 1990
CA-RIV-5495	La Quinta	12+ burned		Strudwick et al. 1994
CA-RIV-64/H	La Quinta		1181 (11%) +++ burned Bone tools burned (awl, other)	Love et al. 2001a Love et al. 2002a
CA-RIV-6352/-6356	La Quinta		3	Love et al. 2001b
CA-RIV-3013	La Quinta	1	3 Bone tools (awls, tubes)	Love et al. 2002b
CA-RIV-7398	Martinez Mt.		125 Med/Lg 6 Lg all fractured/burned	Mirro and McDougall 2010
CA-RIV-1331	Martinez Mt.		76	Schaefer et al. 1993
CA-RIV-1349	Martinez Mt.	7	497	Schaefer et al. 1993
CA-RIV-1343/H	Valerie		+ Modified bone (awl)	Love et al. 2002c
CA-RIV-6103/H	Valerie		Modified bone (awl)	Love et al. 2002c
CA-RIV-6110/H	Valerie		37	Love et al. 2002c
CA-RIV-6116/H	Valerie	1		Love et al. 2002c
CA-RIV-6118/H	Valerie		1 burned	Love et al. 2002c
CA-RIV-5212	Valerie	1 butchered	++ butchered	Hogan et al. 2005a
CA-RIV-7204	Valerie	1	8 burned (prob. bighorn)	Hogan et al. 2005a
CA-RIV-6896	Myoma		12 (11.8%)	Moratto et al. 2007
CA-RIV-6897	Myoma		1	Moratto et al. 2007
CA-RIV-7458/-7459	Myoma		6	Wetherbee and Goodman 2006
CA-RIV-6393	Indio		5 (1%)	Hogan et al. 2005b
CA-RIV-7318	Indio		195 (2.8%)	Hogan et al. 2005b
CA-RIV-6686	Indio		++	Hogan et al 2005c
CA-RIV-1246 (Two Bunch Palms) Locus E AD 1000	Seven Palms Valley		+	John Eddy, personal communication 2012
CA-RIV-2642 Locus I	Seven Palms Valley	140	727	Goodman 2010
CA-SDI-813 (Mine Wash Site)	Borrego Valley	13	36	Christenson 1987
Lake Cahuilla shoreline site		2		Wilke in Christenson1987:11

Table 3 *(Continued)*

ARCHAEOFAUNAL DATA FOR *OVIS CANADENSIS*, AND NON-SPECIES-IDENTIFIED LARGE MAMMALS/ARTIODACTYLA WESTERN PORTIONS OF THE COACHELLA AND IMPERIAL VALLEYS, CALIFORNIA

Site	USGS 7.5 Quadrangle	*Ovis* elements	Large Mammal/Artiodactyla Elements	Reference
CA-SDI-2537 (Indian Hill Rockshelter)	Sombrero Peak	242	–	Yohe et al. 1986
CA-SDI-161 (Carrizo Gorge)	Jacumba/Sweeney Pass	+?	+	Shackley 1981
CA-SDI-2319/H	Borrego Palm Cyn.		2 bone tools 25 (2.6%)	Arter 2005
CA-SDI-4443 CA-IMP-2322 C-111 (Barrel Springs)	Shell Reef	1	10 (1% subsurface)	Hines 2002
Carrizo Stage Station	Carrizo Mtn. NE	1	–	Mayer 2007

assemblages. Bone awls were often made of artiodactyla medipodial and metacarpal bones because of their size and shape. Gifford (1940) has described these and a number of other bone tools made from artiodactyla skeletal elements. The faunal collection from Mitchell Caverns (eastern Mojave Desert) contained leather pieces made from bighorn sheep legs that included the dewclaws of the animal; these evidently were used specifically for sandals (Pinto 1989). A description of the bone tools found with ten cremations that were collected in the early part of the twentieth century from an area that is now Joshua Tree National Park included items that are probably ornaments made from bighorn sheep phalanges (Schneider 1990:6.19). As far as we are aware, no objects specifically made from bighorn sheep have been identified in site assemblages from the study area, although collections of bighorn sheep horns have been described historically. In spite of the unlikelihood that bighorn sheep were hunted primarily because of a need for tool bone and leather, the fact that bighorn sheep bone tools, leather items, and ornaments are present in archaeological assemblages does support the subsistence data (see Table 3).[7]

Less direct, but more archaeologically visible, evidence of bighorn sheep hunting is present in petroglyphs and pictographs throughout the greater Southwest. Perhaps the earliest documentation of bighorn sheep hunting by indigenous people are the stylized bighorn sheep motifs directly associated with motifs interpreted as being dart throwers (*atlatls*) at rock art sites in the Great Basin (see Kelly 1980:337); dart throwers are characteristic of the Archaic period (i.e., before about 1,500 years ago) and predate the introduction of the bow and arrow. The best known and highest concentrations, as well as the most studied and interpreted, bighorn sheep petroglyphs are located near Ridgecrest, California in the Coso Mountains area of the southern Great Basin (e.g., Grant 1980; Grant et al. 1968; Hildebrandt and McGuire 2002; Whitley 1982, 1998).

Unfortunately, the Colorado Desert does not seem to have such a distinct record. First, the rock art record in the Colorado Desert, especially in ABDSP, consists overwhelmingly of pictographs which usually tend to deteriorate more rapidly than petroglyphs, especially in non-protected environments. Our research and inquiries (Kenneth Hedges, personal communication 2013) have failed to find any rock art motifs that can be definitely identified as bighorn sheep, or any artiodactyla, for that matter. While rock art has confirmed the importance of bighorn sheep hunting in other areas of California and the Desert West, it has not done so (as far as we are aware) in ABDSP and its immediate environs.

In addition, the indigenous cultural groups that can be closely identified with the ABDSP region (Cahuilla and Kumeyaay [Takic and Yuman-speakers, respectively]) are linguistically distinct from groups in the Great Basin (Numic-speakers), which is likely to have promoted different cultural expressions of the importance of bighorn sheep. For example, there have been reports of ritual bighorn sheep cremations and

bighorn sheep shrines (Bolton 1930; Nabhan 1993) among other groups. However, there is an early account of tacks of bighorn sheep horns along a trail and within a cave (Clark and Clark 1973:10, 12) in the area of ABDSP. Drucker (1941:103) wrote that the Diegueño (i.e., Kumeyaay), as well as other Yuman groups, had caches of bighorn sheep horns in the mountains.

FURTHER DISCUSSION

When Brook (1980) described the Saline Valley hunting-blind settings as having stone walls (circular, semi-circular, or horseshoe-shaped; two or three courses high and built of boulders, often incorporated into natural stone outcrops) and rows of dummy hunters made of stone, he could have been describing the features seen in Yaqui Pass and elsewhere in ABDSP.

A comparison of the data from the Yaqui Pass stone-feature complex and Brook's data from hunting blinds in the Saline Valley shows many similarities and some differences. In the Saline Valley, the blinds are described as circular, semi-circular, and horseshoe-shaped. In Yaqui Pass, some are curved and some are straight. Structures at both locations were built of local boulders and cobbles and were often incorporated into natural bedrock outcrops. The Saline Valley structures averaged about 1.75 m. long (range: 60 cm. to 4.2 m.) and 1.2 m. high. The Yaqui Pass structures averaged about 3.4 m. in length and 1 m. in height. The greater length of the Yaqui Pass structures may be due, in part, to the configuration of the bedrock outcrops into which they were incorporated.

Lines of stone cairns with brush enhancements likely would have presented a visual obstruction to bighorn sheep and serve to channel their movements (cf. Anell 1969; Muir 1894). The response of bighorn sheep when scared, startled, or driven is to run uphill to the highest prominence available (Driver 1937; Grant 1980; Muir 1894). Home ranges, daily rounds, and seasonal migrations, as well as well-worn bighorn sheep trails, were well-known to native peoples (Goodman 1962; Simmons 1980; Welles and Welles 1961).

CONCLUSIONS

Our hypothesis, that the lines of rock cairns and stone walls (i.e., blinds) in Yaqui Pass were used by indigenous peoples of the area to take bighorn sheep, is supported by data we have gathered, ethnographic accounts of methods of bighorn sheep hunting, and the context of the Yaqui Pass complex. Our hypothesis is also dependent on the assumption that indigenous peoples of this area were familiar with populations of bighorn sheep in the Yaqui Pass area. Moreover, they likely understood, from long-term observations and the passing on of traditional knowledge, that when startled, bighorn sheep climb to the nearest high point, often out of the range of the hunter. The topography of the slope on which CA-SDI-2651 is located, as well as its geographical position within an area known to have high frequencies of bighorn sheep (and at the edge of bighorn sheep range), would have made it an ideal location for hunting these animals.

The cultural features seem to reflect two tactics for taking the bighorn sheep: (1) startling the animals at the base of the hill so that one or more would run up a steep incline and past rock-walled structures where hunters would be hidden; and (2) using a line of obstacles to channel a more herd-centered bighorn sheep retreat up a more moderate slope so that the bighorn sheep would run past hunters lying hidden in wait behind natural stone outcrops at the summit of the slope of the hill. We are uncertain as to whether both tactics were used simultaneously or if each tactic was used at a different time, if their use was separated by season, or if ethnic differences and/or differing traditional hunting methods might account for the two types of cultural features in Yaqui Pass. The geographical locations of the two types of stone features (the stone-walled structures and the lines of rock cairns) in an area known to support a reliable population of bighorn sheep, however, suggest that both types of features are associated with indigenous hunting tactics of prehistoric groups living in this area of the Colorado Desert. Figures 10 and 11 illustrate how each hunting tactic might have been used at Yaqui Pass.

For the use of the stone-walled structures (Fig. 10):

- Bighorn sheep habitually use certain trails and terrain dictated by availability of forage and water, ease of access, and opportunities for escape. Yaqui Pass is one of these areas.
- Bighorn sheep behavioral patterns include retreating upwards when startled.

Figure 10. Schematic rendering of the manner in which the rock-walled structures were used. View to the west. Big horn sheep are climbing up the sharp incline of the western face of the hill and past hunters concealed behind the rock-walled structure.

Figure 11. Schematic rendering of the manner in which the rock cairn lines were used. View to the north and downslope. The enhanced rock cairns act as a visual obstruction and channel the big horn sheep between the cairn line and the natural rocky ridge running along the western crest of the hill. Hunters lie in wait behind the natural outcrop.

- Hunters were concealed behind stone-walled structures on the upward slope of the hill on the eastern side of Yaqui Pass.
- When bighorn sheep descended from foraging on the western side of Yaqui Pass to cross the drainage, they could have been observed from the stone-walled structures. If startled by a noise or movement, purposely made, they likely would retreat up the slope to the east and past the concealed hunters.
- As they ran past, hunters rose to dispatch one or more of them.

For the use of the lines of enhanced rock cairns (Fig. 11):

- Bighorn sheep habitually use certain trails and terrain dictated by availability of forage and water, ease of access, and opportunities for escape. Yaqui Pass is one of these areas.
- Bighorn sheep behavioral patterns include retreating upwards when startled.
- Hunters increased their chances of getting within shooting range of bighorn sheep by constructing lines that would channel a startled herd of bighorn sheep past hunters. Bighorn sheep behavioral patterns, in addition to running uphill to escape from danger, also include not crossing over or through visual obstructions.
- The cairn lines represent the supporting bases of bunches of brush or human-like shapes (perhaps made of brittle bush or ocotillo) that either tricked the bighorn sheep into thinking that they represented an obstruction or that they were hunters.
- When a bighorn sheep herd descended from foraging on the slopes on the western side of Yaqui Pass to the water in the drainage, they could have been observed from the stone-walled structures.
- Startled by noise or movement, purposely made, the herd would likely rapidly retreat up the slope to the east, over the ridge of the hill, and be intercepted by the "fence" of dummy hunters and/or clumps of brush. Perhaps other people would be stationed downhill to prevent them running past the toe of the ridge.

- As they reached the visual obstruction of the enhanced line of rock cairns, the bighorn sheep would veer upward and to the right, running for the top of the hill, the cairns forming a visual barrier that would not be crossed. Thus, the bighorn sheep were channeled close to the rocky ridge at the western crest of the eastern hillside.
- Near the top of the hill, armed hunters would be waiting, perhaps concealed by the natural outcrops running along the crest of the hill. The line of enhanced rock cairns encouraged the bighorn sheep to pass close to the armed hunters and within shooting range; the hunters would dispatch one or more of them.

Begole's observations that some of the rock cairns appeared to have been rebuilt after falling would be concordant with the scenario described above. Bighorn sheep hunting was probably not an everyday activity, but instead was a regular seasonal one. Each time the hunt took place, the brush superstructures would likely need to be replaced and the cairns refurbished.

Whether or not the two cairn lines that we studied and describe here were used at the same time, as a V-shaped channeling device, or whether each line was used separately in different hunting episodes, was not determined. It is likely that this location was used again and again over a period of time, because of the topographic advantage and the bighorn sheep habitual behaviors within the home range of the herd.

In tactical terms (*sensu* Binford 1978), hunting bighorn sheep in the way we describe would be termed an *intercept strategy*. Indigenous people knew where bighorn sheep were located, knew their habitual ranges, and knew their daily and seasonal habits. They knew when and where it was likely that bighorn sheep would forage and descend to drink or simply move through an area or move to lambing grounds. They knew that, when frightened, bighorn sheep run away from people and retreat upwards on the nearest steep slope. Only a few people would be needed to carry out this type of hunting strategy, as opposed to the large numbers of people needed for an antelope drive. Through the archaeological record, we know that the bighorn sheep was one of the larger game animals in the Colorado Desert that was used for food, tools, and ornaments. Bighorn sheep remains have been found in archaeological contexts in ABDSP and elsewhere in the region. The ethnographic literature, as well as oral histories, make it clear that indigenous peoples in the region hunted bighorn sheep from prehistoric times until well into the historical era. The geographic and topographic contexts, the known ecological and behavioral traits of bighorn sheep, as well as recent data concerning bighorn sheep populations and movements, support our hypothesis that the stone features in Yaqui Pass are a bighorn sheep hunting complex.

NOTES

[1]There are several other similar features in the immediate area of Yaqui Pass.

[2]Common ethnographic terms for the indigenous peoples of ABDSP and the region include Diegueño (referring to those associated with the mission at San Diego), *Kamia*, *Tipai*, and *Ipai*. Today all of these named groups are subsumed under the general term *Kumeyaay*.

[3]It is worthwhile to mention here that the tactics and landscape features involved in the hunting and mass-killing of antelope and gazelle have been recently studied to explain functions of stone features called "desert kites" in the Middle East (e.g., Bar-Oz et al. 2011; Holzer et al. 2010; Nadel et al. 2010).

[4]These investigators determined that bighorn sheep habitat was more likely to be <1,000 m. in elevation while deer habitat was more likely to be >1,000 m. in elevation. Another study determined that the altitudinal extent of bighorn sheep habitat was 1,400 m. elevation, but that habitat was shared with mule deer at the higher end of its range (Clemenza et al. 2009).

[5]The study area was considered to be the western side of the Lake Cahuilla basin, from the western margin of the Salton Sea to the crest of the Peninsular Range, and extending from the Palm Desert/Indio area to the north to the town of Ocotillo on the south. All of Anza-Borrego Desert State Park was included.

[6]Bighorn sheep, like other large mammals, may not have been taken back whole to campsites or semi-permanent village sites (Binford 1978). They might have been butchered where they were taken, with only the meatiest portions of the animal or other selected parts that were considered delicacies or were needed for other uses carried back to residential locations (cf. Sutton and Yohe 1989, for example, who were able to demonstrate that bighorn sheep tongues were selectively brought to the Afton Canyon site). The meaty portions were further prepared by pounding, bones were smashed to get to the marrow, and the animal parts were cooked with few identifiable remains left. Many faunal analysts (see Table 3) note that although faunal specimens could be segregated into general categories such as small, medium, and large mammals, it is often difficult to identify large mammals to the species level because of the fragmentation of bone.

[7]Difficulty in identifying artiodactyla modified bone to the species level in the large bone-implement collection from the Middle Period at Casas Grandes was noted by De Peso et al. (1974). Part of the problem was heavy modification of the bone. Only 34.2% of a collection of 798 mammal-bone tools could be further taxonomically classified to mule deer, pronghorn, or mountain sheep.

ACKNOWLEDGEMENTS

The Colorado Desert Archaeology Society class of 2001–2002 provided the definitive mapping of the stone features that are the subject of this paper. These volunteers included Chuck Bennett, Mary Bennett, Brian Curwen, Vicki Curwen, Joanie Davis, Trudy Lloyd, Ron Matzenauer, Carol Matzenauer, Sabrina Nunnery, Virginia Perrine, Lynn Snyder, Norma Tweedy, John Underhill, Marilyn Underhill, Michael Volberg, and Genna Yoder. Llouise Jee produced the map of the features from data recorded on GPS units and developed several of the figures that include GIS data. John Goodman provided the original schematic representations of how the stone features likely were used; Brian Garvey provided more artistic perspectives that clarified the two hunting tactics. Collared bighorn sheep data for the Yaqui Pass area were contributed by Esther Rubin. Walter Boyce of the Wildlife Health Center, UC Davis, provided guidance. Randy Botta of the California Department of Fish and Wildlife provided data on modern locales where bighorn sheep are present in ABDSP; Susan Arter, San Diego Museum of Natural History, provided a reference to the presence of bighorn sheep in the faunal assemblage from the excavation of the Carrizo Stage Station. Staff at the Eastern Information and the South Coastal Information centers provided access to the archaeological maps, records, and reports during Joan Schneider's archival research for identification of bighorn sheep in faunal assemblages from archaeological sites. John Eddy provided information on bighorn sheep remains in the faunal collections from Two Bunch Palms as well as a reference for chronological data for northern Colorado Desert archaeological sites. We thank four reviewers whose comments and suggestions vastly improved this paper. All errors and omissions are our own.

REFERENCES

Anell, Bengt

1969 Running Down and Driving of Game in North America. *Studia Ethnographica Upsaliensia* XXX. Lund, Sweden: Berlingska Boktryckeriet.

Arkush, Brooke S.

1986 Aboriginal Exploitation of Pronghorn in the Great Basin. *Journal of Ethnobiology* 6(2):239–255.

1995 The Archaeology of CA-MNO-2122: A Study of Pre-Contact and Post-Contact Lifeways Among the Mono Basin Paiute. *University of California Anthropological Records* 31. Berkeley.

Arter, Susan

2005 Animal Remains from the Garra Site (2004). In Joan S. Schneider, *Archaeological Testing at the "Garra Site" (CA-SDI-2319/H) in Coyote Canyon, Anza-Borrego Desert State Park, California*, Appendix D. Report on file at the Begole Archaeological Research Center, Colorado Desert District, California State Parks, Borrego Springs, California.

Bar-Oz, Guy, Melinda Zeder, and Frank Hole

2011 Role of Mass-Kill Hunting Strategies in the Expiration of Persian Gazelle (*Gazella subgutturosa*) in the Northern Levant. *Proceedings of the National Academy of Sciences* 108(18):7345–7350).

Bean, Lowell John

1972 *Mukat's People: The Cahuilla Indians of Southern California*. Berkeley: University of California Press.

Bean, Lowell John, and Katherine Siva Saubel

1972 *Temalpakh: Cahuilla Indian Knowledge and Usage of Plants*. Banning: Malki Museum Press.

Begole, Robert S.

1972 *Site Record for CA-SDI-1492*. MS on file at the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs.

1973 An Archaeological Survey in the Anza-Borrego Desert State Park; 1972 Preliminary Report. *Pacific Coast Archaeological Society Quarterly* 9(2):27–55.

1974a Archaeological Phenomena in the California Desert. *Pacific Coast Archaeological Society Quarterly* 10(2):51–70.

1974b *Site Record for CA-SDI-2651*. MS on file at the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs.

1975a *Site Record for CA-SDI-2637*. MS on file at the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs.

1975b *Site Record for CA-SDI-2638*. MS on file at the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs.

1976a A Continuing Archaeological Survey in the Anza-Borrego Desert State Park: 1975–76 Report. *Pacific Coast Archaeological Society Quarterly* 12(2):1–24.

1976b *Site Record for CA-SDI-2633*. MS on file at the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs.

1976c *Site Record for CA-SDI-2634*. MS on file at the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs.

1976d *Site Record for CA-SDI-2635*. MS on file at the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs.

1977 *Site Record for CA-SDI-4172*. MS on file at the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs. (Update filed 1981.)

1980 *Site Record for CA-SDI-7593*. MS on file at the South Coast Information Center, San Diego State University, and the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs.

1981 1978–1980 Investigations in the Anza-Borrego Desert State Park. *Pacific Coast Archaeological Society Quarterly* 17(4):1–38.

1983a *Site Record for CA-SDI-9831*. MS on file at the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs.

1983b *Site Record for CA-SDI-9723*. MS on file at the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs.

1983c *Site Record for CA-SDI-9724*. MS on file at the Begole Archaeological Research Center, California State Parks, Colorado Desert District, Borrego Springs.

Binford, Lewis R.
1978 *Nunamiut Ethnoarchaeology*. New York: Academic Press.

Bolton, H. E.
1930 *Anza's California Expeditions*. Vol. 2. Berkeley: University of California Press.

Brook, Richard A.
1980 Inferences Regarding Aboriginal Hunting Behavior in the Saline Valley, Inyo County, California. *Journal of California and Great Basin Anthropology* 2(1):60–79.

Buechner, Helmut K.
1960 The Bighorn Sheep in the United States: Its Past, Present, and Future. *Wildlife Monographs* 4. The Wildlife Society.

Campbell, Paul D.
1999 *Survival Skills of Native California*. Layton, Utah: Gibbs Smith.

Carson, B.
1941 Man, the Greatest Enemy of Desert Bighorn Mountain Sheep. *Texas Game, Fish, and Oyster Commission Bulletins* 21.

Christenson, Lynne
1987 *Mine Wash Site Faunal Analysis*. MS on file at the Begole Archaeological Research Center, Colorado Desert District Headquarters, Borrego Springs, California.

Clark, Vermal, and Mrs. Clark
1973 *Interview with Mr. and Mrs. Vermal Clark by William Seidel and Betty Stout*. MS on file in ABDSP archives.

Clemenza, Sean H., Esther S. Rubin, Christine K. Johnson, Randall A. Botta, and Walter M. Boyce
2009 Puma Predation on Radiocollared and Uncollared Bighorn Sheep. *BMC Research Notes* 2:203. Electronic document, http://www.biomedcentral.com/1756-0500/2/230, accessed June 3, 2014.

Coues, Elliot
1900 *On the Trail of a Spanish Pioneer: The Diary and Itinerary of Francisco Garcés*. New York: Francis P. Harper.

Dahdul, M.
2003 *Archaeological Testing and Mitigation at a Portion of Site CA-RIV-150/H, Washington Park Project, City of La Quinta, Riverside County, CA*. Report on file at the Eastern Information Center, University of California, Riverside.

Delaney, D.
1989 Status of Desert Bighorn Sheep in Nevada, 1988. *Desert Bighorn Sheep Council Transactions* 33:13–14.

Di Peso, Charles C., John B. Rinaldo, and Gloria J. Fenner
1974 *Casas Grandes: A Fallen Trading Center of the Gran Chichimeca*. Flagstaff: Northland Press.

Driver, Harold E.
1937 Culture Element Distibutions: VI, Southern Sierra Nevada. *University of California Anthropological Records* 1(2):53–154. Berkeley.

Drucker, Philip
1937 Culture Element Distributions V, Southern California. *University of California Anthropological Records* 1(1):1–52. Berkeley.

1941 Cultural Element Distributions XVII; Yuman and Piman. *University of California Anthropological Records* 6(3):91–230. Berkeley.

Eddy, John J.
2007 Two Bunch Palms: a Late Archaic Habitation Site in the Western Colorado Desert (CA-RIV-1246). Paper presented at End of the Archaic Symposium, Anza-Borrego Desert State Park.

Fowler, Catherine S.
1995 Mountain Sheep in the Sky: Orion's Belt in Great Basin Mythology. *Journal of California and Great Basin Anthropology* 17(2):146–152.

Frison, George C.
1987 Prehistoric, Plains-Mountain, Large-Mammal, Communal Hunting Strategies. In *The Evolution of Human Hunting*, M. H. Nitecki and D. V. Nitecki, eds., pp. 177–223. New York: Plenum Press.

Frison, George C., R. L. Andrews, J. M. Adovasio, R. C. Carlisle, and Robert Edgar
1986 A Late Paleoindian Trapping Net from Northern Wyoming. *American Antiquity* 51(2):352–361.

Gifford, E. W.
1918 Clans and Moieties in Southern California. *University of California Publications in American Archaeology and Ethnology* 14:155–219.

1931 The Kamia of the Imperial Valley. *Bureau of American Ethnology Bulletins* 97. Washington, D.C.

1940 Californian Bone Artifacts. *University of California Anthropological Records* 3(2). Berkeley.

Goodman, John D., Sr.
1962 Annual Migration of Desert Bighorn Sheep. *Desert Bighorn Sheep Council Transactions* 6:43–51.

Goodman, John D., II
2010 Faunal Remains. In *Report of Findings: Archaeological Investigations on a Portion of Locus I, Site CA-RIV-2642 by CRM Tech*, pp. 36–56. Report on file at CRM Tech, Colton, California.

Grant, Campbell
1980 The Desert Bighorn and Aboriginal Man. In *The Desert Bighorn: Its Life History, Ecology and Management*, Gale Monson and Lowell Summer, eds., pp 7–39. Tucson: University of Arizona Press.

Grant, Campbell, James W. Baird, and J. Kenneth Pringle
1968 Rock Drawings of the Coso Range, Inyo County, California: An Ancient Sheep-Hunting Cult Pictured in Desert Rock Carvings. *Maturango Museum Publications* 4. Ridgecrest, Cal.: Maturango Museum.

Hildebrandt, William R., and Kelly R. McGuire
2002 The Ascendancy of Hunting during the California Middle Archaic: An Evolutionary Perspective. *American Antiquity* 67(2):231–256.

Hines, Phil
2002 Mammal and Reptile Remains from Barrel Springs. In Joan Oxendine, *The Archaeology of Barrel Springs*, pp. 8.1–8.5. Salinas, Cal.: Coyote Press.

Hogan, Michael, Boi (Tom) Tang, Mariam Dahdul, Harry Quinn, and Daniel Ballester
2005a *Final Report of Results and Findings: Archaeological Testing and Mitigation Program at the Coral Mountain Expansion Project, City of La Quinta, Riverside County, Cal*. Report on file at the Eastern Information Center, University of California, Riverside.

Hogan, Michael, Boi (Tom) Tang, and Mariam Dahdul
2005b *Archaeological Testing and Mitigation Report. Indian Lakes Resort, City of Indio, Riverside County, CA*. Report on file at the Eastern Information Center, University of California, Riverside.

Hogan, Michael, Boi (Tom) Tang, C. Smallwood, and D. Ballester
2005c *Archaeological Testing and Evaluation Report. Site CA-RIV-6686 (33-11120) Tract Map No. 31601-1, City of Indio, Riverside County, California*. Report on file at the Eastern Information Center, University of California, Riverside.

Holzer, A., U. Avner, N. Porat, and L. Kolska-Horowitz
2010 Desert Kites in the Negev and Northeastern Sinai: their function, chronology, and ecology. *Journal of Arid Environments* 74(7):806–817.

Jertberg, P., and J. Rosenthal
1992 *Archaeological Test Excavation at CA-RIV-150, USGS La Quinta Quadrangle, La Quinta, CA*. Report on file at the Eastern Information Center, University of California, Riverside.

Kelly, Warren E.
1980 Hunting. In *The Desert Bighorn Sheep: Its Life History, Ecology, and Management*, G. Monson and L. Sumner, eds., pp. 336–342. Tucson: University of Arizona Press.

Kroeber, Alfred L.
1925 Handbook of the Indians of California. *Bureau of American Ethnology Bulletins* 78. Washington, D.C. [Reprinted by Dover Publications, Inc.]

Love, Bruce, and Mariam Dahdul
2002 Desert Chronologies and the Archaic Period in the Coachella Valley. *Pacific Coast Archaeological Society Quarterly* 38(2, 3):65–86.

Love, B., H. Quinn, T. Wake, and M. Dahdul
2001a *Final Report. Archaeological Monitoring and Cremation Remains Recovery at Indian Wells Country Club East Course, City of Indian Wells, Riverside County, California*. Report on file at the Eastern Information Center, University of California, Riverside.

Love, B., H. Quinn, M. Hogan, and M. Dahdul
2001b *Final Report on Archaeological Testing at the Palmilla Project Sites CA-RIV-6352 to 6357, City of La Quinta, Riverside County, California*. Report on file at the Eastern Information Center, University of California, Riverside.

Love, B., H. Quinn, M. Dahdul, and A. S. Moreno
2002a *Archaeology of the Archaic Period in the Coachella Valley. Final Mitigation Report for Indian Wells Country Club East Course, City of Indian Wells,Riverside County, California*. Report on file at the Eastern Information Center, University of California, Riverside.

Love, B., K. J. W. Bouscaren, N. Johnson, T. A. Wake, H. M. Quinn, and M. Dahdul
2002b *Final Testing and Mitigation Report, Rancho Fortunado Property, Tentative Tract 28964, City of La Quinta, Riverside County, California*. Report on file at the Eastern Information Center, University of California, Riverside.

Love, Bruce, Michael Hogan, Harry M. Quinn, Richard Norwood, and Mariam Dahdul
2002c *Archaeological Testing and Mitigation. The Trilogy at La Quinta Coral Mountain Project*. Report on file at the Eastern Information Center, University of California, Riverside.

Lubinski, Patrick M.
1999 The Communal Pronghorn Hunt: A Review of the Ethnographic and Archaeological Evidence. *Journal of California and Great Basin Anthropology* 21(2):158–181.

Luomala, Katharine
1978 Tipai and Ipai. In *Handbook of North American Indians, Vol. 8, California*, R. F. Heizer, ed., pp. 592–609. Washington, D.C.: Smithsonian University Press.

Mahan, Shannon A.
2012 *Optically Stimulated Luminescence (OSL) Data and Ages from Rock Cairn #2 (IMP 10,792), Ceremonial Site #1 (Yaqui Ridge), and Ceremonial Site #2 (Yaqui Ridge) of Anza-Borrego Desert State Park, CA*. Report on file at the Begole Archaeological Research Center, Colorado Desert District Headquarters, Borrego Springs.

Mayer, Susan Arter
2007 Faunal Analysis Report, Attachment 3. In S. R. Van Wormer, S. Wade, S. D. Walter, and S. Arter, *An Isolated Frontier Outpost. Historical and Archaeological Investigations of the Carrizo Creek Stage Station*. Sacramento: California State Parks.

McCutchen, H. E.
1981 Desert Bighorn Sheep Zoogeography and Adaptation in Relation to Historic Land Use. *Wildlife Society Bulletins* 9:171–179.

McDonald, Alison Meg
1992 *Indian Hill Rockshelter and Aboriginal Cultural Adaptation in Anza-Borrego Desert State Park, Southeastern California*. Ph.D. dissertation, University of California, Riverside.

McGuire, Kelly R., and Brian W. Hatoff
1991 A Prehistoric Bighorn Sheep Drive Complex, Clan Alpine Mountains, Central Nevada. *Journal of California and Great Basin Anthropology* 13(1):95–109.

Mirro, Vanessa, and Dennis McDougall
2010 *Emergency Data Recovery Investigations at CA-RIV-7398 for the Dike 4 Groundwater Recharge Facilities Project in the Coachella Valley, CA*. Report on file at the Eastern Information Center, University of California, Riverside.

Moratto, M. J., M. C. Horne, R. J. Lichtenstein, D. McDougall, M. J. Mirro, and M. J. Wyss
2007 *Archaeological Evaluation Report 33-011573 (CA-RIV-6896) and 33-011574 (CA-RIV-6897). I-10/Jefferson St. Interchange Improvement Project, Indio, Riverside County, California*. Report on file at the Eastern Information Center, University of California, Riverside.

Muir, John
1894 *The Mountains of California*. New York: The Century Co. [Republished in 1903].

Nabhan, Gary Paul
1993 When the Spring Runs Dry. In *Counting Sheep: 20 Ways of Seeing Desert Bighorn*, G. P. Nabhan, ed., pp. 7–26. Tucson: University of Arizona Press.

Nadel, Dani, Guy Bar-Oz, Uni Avner, Elisabetta Boaretta, and Dan Malkinson
2010 Walls, Ramps and Pits: The Construction of the Samar Desert Kites, Southern Negev, Israel. *Antiquity* 84:976–992.

Noah, Anna
2000 The Zooarchaeology of Joshua Tree National Monument: Results of Analysis of Animal Remains from 24 Archaeological Sites. In C. N. Warren and J. S. Schneider, *Phase II, An Archaeological Inventory of Joshua Tree National Park: Description and Analyses of the Results of a Stratified Random Sample Inventory Conducted 1991–1992*, pp. 7.1–7.27. Report on file at the Division of Cultural Resources, Joshua Tree National Park.

Parr, Robert E.
1989 *Archaeological Investigation of the Huntoon Pronghorn Trap Complex, Mineral County, Nevada*. Master's thesis, University of California, Riverside.

Pendleton, Lorann S. A., and David Hurst Thomas
1983 The Fort Sage Drift Fence. Washoe County, Nevada. *Anthropological Papers of the American Museum of Natural History* 58(2). New York.

Pinto, Diana
1989 The Archaeology of Mitchell Caverns. *California Archaeological Reports* 25. Cultural Heritage Section Resource Protection Division. Sacramento: Department of Parks and Recreation.

Rubin, Esther S.
2000 *Recovery Plan for Bighorn Sheep in the Peninsular Ranges, California*. Report on file at the U.S. Fish and Wildlife Service, Region 1, Portland, OR.

Rubin, E. S., W. M. Boyce, M. C. Jorgensen, S. G. Torres, C. L. Haynes, C. S. O'Brien, and D. A. Jessup
1998 Distribution and Abundance of Bighorn Sheep in the Peninsular Ranges, California. *Wildlife Society Bulletins* 26:539–551.

Sauvel, Katherine Siva, and Eric Elliott
2004 *'Isill Héqwas Wáxish. A Dried Coyote's Tail*. Banning: Malki Museum Press.

Schaefer, Jerry
1994 The Challenge of Archaeological Research in the Colorado Desert: Recent Approaches and Discoveries. *Journal of California and Great Basin Anthropology* 16(1):60–80.

Schaefer, Jerry, Drew Pallette, and Lowell J. Bean
1993 *Archaeological Investigation of Two Lake Cahuilla Campsites near Toro Canyon, Riverside County, CA*. Report on file at the Eastern Information Center, University of California, Riverside.

Schneider, Joan S.
1990 Implements of Bone and Antler. In *Cremations and Associated Artifacts from the Campbell Collection, Joshua Tree National Monument*, A. B. Schroth, ed., Chapter 6. MS on file at Joshua Tree National Park, Cultural Resources Division, Twentynine Palms, California.

Schneider, Joan S., and Steven R. James
2003 *Arrow Site Protection: A Close-up View of CA-SDI-9832*. Report on file at the Begole Archaeological Research Center, California State Parks Colorado Desert District, Borrego Springs.

Schroth, Adella B.
1994 *The Pinto Point Controversy in the Western United States*. Ph.D. dissertation, University of California, Riverside.

Scott, David J. "Jack," Clifford Shaw, and Leeann Murphy
2012 The Monument Ridge Bighorn Sheep Hunting Locale. *California Archaeology* 4(2):273–276.

Shakley, M. Steven
1981 *Late Prehistoric Exchange Network Analysis in Carrizo Gorge and the Far Southwest*. Salinas, Cal.: Coyote Press.

Shipek, Florence
1970 *The Autobiography of Delfina Cuero, a Diegueño Indian*. Los Angeles: Dawson's Book Shop.

Simmons, Norman M.
1980 Behavior. In *The Desert Bighorn Sheep: Its Life History, Ecology, and Management*, G. Monson and L. Sumner, eds., pp. 124–144. Tucson: University of Arizona Press.

Spier, Leslie
1923 Southern Diegueño Customs. *University of California Publications in American Archaeology and Ethnology* 20:292–358. Berkeley.

Steward, Julian H.
1938 Basin-Plateau Aboriginal Sociopolitical Groups. *Bureau of American Ethnology Bulletins* 120. Washington, D.C.: Government Printing Office.

Strudwick, I. H., D. L. Taylor, and B. L. Strum
1994 *Test Level Investigations at CA-RIV-5495 and National Register Evaluation of Cultural Resources within the Lowe Reserve Project Area, Riverside County, California*. Report on file at the Eastern Information Center, University of California, Riverside.

Sutton, Mark Q., and Philip J. Wilke (eds.)
1986 *Archaeological Investigations at La Quinta, Salton Basin, Southeastern California*. Report on file at the Eastern Information Center, University of California, Riverside.

Sutton, Mark Q., and Philip J. Wilke
1988 *Archaeological Investigations at CA-RIV-1179, CA-RIV-2823, and CA-RIV-2827, La Quinta, Riverside County, California*. [*Archives of California Prehistory* 20.] Salinas, Cal.: Coyote Press.

Sutton, Mark Q, and Robert M. Yohe II
1989 An Analysis of the Vertebrate Faunal Remains from the Afton Canyon Site (CA-SBR-85). In J. S. Schneider, *The Archaeology of the Afton Canyon Site*. [*San Bernardino County Museum Association Quarterly* 36(1).]

United States Fish and Wildlife Service
1998 Endangered Status for the Peninsular Ranges Population Segment of Desert Bighorn Sheep in Southern California. *Federal Register* 63:13134–13150.
2000 Final Rule to List the Sierra Nevada Distinct Population Segment of the California Bighorn Sheep as Endangered. *Federal Register* 65:20–30.

Weaver, R. A.
1985 The Status of the Desert Bighorn Sheep in the United States. In *Wild Sheep, Distribution, Abundance, Management, and Conservation of the Sheep of the World and Closely Related Mountain Ungulates*, M. Hoefs, ed., pp. 82–85. [*Northern Wild Sheep and Goat Council Special Report*] Whitehorse, Yukon: Yukon Wildlife Branch.

Welles, Ralph E., and Florence B. Welles
1961 The Bighorn Sheep of Death Valley. *Fauna of the National Parks of the United States, Fauna Series* 6. Washington, D.C.: National Park Service.

Wetherbee, Matthew, and John D. Goodman II
2006 *Archaeological Investigations for the España Project, City of Indio, CA*. Report on file at the Eastern Information Center, University of California, Riverside.

Whitley, David S.
1982 Notes on the Coso Petroglyphs, the Etiological Mythology of the Western Shoshone and the Interpretation of Rock Art. *Journal of California and Great Basin Anthropology* 4(2):262–272.
1998 Meaning and Metaphor in the Coso Petroglyphs: Understanding Great Basin Rock Art. In *Coso Rock Art: A New Perspective*, Elva Younkin, ed., pp. 109–176. [*Maturango Museum Publications* 12.] Ridgecrest: Maturango Museum.

Wilke, Philip J.
1978 Late Prehistoric Human Ecology at Lake Cahuilla, Coachella Valley, California. *University of California Archaeological Research Facility Contributions* 38. Berkeley.
1986 Aboriginal Game Drive Complexes At and Near Whiskey Flat, Mineral County, Nevada. Paper presented at the 1986 Great Basin Anthropological Conference, Las Vegas, Nevada.

Wilke, Philip J., Meg McDonald, and L. A. Payan (eds.)
1986 *Excavations at Indian Hill Rockshelter, Anza-Borrego Desert State Park, California*. MS on file at the California Department of Parks and Recreation, Sacramento.

Yohe, Robert M., II
1990 *Archaeological Investigations at Five Sites Located at One Eleven La Quinta Center in the City of La Quinta, Central Riverside County, California*. Report on file at the Eastern Information Center, University of California, Riverside.

Yohe, Robert M., II, and Alan P. Garfinkel
2012 Great Basin Bighorn Sheep Ceremonialism: Reflections on a Possible Sheep Shrine at the Rose Spring Site (CA-INY-372), Rose Valley, Alta California. *California Archaeology* 4(2):201–224.

Yohe, Robert M., II, Roy A. Salls, Murray Smith, and Barry R. Neiditch.
1986 Faunal Remains. In *Excavations at Indian Hill Rockshelter, Anza-Borrego Desert State Park, California 1984–1985*, P. J. Wilke, M. McDonald, and L. A. Payen, eds., pp. 118–136. Report on file at the California Department of Parks and Recreation, Sacramento.