The archaeology of the Three Sisters Lagoons, Baja California, Mexico

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Introductory remarks

In retrospect it is not amazing to have discovered plentiful archaeological remains around Laguna Ojo de Liebre, Laguna Guerrero Negro, and Laguna Manuela, or the Three Sisters' Lagoons (Figure 1). This is a fertile stretch of protective waters within the west-central Baja California peninsula, buoyed by terrestrial foods. The apparent potable water impoverishment and outward-appearing visual monotony noticeable to a casual modern visitor is misleading. Even the historic record is deceptive. Aschmann (1959:43, 163, 165) noted the transient occupation of the entire Central Desert Pacific shoreline and indicated more specifically that the area of interest at this time was virtually unoccupied due to the presence of salt flats interspersed with poorly vegetated active sand dunes. An archaeologist only has to examine the near-shore cultural remains and local dynamic environmental niches to begin to appreciate the true extent and complexity of Indian use here.

Cooperative Instituto Nacional de Antropología e Historia and University of California, Berkeley archaeological studies of the central Pacific lagoons were undertaken under the author's direction between 1997 and the present (2002) (also see work by Breiner et al. 1999). Informal visits to these lagoons by the author in the 1980s in which archaeological remains were witnessed suggested that this was a locality with robust research potential and serious cultural resource management problems. These observations led to the ongoing studies summarized in this article.

Three expeditions to the locality have brought systematic studies to an archaeological leading edge directed at the development of a series of working hypotheses and a model regarding the sociocultural aspects of these past peoples. The fieldwork also has cultural resource management implications. The interdisciplinary approach assists not only in better understanding the culture historical foundations of the locality and the central peninsula but also serves to better illuminate our constructions of past social operations. Past societal and cultural changes and processes involved in human lifeway variability were interrelated with the regional environment and nuances of changes in landforms, climate, sea level, plant and animal habitat, and general ecology.

Environmental backdrop

The study locality is part of the Central or Vizcaíno Desert, straddling the modern political line between Baja California and Baja California Sur, Mexico. This coastal setting of three adjoining lagoons is the westerly terminus of an expansive plain bordered on the east by the Sierra de San Francisco and on the west by the Pacific Ocean and Bahía Sebastian Vizcaíno. A nearly flat sandy plain, rich in sodium and calcium and covered by high active dunes,

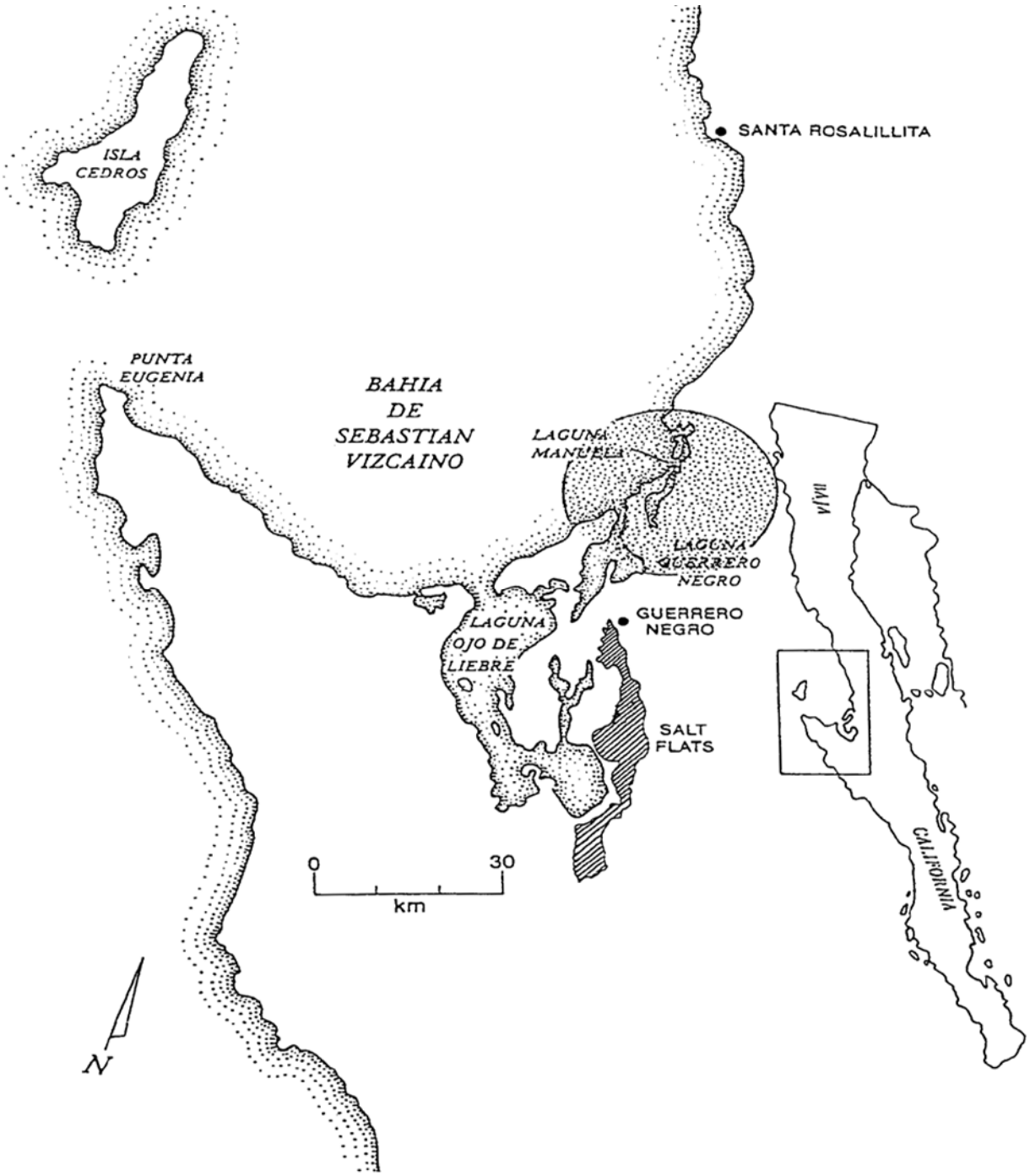

Figure 1. Map of study area.

characterizes the coastal reaches. Just inland from the eastern side of Laguna Guerrero Negro and Laguna Manuela is an older beach berm, a focus of prehistoric activities. At Laguna Ojo de Liebre, an older terrace or beach berm has been dated at around 10,000 years ago (Ritter and Payen 1992:254). Phleger (1965:206) has noted old storm berms on the Laguna Guerrero Negro lagoonal barrier 900-1,500 m inland that date to about 2,000 years ago, suggesting a prograding coast and sea level over the last several millennia. The relatively level coastal environment at first glance fails to reveal a dynamic terrain, one that undoubtedly influenced past human uses at

the locations.

The coastal Pacific air is moist, with considerable wind blowing year-round from the northwest. Fog is often present, and the air temperature is moderate, even by summer standards, with a range from 5 to 29°C. While precipitation can come during the winter and summer, only about 35-150 mm/year of rainfall occurs.

Shreve (1951) and Wiggins (1980) designate the general area as sacrcophyllus desert. Dominant plant communities are the coastal sand dune and coastal salt marsh communities.

Marine life is especially abundant here, with over 300 fish species representing an admixture of wide-ranging types from northern and southern locations. Mollusks on the stretches of the Pacific coast also number in the hundreds.

Galina et al. (1991:177) indicate that in the Biosphere Reserve of the Vizcaíno Desert there are 309 species of terrestrial and marine vertebrates, excepting fishes. This includes four amphibians, 43 reptiles, 192 birds, and 69 mammals. Nelson (1919:111) relates: "When Lower California was discovered [by Euroamericans] its shores swarmed with whales, elephant seals, fur seals, and sea otters and game abounded." Sea turtles were formerly abundant in these lagoons, probably year-round (see Nelson 1919:Fig. 2; Scammon 1970:19, 28, 71). This is also an especially important area for waterfowl, situated along the Pacific flyway. Orr (1960:142) notes that there are 97 named species of native land mammals in Baja California, the most important locally likely being rodents, lagomorphs and artiodactyls.

Finally, and with exceptional relevance to Indian use of these lagoons, is the issue of portable water. The nearest known natural source today is a spring at the eastern end of Laguna Ojo de Liebre (cf. Moriarty 1968), up to 40 km or more from some locations along the Three Sisters' Lagoons. Other than this source, one can only speculate that, aside from transportation from some distance, local sources could have included dew accumulations in puddles and *batequis*, or excavated wells. Modern-day excavation for potable water in one area of the present shoreline showed fresh water between 2 and 3 m below surface, a depth not beyond access by aboriginal peoples and perhaps closer to the surface in past times.

Theoretical and methodological approach

The archaeological work is socio-ecologically oriented, following an interdisciplinary strategy. Paramount, of course, is the continuing need to refine the culture-historical baseline. Testing of hunter-gatherer-fisher foraging models based on a consideration of mid-range theory, searching for cultural evolutionary evidence, and trying to understand influences of ritual on past behavior are other aspects of the approach. Overall, the method is rationalistic and scientific, a process combining the rigors of scientific testing, humanist concerns, and historical research (cf. Ritter 2002 for further details). Understanding sociocultural and individual and subgroup behavioral variability within the changing paleo-ecological parameters of the locality should hopefully become increasingly clear with the ongoing efforts.

While details of the first two seasons' fieldwork are presented in the author's *informes* of 1999 and 2002, a summary of three seasons' work is offered here. Earlier informal work at Laguna Ojo de Liebre aside (cf. Ritter and Payen 1992), the principal efforts included systematic inventory at ca. 30-m intervals of five rectangular blocks following the ancient and modern shorelines of Laguna Guerrero Negro and Laguna Manuela. These blocks were spaced out at variable intervals for over 20 km along the eastern shore, generally following known or expected locations of prehistoric coastal use. These blocks are 2 km or less in length and about 0.5 km

Figure 2. Systematic artifact collecting at site LGN-3.

wide.

Adjustments during the inventory were made if systematic coverage was found to deviate from the main strip of cultural remains. The spacing of the blocks was contingent upon access and to assure that representative areas of the two lagoons' eastern shoreline (northeast Laguna Guerrero Negro, the eastern Laguna Guerrero Negro-Laguna Manuela interface, and southeast, central-east and northeast Laguna Manuela) were examined. The inventory was for the purpose of documenting a representative sample of archaeological patches and clusters of patches that would form reasonably separable sites. In the larger sense, the sampling formed part of a long, linear north-south strip. Detailed site accounts with photographs and digital image records were completed. In addition to the systematic inventory, intuitive forays were made at variable locations along the lagoons, and examination was conducted of roads and informal trails while accessing block survey areas. Very little assessment was made of the southern reaches of Laguna Guerrero Negro, of sites near the present outer coast, at the northern end of Laguna Manuela, or inland beyond several kilometers of the present or more ancient eastern shores.

Systematic and nonsystematic collections were carried out of the generally shallow sites' artifacts and ecofacts (most sites were only 5-15 cm deep, with one over 50 cm deep) (Figure 2). An attempt was made to garner a representative sample of artifact types and their distribution, along with floral and faunal samples representative of subsistence practices. Unique artifacts, formed artifacts suitable for museum display and surface artifacts that would be sought out by illegal collectors were gathered as well. Limited archaeological excavations were conducted at select sites to recover certain categories of cultural materials and to lessen recovery biases with

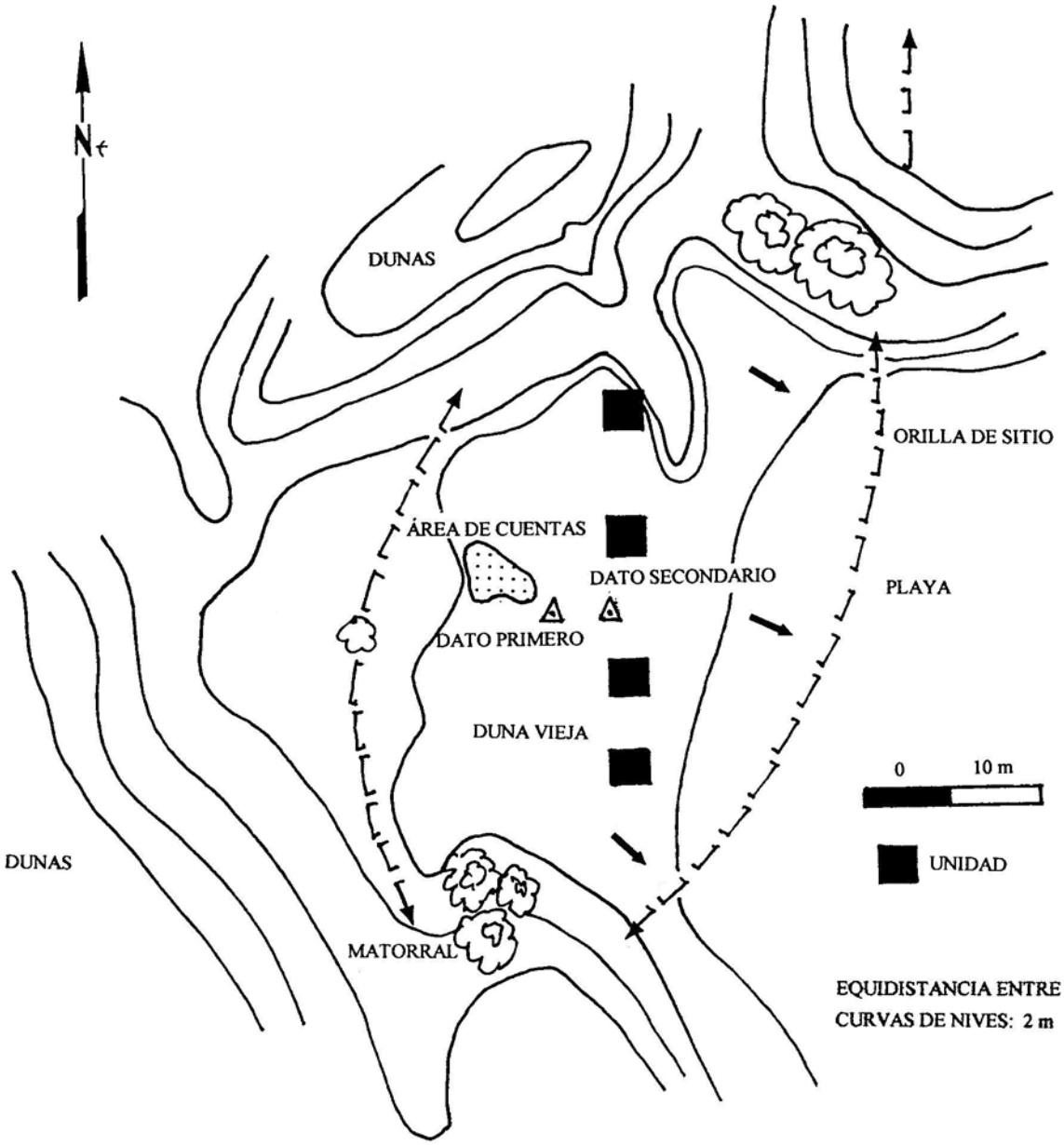

Figure 3. Site map for LGN-3 showing excavation unit distribution.

less systematic surface collections. These were generally in the form of isolated 2-x-2-m units or 2-x-2-m units in spaced alignment or adjoining one another (Figure 3). Circular surface scrape units were also undertaken at select sites, primarily to recover detailed faunal and floral remains (Figure 4). One human burial and several cremations were recovered through units placed over them. Other cremations were documented in the field. Excavated materials were passed through 3-mm mesh or 850-micron screens. Standard recording forms were used for unit levels, features and burials.

Archaeological sites

During the course of inventory, 34 sites were documented along present and past shores

Figure 4. Collection of faunal remains from circular unit at site LM-6.

of Laguna Guerrero Negro and 18 sites along or near the shore of Laguna Manuela. A number of sites are known informally from the shores of Laguna Ojo de Liebre, but only two have been systematically studied and dated (Moriarty 1968; Ritter and Payen 1992). There is also limited information gathered by avocationalist archaeologists on a number of sites from the lagoons.

The identification and assessment of site distribution, content and vulnerability to modern impacts serves interpretive/explanatory and management goals. With the exception of two very dispersed special-use sites near the mouth of Laguna Guerrero Negro, the site characteristics generally speaking are very similar. There is a patchwork of mostly shallow (ca. 5-15 cm maximum) residential/activity debris found along what appears to be an older shoreline of Laguna Guerrero Negro and southern Laguna Manuela. Sites along the middle and northeastern side of current Laguna Manuela are nested within pockets of large semi-stabilized coastal dunes, some adjoining and some more distant from the prograding shoreline. The patches are of variable size and distribution. Those sites farther to the south are located upon inter-dune pans or flats, or in lower, older dunes. This location is also within or immediately south of the higher active dune field that originates from the southern end of Laguna Manuela and continues southeast, moved by the northwest winds. Variable wind and storm activity indicates that dunes are covering and uncovering cultural remains on a periodic basis. At one site, 8-m-high active dunes were moved 8 m during one large storm event.

The subdivision of a site into loci was based on the definition of clusters of discrete patches of cultural materials separated by less than 50 m. Where there was a larger void between cultural patches, generally beyond 50 and 100 m, a separate site was defined. Sites range in size

from 75 m^2 to over 39,000 m^2, with actual cultural debris on larger sites dispersed among a number of loci. The largest site (LGN-12), for instance, actually included cultural debris within only 30% of the total site area. These cultural patches in turn may include up to 80% of the surface covered with archaeological debris, mainly shellfish remains. Over half of the sites are less than 5,000 m^2 in size. Toward the north along Laguna Manuela, the patches of material generally became sparser and smaller in size. Cultural debris may cover only 10-15% of the surface of a locus, and the cluster of loci may be 95% bare overall. Still, from north to south, rich patches of archaeological remains can be found. These patches do show a gradation in appearance and content from south to north, as discussed below.

Subsistence remains

Archaeological remains on the sites are dominated by shellfish, primarily *Argopecten circularis*, with an increasing percentage of *Chione* sp. toward the north. Less frequent taxa include *Ostrea* sp., *Solen/Tagelus* sp., *Crepidula* sp., *Macron aethiops,* and *Crucibulum* sp., among others. Notable in its absence is *Haliotis* sp. Shellfish are represented in the millions within these sites, attesting to their importance in the diet.

Fish remains are also abundant in these sites and may represent the principal food source of lagoon visitors. In one 2-m circular unit at site LM-1 that was surface-scraped and screened through 850-micron mesh screen, over 100 fish are represented, mostly small lagoon species, suggesting that millions of fish were procured along the lagoons. An analysis by Gobalet (1999) of a grab sample of fish bone from site LGN-1 revealed the presence of 12 types, including bat ray (*Myliobatis californica -- raya murciélago*), shovelnose guitarfish (*Rhinobatus productus -- angelito*), shark (cf. *Triakis semifacciata, Galeorhinus zyopterus* or *Mustelus* sp. -- *tiburones*), scalloped hammerhead shark (*Sphyrna* sp. -- *tiburón martillo*), Pacific porgy (*Calamus brachysomus -- pez pluma* or *mojarra*), bullseye puffer (*Sphoeroides* sp. -- *botete*), opaleye (*Girella nigricans -- chopa verde*), diamond turbot (*Hypsosetta guttulaca -- platija diamante*), Cortez halibut (*Paralichthys californicus -- lenguado de California*), white seabass (*Atractoscion nobilis -- corvina loca*), yellowfin croaker (*Umbrina roncador -- verrugato de aleta amarilla*) and, more generally croakers or corvina (family Sciaenidae -- *gurrubatas*). Arter (1999) has added manta ray (*Manta birostris -- mantaraya*) from other sites. Graybar grunt (*Haemulon sexfasciatum -- burro almejera*) remains were found at site LGN-20.

Other faunal remains include sea turtle (Chelonidae -- *tortuga de mar*), more notable at Laguna Guerrero Negro sites than those by Laguna Manuela. Scavenging by dogs and coyotes may have reduced the presence of such remains in the trash. Williams (1999) has identified six species of crab from various sites in the study locality. Gobalet, in a grab sample of bone from LGN-1, found coyote (*Canis latrans)*, pocket gopher (*Thomomys bottae -- topo*), kangaroo rat (*Dipodomys* sp. -- *rata canguro*), deer (or other artiodactyls) (cf. *Odocoileus hemionus -- venado*), possibly harbor seal (*Phoca vitulina -- foca*), sea otter (*Enhydra lutris -- nutria de mar*), black-tailed hare (*Lepus californicus -- liebre de cola negra*) and rabbit (*Sylvilagus* sp. -- *conejo de cola de algodón*). At least one juvenile whale vertebra was also noted, along with bird bone. Arter (1999) has identified pelican (*Pelicanus occidentalis -- pelicana café*), common loon (*Gavia immer -- somorgujo común*) and one of the shorebirds of the family Scolopacidae (*zarapico*?).

Also discovered in the dune sites were one primary human interment, a number of cremations, a vast array of flaked and ground stone tools and implements, bone and shell

artifacts, broken and unbroken introduced rock, and various historic artifacts. These are briefly discussed below.

Features

Features noted at the various sites included half a dozen cremations, one with an apparent bed of *Argopecten* valves and a few with shell beads, and a primary interment, possibly buried flexed on its back. Other features include cooking areas dominated by charcoal concentrations and animal bone, especially turtle; hearth-like areas; local concentrations of single shellfish species; obsidian and other flaked stone workshops; an especially large obsidian core and hammer stone; locations of abandoned metates and a few assemblies of cobble tools.

Artifacts

Milling tools

Tabular metates and grinding palettes, generally unshaped or little-shaped volcanic stone or in one case a block of caliche, occur in low numbers at about one-third of the sites along the two northern lagoon shores. These grinding implements are found generally at those larger, denser site locations. Mortars and abraders of volcanic material are infrequent. Ovate cobble manos, about two-thirds unshaped, occur in low numbers at just over one-half of the sites scattered throughout the sample blocks. These volcanic, quartz and granite tools often contain presumed anvil pits and edges that demonstrate pounding actions. Materials are from up-coast and interior sources, and use in such activities as grinding fish bone and seeds is supposed.

Chacuacos

Chacuacos, or short ground volcanic stone tubes, were found at one Laguna Guerrero Negro site by the researchers, with a number of others collected from the locality by other visitors. These presumed shamanic devices, unfinished in one case, demonstrate probable ritual activities, such as curing rites, among visiting family groups.

Hammer stones

These common tools are represented by wide range of stone, including volcanic, granite and quartz. They occur in a broad array of sizes and forms, from pebble hammer/burnishers to larger cobble hammer stones and combination hammer/mano (Figure 5g) or hammer/chopper-like configurations. Most exhibit heavy use and breakage. These are not unlike the multifunctional cobble tools among the Seri described by McGee (1898:234).

Cores/core tools

These widespread tools can be generally divided into bipolar obsidian cores and larger cores/core tools of diverse material and configuration (Figure 5j). The smaller bipolar cores on pebbles likely functioned to produce diminutive special-edged tools, flakes and small wedges or splitters of bone and other hard materials. The larger cores/core tools, including obsidian and

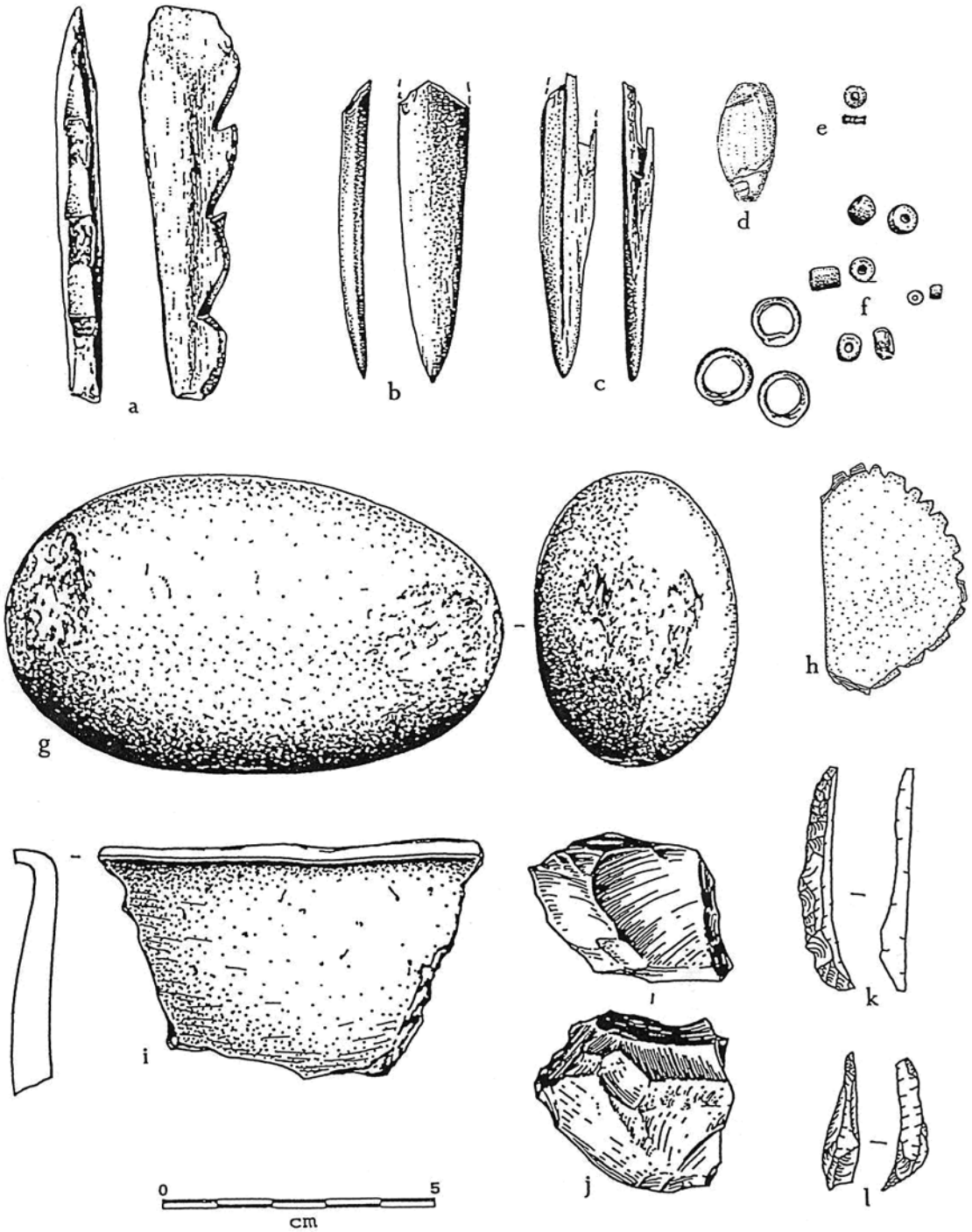

Figure 5. Miscellaneous artifacts: (a) LGN-1-176 bone harpoon, (b) LGN-1-168 bone pin, (c) LGN-1-169 bone awl, (d) LM-4-12 *Olivella* bead, (e) LGN-3-77 small shell disk bead, (f) LGN-1 barrel, spheroid and ring glass trade beads (various colors), (g) LGN-8 quartzite hammer stone/mano, (h) LGN-3-77 mother-of-pearl shell ornament, (i) LGN-1 nission ware ceramic rim sherd, (j) LGN-6 cryptocrystalline silica core, (k) LGN-1-84 obsidian burin spall, (l) LGN-4-24 obsidian burin spall.

basalt boulders down to small cobbles, served many purposes as well. Such uses included sources of flakes for artifacts and flaked stone cobbles for heavy-duty chopping/scraping-like functions, as on meat, bone and hides. Because of its superior flaking quality, obsidian was particularly prized for a wide range of flaked stone artifacts, more prevalent around Laguna Ojo de Liebre and Laguna Guerrero Negro and less so as one proceeds up the side of Laguna Manuela to the north, where quartz and siliceous volcanic materials become much more customary. Overall, having cores at hand expedited the manufacture of many tools and was worth the considerable effort necessary to bring these materials to the locality, often from some distance.

Debitage

The most common artifacts recognized in the locality are flakes and flake fragments from stone tool manufacture, use and rejuvenation. These include obsidian, quartz and a wide range of fine-grained to crystalline or siliceous volcanic materials. Non-obsidian reduction is largely of the hard-hammer variety, mostly involving larger core and flake tools but with some smaller bifacial reduction evident. Obsidian reduction, on the other hand, includes a wide gamut of techniques on boulders, cobbles, pebbles and large flake blanks. Hammer stone reduction is evident with some platform preparation, especially during biface reduction. A bifacial production and maintenance industry dominates, although various edge-modified obsidian flakes from core, biface, bipolar, radial, and burin techniques are broadly distributed and common, especially core-early biface reduction flake use. Obsidian appears to have been used and reused for implements, down to small pieces in many instances. Most noteworthy is the range of techniques and obvious familiarity with flaked stone tool possibilities, a breadth of technology not recognized to date elsewhere in the peninsula.

Common flaked stone artifacts

Smaller and larger edge-modified flakes and flake fragments of obsidian, quartz and various siliceous volcanic rocks are found throughout the study area. These include large flaked knife and scraper-like tools, unifaces (Figure 6c, d), and smaller edge-modified flakes with a wide variety of edge types made on many different types of flakes. They seem typical of a tool kit expected for hunters-gatherers undergoing numerous logistical forays where a variety of cutting, incising and scraping functions would be necessary on animal parts and wood products, among others, tasks related to both direct food processing and tool making and maintenance. These implements, of course, would complement a number of other artifacts within the tool kit discussed herein.

Edge-modified bifaces

This artifact form is also widespread. Broken bifaces have been recycled as tools suitable for various scraping and cutting functions and to manufacture burin spalls as discussed below. These tools are another representation of a maximum use of flaked stone for predominately utility purposes likely related to food processing and tool manufacture and upkeep.

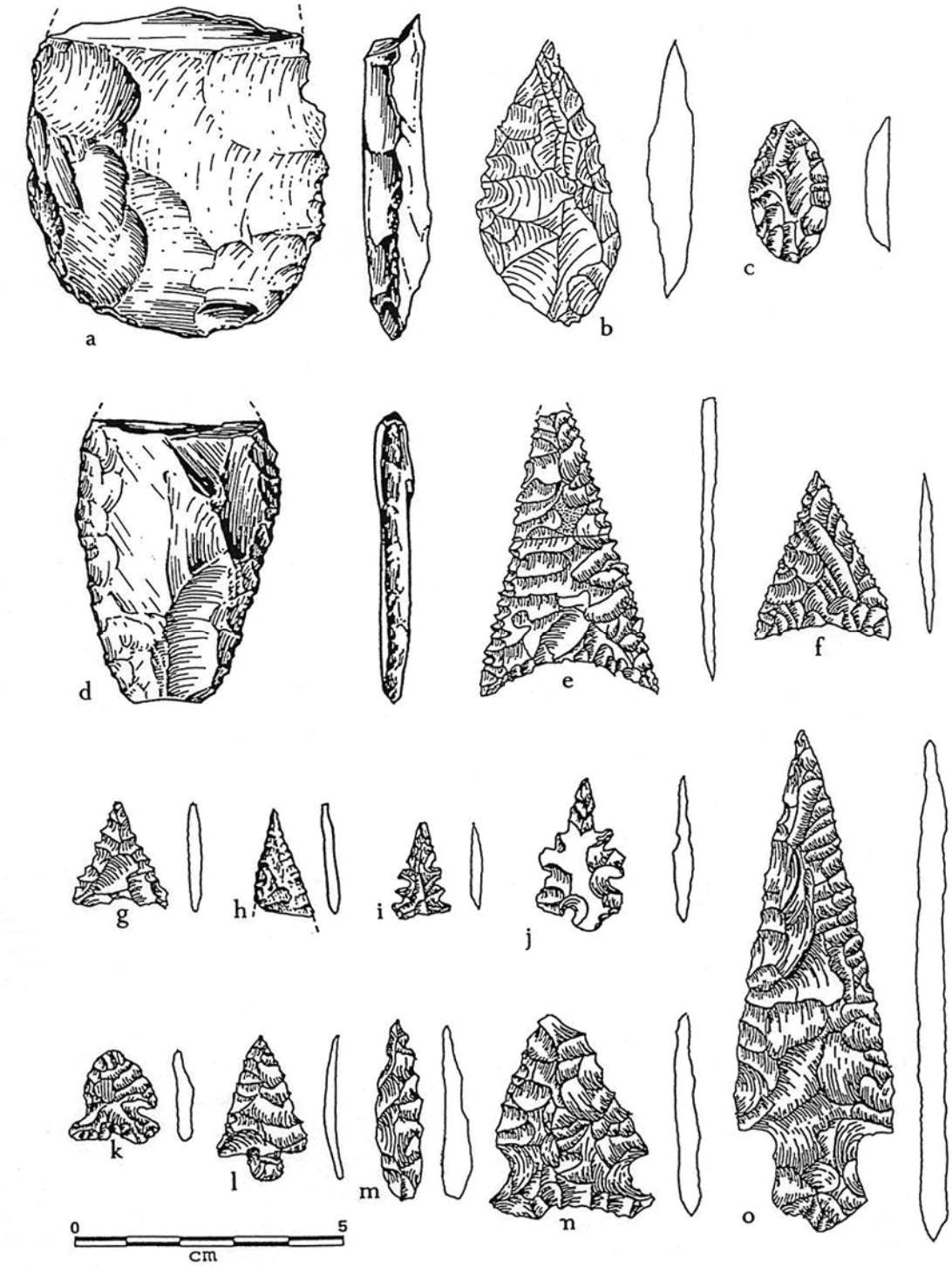

Figure 6. Bifaces, unifaces and projectile points: (a) LM-1-172 siliceous volcanic biface, (b) 495-PJ224 siliceous volcanic biface, (c) 27B 9-10-78 obsidian uniface, (d) LGN-2 obsidian uniface, (e) 495-263 cryptocrystalline silica Guerrero Negro series projectile point (large subtype), (f) 495-PJ303 cryptocrystalline silica Guerrero Negro series projectile point, (g) 495-PJ265 obsidian Guerrero Negro series projectile point, (h) LGN-1-156 green glass projectile point tip, (i)27-495-149 obsidian Comondú series projectile point, (j) 27-59-495 obsidian eccentric point, (k) 27-85 obsidian Guajademí split stem projectile point, (l) 27-11-495 obsidian small tapering stem projectile point, (m) 27-48a, 495-155 cryptocrystalline silica leaf-shaped projectile point, (n) 27-46, 495-169 siliceous volcanic Elko-like projectile point, (o) PJ495-215 cryptocrystalline silica large unnamed narrow expanding base projectile point.

Burin spalls, perforator/gravers and a flaked stone splitting tool

Burin spalls are relatively common at sites in the locality, found at about half those documented (Figure 5k, l). This specialized industry is not known from elsewhere in Baja California. Transverse or oblique longitudinal flake removal from an edge occurs on mostly obsidian flakes, bifaces, unifaces, cores and other flaked stone tools. Burin spalls were removed to form a useable, generally obtuse edge and/or sharp end facet, to rejuvenate a dulled edge, or to form a generally obtuse longitudinal tool in its own right. The wear patterns on many of the burin spalls are consistent with heavy use in working bone and perhaps shell and hard wood. Uncommon artifacts in the tool kits include small flaked stone graver/perforator tools and a wedge-shaped obsidian tool perhaps used in splitting bone and/or wood.

Bifaces

A well-developed biface industry occurred in the locality, with a variety of stone types represented. All sites are characterized by biface manufacture or use. There is a general linear progression in forms from thinner, narrower specimens to thicker, wider examples with no clustering evident except for the thickest, widest specimens (Figure 6a, b). Generally, larger bifaces are not obsidian due to their apparent heavy use and reuse. Artifacts from all three stages of production were used. A staged biface technology was employed for knife-like tools, to produce burin spalls, and to manufacture projectile points of various forms. It is also probable that some of these artifacts were carried to the study area from other locations such as in the interior. Some of the bifaces were likely multifunctional (cutting, piercing, scraping, etc.). Such artifacts were an integral part of the coastal visitors' tool kit, a technology that appears to have transcended temporal/spatial boundaries in the central peninsula.

Projectile points

Projectile points are found throughout the study locality in a variety of types (cf. Ritter and Burcell 1998). Such types appear to represent local types and styles that had diffused into the central peninsula from other areas of Baja and Alta California, the Great Basin and the Southwest. There are four general categories of projectile points present, one of which is more a catch-all grouping of a number of unique or rare types. Most common are the triangular late prehistoric/protohistoric Guerrero Negro series projectile points (Figure 6e-g). These are almost always made of obsidian. One point appears to have been fashioned from a Ming dynasty (ca. 1570s) porcelain sherd (Von der Porten 1999). This point style was first defined by Ritter and Payen (1992) and later refined by Ritter and Burcell (1998). These may have possibly served as harpoon point insets.

Another late prehistoric point type is the Comondú series arrow point, perhaps a complement to the Guerrero Negro series point. These, too, are largely obsidian, although a quartz crystal and a possible green glass specimen were found at study sites (Figure 6h, i).

Elko-like points, almost all non-obsidian, were found throughout the area, but more frequently at sites around Laguna Manuela (Figure 6n). Such occurrences could indicate earlier uses for the northern sites, or their distribution could be affected by previous informal collections by private citizens. These points may date from as early as 5,000-6,000 years ago until ca. A.D. 400. These were probably atlatl dart points, a technology that for a time may have been

contemporaneous with bow and arrow use.

Large unnamed corner-notched points were found occasionally on sites, especially those around Laguna Manuela (Figure 6o). This type of point could have been hafted to a spear or lance or could have been used as a short-handled knife blade. These are manufactured of various fine-grained or siliceous volcanic materials. Rare point types include Guajademí split-stemmed points (likely arrow points) (Figure 6k), a La Paz/Gypsum Cave type and unnamed small stemmed (Figure 6l), leaf-shaped (Figure 6m), eccentric (Figure 6j) and triangular points.

Many points were probably carried to the locality from elsewhere, some perhaps even scavenged. However, there is evidence that at least some points, especially the Guerrero Negro series points, were made locally. Point variability suggests not only technological and utilitarian (e.g., differing prey) demarcation, but also temporal variability (late prehistoric/protohistoric and earlier times) and interaction among groups with stylistic (ethnic/social) variation (cf. Wiessner 1998).

Bone artifacts

Implements of bone were an important component of the assemblage. Most of these infrequently occurring artifacts are bone awls (Figure 5c), probably used in leather and/or basketry work and the like. Also occurring are rare bone pins (Figure 5b) (e.g., hair pins, pitahaya hook component?) and spatulates and bone harpoon tips, one single-sided (Figure 5a) and the other double-sided. A wing bone of a large bird also shows cutting at one end, possibly to form a tubular artifact of unknown use. For unknown reasons, bone artifacts decrease in occurrence as one proceeds north along Laguna Manuela. Possibly less acquisition and processing of sea turtle and sea mammals was occurring by occupants of these sites.

Shell artifacts

Two classes of shell artifacts occur at sites along the lagoons. These include utilitarian items such as *Dosinia* flaked shell implements and *Laevicardium* bowl-like utensils. Also found were a series of shell beads and ornaments, many probably associated with cremations. Included are spire-lopped *Olivella* shell beads (Figure 5d), small cupped/cylinder beads of unknown shell type (Figure 5e), and mother-of-pearl circular ornaments (Figure 5h), one finely incised with a grid-like design. The small disk beads are similar to types found in the Southwest, although a connection is not proven. The presence of ornamental shell suggests that the locality was the scene of visitation by groups bringing with them more than basic subsistence necessities. The harpoons are consistent with ethnographic accounts (cf. Bennyhoff 1950) and correlate well with the maritime economy so evident in faunal remains.

Rock origins

A revealing aspect of archaeological discoveries in the locality is the determination of rock types and sources, especially obsidian. Most obsidian is from the Valle del Azufre source some 145 km away. Additionally, there are minor amounts of obsidian from two unknown sources. Rocks of unknown function were found at a few locality sites. These include pieces of magnetite and hematite. Dr. Gordon Gastil, a geologist at San Diego State University, found samples of granitic rock that originate mostly in the eastern portion of the peninsula, a suggestion

of considerable transport distance.

Historic artifacts

Five sites close to the northeast end of Laguna Guerrero Negro contain historic-era artifacts, LGN-1 or El Arpon in particular. The collection of Mission Series sherds of the Tizón Brown Ware, Santo Tomás type from LGN-1, where they are most abundant, suggests at least 40 vessels were present, mostly of utilitarian bowl and less often olla forms (Figure 5i). Also found at two sites were Chinese porcelain sherds of an underglaze blue-on-white series of wares (one group also has overglaze enamel decoration) from the early years of the Wan-li emperor probably dating to the 1570s. These sherds from shipwreck debris were sometimes utilized for tool making, including small scraper-like tools and a Guerrero Negro series projectile point.

At least 10 types of glass beads (about 200 total) were found at three sites, with the most abundant being turquoise, dark blue and the red-and-green *Cornaline d'Aleppo* types (Figure 5f). Copper-based artifacts of unknown source include thin (~< 1.5 mm thick) and thick (~ 2-3 mm thick) scrap and rolled sheets, and copper-based wire fashioned into links and connected as in a chain. A single perforated copper-based "current reign" coin with lettering and image representing Joseph II of Austria dates to the late 1700s. Also found were various decomposing pieces of wrought iron at two sites, several of which might be spikes and some clearly platy in appearance. Finally, a handful of green bottle glass flakes were found, along with small green glass arrow points and two small glass edge-modified flakes. Other historic artifacts possibly relating to Indian use include a hardwood peg from site LGN-10 and redwood fragments. The outer shores of the lagoons include at least four redwood canoes, at least one of Tolowa design from northern Alta California (Moriarty and Moriarty 1980). These likely drifted down coast with the California Current.

Interpretations and Conclusions

A number of interpretive and explanatory issues regarding human uses and lifeways at the Three Sisters' Lagoons have been and continue to be addressed and revisited. These are briefly summarized here, based on previous reports (Ritter 1999, 2002; Ritter and Burcell 1998; Ritter and Payen 1992) and ongoing research.

Environmental shortcomings and paleo-landscape

One of the major data gaps continues to be the absence of detailed paleoenvironmental and local biotic and floristic studies. Dating suggests the presence of an ancestral shoreline on the order of ca. 500-2,000 years ago. This food-rich shoreline location was offset by apparent fresh water impoverishment. Certain areas of shoreline may have been abandoned before the Spanish *entrada* due to a prograding shoreline and dune field encroachment, especially in areas along Laguna Manuela.

Chronology

Radiocarbon dates, obsidian hydration readings, projectile point styles, and historic artifacts suggest that most lagoon use was relatively late in time. Less evident from obsidian

hydration and projectile point styles is the suggestion of an earlier period. The historic artifacts also are indicative of a protohistoric or contact period. The principal period is defined as a Guerrero Negro focus of the Comondú period (ca. A.D. 500-mission period) with a protohistoric aspect as mission-influenced Indians journeyed to specific locations along the western peninsular shore. Habitation earlier than currently found around the lagoons is evident in the nearby highlands (cf. Hyland 1997).

Technology

The lagoon site technologies are characteristic of very mobile populations and possibly long-range interactions, extending at least to the central cordillera if not beyond. Flaked stone technologies include the Guerrero Negro series projectile points, the burin spall industry and a diverse and efficient obsidian reduction know-how; the extensive use of tools and their rejuvenation are a function of acquiring primarily marine foods and processing such remains. A level of residency where many tasks were performed is implied by the tool kits. The quality stone, bone and shell tool kit implies multiple tasks, heavy utilization of tools, scavenging and reuse, caching, and implement diversity associated with a rich, varied set of resources.

The nonperishable nature of the tool kit is relatively even in its distribution, but there are some variations from south to north. Artifacts that dominate are presumed to have been used for cutting, scraping, piercing, pounding, abrading, grinding, smashing, cooking, transporting, etc.; tools range from delicate to heavy-duty, including those focused on maritime prey.

Not all technology was focused on subsistence-related tasks. There are ornaments of shell, glass and metal and specialized items such as *chacuacos* and curiosities like magnetite, along with items suggesting adornment, ritual and perhaps play. Such items as bone awls, harpoon and projectile tips, beads to be strung, etc. imply perishables.

Site variability and behavior implications

Ritter and Payen (1992:263) found that archaeological remains around the Three Sisters' Lagoons represent human activities that were as a whole neither greatly limited nor accidental. Instead, there is found evidence of a specialized maritime-oriented adaptation on a seasonal basis, one different from the contemporary inland terrestrial plant- and animal-based economy that probably characterized much of the year. There is a subsequent difference by locality (inland versus coastal) in group organization, technology, camp structure, subsistence, water management, artistic expressions, use of the landscape, etc. Maritime food acquisition skills by late prehistoric times were well developed, providing economic benefits from a wide range of shore and near-shore habitats, including littoral, bay, estuarine, terrestrial lowlands and coastal dunes.

In a broad-brush view, sites are quite similar along the ribbon of refuse. However, there are variations, both in intensity of use and assemblages, especially as one moves from south to north. Residential patches around Laguna Guerrero Negro are most complex and dense. Toward Laguna Manuela, obsidian density drops dramatically; there are few if any artifacts such as Guerrero Negro series projectile points, burin spalls, and obsidian bipolar cores. Larger projectile points are more common to the north, and evidence of turtle and sea mammal hunting is far less. Shellfish density and type also change. No historic-era artifacts are found either around Laguna Manuela or, as yet, around Laguna Ojo de Liebre. This latter lagoon also appears to have a well-

developed obsidian technology and acquisition association (see Ritter and Payen 1992).

Camp arrangements

Density of cultural materials along the shore in a string of patches suggests relatively long-term, overlapping use by visiting groups over hundreds of years. Archaeological sites may reflect the Seri pattern of coastal use across the Gulf of California (cf. Felger and Moser 1985:3) where fresh water may have limited visits to small, mobile social groups utilizing temporary camps of several or more extended families. Aschmann (1959:123) notes that information from Father Fernando Consag of the San Ignacio mission indicates "an interior group visiting the seacoast to exploit its resources would … act as a social unit". Interestingly, the denser concentrations are not only near the present shore of Laguna Guerrero Negro but also close to an area where potable water is relatively close to the surface. Seasonal concentrations of water may have also occurred in shallow arroyos just east of Laguna Manuela. It is probable, based on sources of introduced stone such as obsidian and granite, that groups from variable locations to the east used these coastal stretches.

Influences on culture change and cultural responses

Why use of this coastal stretch flourished over the last several thousand years or so is an important question for archaeologists in their study of culture change and process. Various factors analyzed include population expansion, climatic influences (see Jones et al. 1999 and Sankey et al. 2001 for discussions of late Holocene climatic changes), technological breakthroughs (e.g., bow and arrow and harpoon type introductions, watercraft development, and even use of canoes from the north that drifted into the area), or even group movements and interactions, as with a developing, specialized culture on Cedros Island. Numerous scholars have noted how population increases influence societal change (cf. Bernbeck 1991; Binford 2001:385-386; Pálsson 1988:203; Price and Brown 1985:10). Binford (2001:386) has developed a generalization possibly applicable to the central peninsula, where "among groups dependent upon terrestrial plants, packing drives the buildup of intensification pressures. The only available responses are to increase the net returns per unit area from plant resources and to expand niche breadth by increasingly exploiting aquatic resources, wherever possible." Another response may be an increase in ritual and ceremony, overseen by a religious formulator. One result may have been the elaborate central highlands rock art. Of course, occasional coastal use over the length of human occupation is likely, and east coast uses near the same latitude are known to extend back many thousands of years (cf. Bendimez et al. 1993).

Increased uses of the western lagoons imply decision-making in access, acquisition, processing, transportation, storage and caching. Some of this decision-making is evident in the specialized tool kits found at lagoon sites and in the virtual band of residential/use debris along the coast.

Diet, subsistence and hierarchical considerations

Food values and effects on settlement and mobility were briefly explored in previous regional studies cited above. Evidence in food refuse and artifacts suggests marine foods were extensively exploited and likely more abundant than today, with historic-period overexploitation

and lagoon infilling. Productivity during prehistoric use was probably always high, with a diverse set of foods used ranging from mollusks, fish and crustaceans to sea mammals and sea turtles. Terrestrial foods and waterfowl were also consumed. There is minimal use of whales apparent, probably representing beached juveniles.

Cooperative and individual labor was seemingly employed, and surpluses were likely developed for transportation to the interior, such as in dried or powdered form. If surpluses were present, there may have been certain society inequalities and limited ranking (cf. Binford 2001: 467; Wiessner 2002:234). Possibly there was more prestige and importance to water stewards, religious formulators, specialists or craftsman, hunt leaders, balsa/raft/canoe tenders, elders, etc. (note also burial technique and disproportionate goods' variations). There may have been an economic scaling of sorts among groups visiting the lagoons. Clearly, some groups were in the obsidian loop from interior sites and some were not, and those more involved in the obsidian loop (with tool-making advantages) were from resource-richer interior areas than those further north apparently visiting Laguna Manuela, an ecosystem that may have been less productive than Laguna Guerrero Negro and Laguna Ojo de Liebre (see accounts by Scammon 1970).

Concluding Remarks

All has not been answered, and research continues in the lagoon locality. There appear to have been short term and probably at times regularized visits by Indian groups to the western lagoons for up to two millennia, with early sporadic use by hunters. These family and small group-based forays were by mobile social units probably converging on the coastal lagoons from many routes and locales in the interior. By mission times, groups were clearly under mission influence but still foraying to Laguna Guerrero Negro. The fate of the Cochimí Indians is well known (cf. Aschmann 1959), and the cessation of lagoon visits by the early 1800s was a matter of culture extirpation. The timing of visits to the coast probably varied as plentiful resources were present year-round, century after century, mediated to some extent by the absence of potable water locally.

The archaeology of these lagoons is extraordinary in its richness and diversity. The landscape is dynamic, and there is still much to learn about peoples' use of this varied ecosystem. At the same time, archaeological sites along the coast are vulnerable to destruction from many avenues. It is recommended that developments in the area should be monitored and areas closed to off-road vehicle use. It may be prudent to expand the Vizcaíno Biosphere Preserve to include areas of Laguna Guerrero Negro and Laguna Manuela beyond locations of current development and to oversee these added areas at the same level as the current Biosphere or within the parameters of recommendations offered by Castellanos et al. (2002). Finally, research within both coastal and interior areas must continue so that the fuller picture of the cultural systems and interactions of these past mobile hunter-foragers can be illuminated.

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