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Tule Reeds and Stone: Localized, Non-Specialized Technology in Laguna Canyon, Santa Cruz Island

A thesis submitted in partial satisfaction of the
requirements for the degree of Master of Arts in
Anthropology

by

Scott David Sunell

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ABSTRACT OF THE THESIS

Tule Reeds and Stone: Localized, Non-Specialized Technology in Laguna Canyon, Santa Cruz Island

by

Scott David Sunell

Master of Arts in Anthropology
University of California, Los Angeles, 2013
Professor Jeanne E. Arnold, Chair

This project aims to understand the ways in which the Island Chumash who were not participating in specialized bead-making activities invested their labor. Considerable research on the Northern Channel Islands focuses on the nature and distribution of specialist labor spent on beads, drills, and sewn-plank canoes. The history of small-scale production based on the resources in individual canyons on the islands has received less attention. I categorize two new types of heavy igneous tools that may have played a significant role in the occupation of Laguna Canyon on the south side of Santa Cruz Island. I did not identify any significant evidence for bead manufacture. Instead I recovered artifacts suggesting long-term, informal use of local igneous material. This research demonstrates a significantly different history of resource exploitation and production in Laguna than elsewhere on the south side of Santa Cruz Island. In addition to this work, I also provide a basic pattern of settlement and an outline for future work to improve our understanding of occupation during a critical period of the island’s past.

The thesis of Scott David Sunell is approved.

Charles S. Stanish

Gregson Schachner

Jeanne E. Arnold, Committee Chair

University of California, Los Angeles

2013

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Introduction

This project focuses on the economic activities of the Island Chumash in Laguna Canyon on Santa Cruz Island, likely the largest previously uninvestigated drainage on any of the northern Channel Islands. My work encompassed systematic survey of the canyon, site recording, mapping, augering, and a small test excavation at one site near the coast. This canyon is of interest in the present day due to a marshy lagoon area at its mouth. Had it been present in the past, it may have prompted local residents to invest in the production of lithic tools for reed processing. Tule reeds were used in the construction of houses and reed balsas and rafts, essential for everyday life in the region, but archaeologists have not identified clear evidence of tule harvesting or processing in the Chumash territories. Because of these factors, Laguna Canyon has the characteristics that would make it a suitable location to investigate the question of boat construction. Of particular interest in this regard are robust stone tools and possibly large Pismo clam tools (Hudson and Blackburn 1984).

The Chumash occupied the Santa Barbara Channel region (see Figure 1; all Figures and Tables can be found in the Appendix, the Figures preceding the Tables) for millennia and utilized its natural abundance to support large populations living in settled villages, with a complex political and economic hierarchy in place by the 14th century. Santa Cruz Island, along with the rest of the region, was the center of intensive craft specializations that led to spectacular developments in material culture by the time of European contact (Arnold 1992). While much attention has been focused on craft specialization and the production of microdrills and shell beads, scholars have not investigated economically important but likely non-specialist production assemblages, including lithic assemblages featuring coarse-grained, large lithic tools.

It is likely that both islanders and mainlanders were making tule reed boats (Arnold 1995), but tule-processing has not been identified on either side of the channel.

Canyons on the south side of Santa Cruz have a wide array of different geological and geographical configurations, water supplies, and occupational histories. Each drainage on the island reveals the distinctive investments of the Chumash in the landscape, and each has a unique history of resource access (Arnold 2001; Timbrook et al. 1982). In future work, I hope to tie the occupational history of multiple drainages together, but for present purposes I focus on the vast and unsurveyed Laguna Canyon, with a goal of understanding the local resource focus of those living in Laguna.

The most well documented island craft specialization industries, lithic microdrills and shell beads, were organized based on the location of the resources required for their production. While not part of an industry in the same sense, building boats required both labor investment and time because they were necessary for daily life. Tule reed (*Scirpus acutus*) is present at only a small number of marshy locations on Santa Cruz Island, and one of its many uses is in boat construction. Despite the necessity of watercraft for Chumash life and the presence of the necessary resources on the island, archaeologists have not yet identified the locations where people made reed boats on Santa Cruz. Finding evidence for the production of reed boats, also called balsas, on the islands is difficult for a number of reasons, mainly the poor preservation of the component materials of boats. Our picture of Island Chumash culture is skewed without such data because watercraft were an essential tool for a host of daily activities. Understanding the choices they made in allocating time and energy to exploit specific economically important local resources such as reeds and lithic cobbles will provide insight into the way they lived.

Hypothesis

Although researchers have identified marshes and asphaltum deposits on the mainland that provided an ample supply of reeds and waterproofing material there, they have not identified reed harvesting or boat-making localities on Santa Cruz (Arnold 2001; Salwen 2011). I propose that the exploitation of reed resources on Santa Cruz Island took place on a larger scale in Laguna Canyon than elsewhere on the island, based on the ethnographic record of marsh exploitation and the similarities between Laguna and the mainland coast marshes (Hudson and Blackburn 1984; Hudson et al. 1978). My survey and testing of sites in Laguna seeks evidence of the canyon settlement pattern and localities for the production of tools that might have been used in gathering tules and making reed rafts or balsas, and that, based on the high availability and low quality of the raw lithic material, would have been informally produced in the canyon (Andrefsky 1994: 30). In subsequent work, I plan to compare the findings from this project in Laguna to other south-side drainages that have been extensively investigated: Coches Prietos and Posa Creek.

Previous Research

The history of research in Laguna Canyon itself is quite limited. Ronald Olson, from the Anthropology Department at UC Berkeley, reported a few sites informally 60 to 80 years ago, but little to no work was conducted there apart from basic reconnaissance (Glassow 1977:126-130). In 1976, a businessman hunting in Laguna Canon discovered a wooden paddle, most likely used in food preparation, at a rock shelter site recorded as SCRI-387 (Timbrook 1980). Later museum work at that site, however, did not include excavation. The lack of interest in the canyon is most likely due to the fact that there is no large coastal midden in Laguna. Because most work on the island has focused on such middens, past researchers' explanation for small inland sites on the island was that such locations represented mostly seasonal camps intended to exploit terrestrial resources such as pine nuts (Peterson 1994).

Though this paper focuses on the identification of reed exploitation and boat production, the identification of bead making in Laguna Canyon has the potential to significantly impact interpretations of both systems of production and the nature of settlements there due to the interrelated nature of labor investment in a variety of island industries. Small sites in other drainages have distinctly different occupational histories, revealing important distinctions between Laguna and other drainages on Santa Cruz Island. Evidence for this industry is prevalent across the southwestern quarter of Santa Cruz Island at both large and small sites, and relating the material evidence in Laguna to other drainages provides a clearer picture of how those living in Laguna allocated their labor in a variety of systems of production.

Landscape of the Canyon

Understanding the economic activities in Laguna, including possible specialization, requires an understanding of both the landscape and the way the Chumash allocated their labor. Many researchers have focused on human-environment dynamics in the Santa Barbara Channel region, providing a wealth of data concerning human relationships with and impacts on the environment dating as early as the end of the Pleistocene (Braje et al. 2007; Erlandson et al. 2011; Rick et al. 2005). Likewise, significant work concerning the methods of production and systems of labor investment in the shell bead industry of Santa Cruz has yielded a deep understanding of the nature of craft specialization in the region (Arnold 2001; Arnold & Graesch 2001; Arnold & Munns 1994; Perry and Jazwa 2010). The settlement pattern in Laguna is contextualized within the landscape specific to southern Santa Cruz Island. The topography and vegetation of the area present significant difficulties and opportunities. Two types of landscape define the canyon today (see Figure 3). On the one hand, there is the verdant canyon bottom, thick with mulefat, willows, toyon, lemonade berry, and, at its mouth, salt grass and Scirpus reeds. This area is generally flat, but is difficult to traverse because of the vegetation. On the other hand, there is the rugged slope of the drainage basin, covered with sparse grasses, various species of oak, island manzanita and buckwheat, and little else. This terrain is steep and heavily eroded, a factor that contributes to the friable nature of the tufa and conglomerate bedrock composing most of the canyon (part of the Sierra Blanca formation). As is the case throughout the region, midden deposits are marked by dark anthrosols and the presence of significant shellfish remains. Although midden density in Laguna is only moderate, the species are consistent with middens found elsewhere on the island, and they represent food remains exploited by those living in the canyon (Arnold 2001; Braje et al. 2007; Peterson 1994).

With two definite exceptions (and a possible third), ancient sites are found on the margin between these two zones. The majority of sites in Laguna are on the flat ends of ridges, suitable for long-term occupation but raised above the thick canyon-bottom vegetation. These locations provide access to plant communities in both areas, though proximity to any specific type of useful vegetation was most likely not a particularly important determining factor for settlement in itself (Peterson 1994: 216). Chumash land management practices, which commonly included burning and selective maintenance of certain useful plant species, influenced broader landscape formation processes throughout the Santa Barbara Channel region (Timbrook et al. 1982). Though it is known that the Chumash altered their landscapes in the past, the degree to which such processes took place in and affected the landscape of Laguna specifically is unclear. Regardless of the prehistoric land management regime, its fingerprint on the landscape has been significantly impacted by the ranch stock, both sheep and cattle, that roamed Santa Cruz Island until the 1990s.

Posa Creek Canyon to the west has not been fully investigated, but the Coches Prietos drainage 8.3 km east has (Peterson 1994). Peterson's description of that canyon suggests a landscape that is broadly similar to Laguna's:

> In general, the terrain is quite rugged, mainly made up of projecting ridges separated by steep sided canyons. …grassland covers the largest percentage of the drainage system. The exceptions are the relatively extensive riparian zones along the major streams and oak woodlands on some north-facing slopes (Peterson 1994: 218).

Sites there also seem to be similar to those of Laguna in other ways. Many of the sites are quite small, and according to Peterson they represent temporary occupation by small groups, perhaps single families. He identified 22 sites in Coches during his project in 1994 (Peterson 1994: 215). His survey methods are ultimately based on Mike Glassow's pioneering work in the 1960s and 1970s, which provided a basic system of methods for survey work and a definition for site identification on the Northern Channel Islands (Glassow 1977). While essential as a source for understanding small sites, Peterson's results have a few weaknesses as comparisons to this work in Laguna. His work focused on a smaller overall area without a clearly-defined survey intensity, which makes direct comparison between the number of sites in both drainages difficult. The sites he did recognize have “moderate to dense middens” and evidence of bead manufacture (Peterson 1994: 219-220). This study suggests that the patterns of settlement and inland occupation were broadly similar with regard to long-term, small-scale occupation within different canyons on the south side of the island. In both places, as elsewhere on the island, natural rock shelters were extensively utilized for a range of functions, and there is some, albeit quite limited, evidence for local engagement with the island–wide bead industry, which may suggest seasonal or part-time bead production in the canyons and a distribution of labor worthy of further attention.

Erosion in Laguna

While it could be argued that the observed settlement patterns are an artifact of the process of erosion that has taken place in the past two centuries, it is unlikely that they are entirely the product of taphonomy. For example, fluvial events can have significant effects on the settlement patterns throughout the islands; a well-recorded example of this is a case of site destruction described by Erlandson on San Miguel Island, the result of successive El Niño-Southern Oscillation (ENSO) events (Rick et al. 2006: 573-574). While such events have undoubtedly shaped the observed settlement pattern in Laguna to some degree, a number of factors suggest that they are not entirely responsible. Evidence for erosion in Laguna comes from a variety of sources, including the cut banks along the stream channel and the gullies cut into the canyon sides. Most importantly when considering the archaeological record, many of the sites themselves are being undercut by water runoff, which has significantly damaged some sites (such as LC-9, which is almost an entirely superficial deposit).

In order to test whether the pattern of archaeological sites in Laguna is primarily the result of taphonomic processes rather than human planning, I performed subsurface testing of a large open area in the mid-canyon, seemingly ideal for a village site, that shared many physical characteristics with the locations of recognized sites. The purpose of this testing was to identify whether overburden had covered site deposits, whether any deposits may have been superficially eroded but survived below the surface, and whether those deposits, if they existed, could be identified via subsurface testing. The complete destruction of sites also likely occurred, but evidence for such destruction would not be tested with this method. At this location, marked by the circle in Figure 2, I placed 10 augers in two transects, one north-south and another east-west. These augers yielded sterile (non-archaeological) geological materials until rocks blocked further sampling. In each case, clear size sorting could be seen in the rough stratigraphy provided by the auger. The upper levels were generally free of rocks, then below about 50 cm medium cobbles began to appear, and between 70 cm and 100 cm most of the augers stopped due to large cobbles. The deepest auger, 190 cm, and the shallowest auger, 50 cm, had the same pattern of rock size, though the specific depths at which these changes in soil composition occurred were obviously different.

The size sorting suggests at least one flood event in the past that affected significant portions of the canyon. A cut bank, extending through the majority of the canyon bottom in the central drainage, reveals stratigraphic levels of successive floods with similar size sorting. This bank exposes a view of the canyon’s past that would otherwise be impossible to fully investigate, though this flood events that it uncovered may have been recent events. My auger probing was limited to one small area within the canyon, and the full extent of such events in Laguna is impossible to know. Settlement choices were based on more than a simple topographical assessment of the landscape.

Craft Production on Santa Cruz Island

During the early 20th century, archaeologists focused their efforts on large sites with human remains. As a result of this, work on the Channel Islands retained a distinctly antiquarian bent during the early 20th century (Arnold 2001:21-22). Ronald Olson, D.B. Rogers, Philip Jones, and Phil Orr, backed by the University of California at Berkeley and a number of natural history museums, all focused their efforts on cemeteries (Glassow 1977). The early work on the islands gave way to more scientific approaches in the 1960s and beyond, when archaeologists based in regional universities began working on both sides of the channel. Researchers at UC Santa Barbara were at the forefront of this shift, developing and implementing new methods for archaeological research in the region (Glassow 1977).

When Spanish explorers first arrived in the Santa Barbara Channel, the Chumash were engaged in a number of highly developed craft industries on the northern Channel Islands. In particular, the Chumash focused their labor on the production of three important goods. The first was the production of Olivella shell beads, made in massive quantities on the northern Channel Islands and used extensively as currency in the local economy. The second was the manufacture of chert microdrills on eastern Santa Cruz Island, used to produce the beads. The third was the *tomol*, sewn-plank, ocean-going canoes designed to transport heavy loads across the deep waters of the channel (Arnold 2001:15-16; 2007). The development of these specializations occurred during the late first millennium AD and accelerated in the early centuries of the second millennium, especially during the Transitional period from AD 1150-1300 (Arnold 2001:23). Nearly five centuries after their earliest development, these quintessentially Chumash practices were still central to the political economy of the Channel Islands. They were driven by contexts and conditions – patchily situated resources, settled populations, and the capacity to trade – and were facilitated by the tomol in the pursuit of marine resources, the expansion of political complexity, and an explosion of economic activity on both sides of the channel.

The beginnings of this system coincided with a period of climatic disturbances including several extended droughts in the region. Significant scholarship focused on this topic has recognized the impacts of sustained drought as among the important factors in the sweeping social changes at the same time (Arnold 2001; Graesch 2004; Peterson 1994). While the environment does not cause human actions, these dramatic developments suggest a complex relationship between the physical and cultural worlds in which the Chumash lived. Whatever the relationship between large-scale changes in the channel region and local resource exploitation on Santa Cruz Island, the production of microdrills, shell beads, and the tomol were integral pieces of Chumash life.

Beads and Drills

The rise of intensive bead production and the increase in the variety of bead types associated with the Transitional period is especially important on Santa Cruz, because it and neighboring Santa Rosa effectively served as the mint for the entire Chumash world (Arnold 2001:74-77). The Chumash focused a great deal of energy and activity on the shell bead industry. The craftspeople on the islands drilled millions of beads over several centuries, resulting in spectacular archaeological deposits containing “thousands of *Olivella* [*biplicata*] bead blanks, bips [beads-in-production], and beads per cubic meter” (Arnold 2011:5). Work at six of ten known historic village sites on the western 70% of SCRI reveals that shell bead manufacture routinely took place at this intensive scale.

The foundations of the bead industry have been described in detail elsewhere, and the basics of bead production are well known. Beads also provide relative dates based on the archaeologically recognized bead typologies (Arnold and Graesch 2001; Arnold and Munns 1994; Graesch 2004; King 1990). After the shells were harvested and blanks were prepared, laborers involved in this industry produced a variety of wall beads, callus beads, and others, each made from different parts of the Olivella shell. Each step in the process required great training and significant investment of time, both in learning the skills and in producing the beads.

The manufacture of microdrills is similarly intensive and coastally oriented at three primary villages (Arnold 1987; Arnold et al. 2001; Perry 2004). This is not surprising since the lithic industry was closely connected to bead production and reliant on a group of quarries on eastern Santa Cruz. In order to make the lengths of beads (with fixed economic value), the Chumash produced microdrills from local chert deposits, a task for which the island chert is well suited (Nigra and Arnold 2013; Perry and Jazwa 2010: 180).

Lithic production may have been confined to eastern Santa Cruz, but bead production was widely distributed on the island, occurring at nearly every major coastal village with access to sandy beaches [Olivella live in the sandy intertidal zone]. Few studies have focused on inland sites. One such project, Robert Peterson’s survey of the Coches Prietos drainage on the south side of the island, hints at how small inland sites articulated with larger coastal settlements. He found remnants of small-scale craft production, suggesting that these settlements played a role within the larger Chumash bead-making economy (Peterson 1994: 219-220). Evidence of such widely distributed craft production makes clear that this type of activity was important in Chumash society and daily life, but much of the growing importance of these activities was also tied to an important invention: the tomol.

Watercraft

Much like the spread of bead currency, the tomol had far-reaching impacts on the Chumash world. At the time of European contact, an established guild of craftspeople called the Brotherhood of the Tomol was responsible for constructing the canoes and for maintaining the knowledge of their production. Building a tomol required a significant amount of redwood, collected off of the beaches as driftwood from northern California, which was then hewn into planks and sewn together to form the hull of the canoe (Hudson and Blackburn 1984: 350-365). Such watercraft, with a capacity nearing 2000 kilograms, provided a reliable method of crossing the channel from the northern Channel Islands to the mainland coast and transporting great quantities of goods with relative ease. Due to the investment of labor and materials required to produce the tomol, owning one was a sign of prestige requiring significant personal and community investment. The tomol was invented fairly late in the Chumash sequence, however, and other watercraft were central to the lives of Middle period Chumash.

Before the tomol, and for most people even after its invention, near-shore fishing activities and even channel crossings were accomplished in rafts or balsas, bundled reed watercraft made from tules and smeared with asphaltum as caulking (Hudson and Blackburn

1984: 350-365). These balsas were vital to successfully exploit near-shore marine habitats and to maintain local social networks. Though shellfish and a limited range of fish could be accessed directly from the shore, catching a broader range of fish species required seaworthy boats. So too did crossing the channel with small loads of goods. The construction and maintenance of tule balsas was an important concern for the Chumash. While unskilled workers could produce such watercraft, as opposed to the specialized knowledge required to construct the complex tomols, they still required time and labor to build.

Balsas required a few basic materials: regular access to an abundant source of reeds and willow poles; lithic or clam tools for harvesting the reeds and for cutting the reeds into lengths; average grade asphaltum; and asphaltum applicators. There were two variants of the reed boat, a three- and a five-bundle version (Hudson and Blackburn 1984: 331-337). First, boat builders harvested reeds from marshes, which were allowed to dry in the sun for a few days (Hudson et al. 1978: 28). In order to cut the reeds, they used heavy chopping tools made from dense igneous material or from shells such as *Tivela stultorum*, commonly called Pismo clam. Once dry, they bundled the reeds together. In both types of reed boats, a large bundle formed the keel and most of the hull, while the gunwales were made from two smaller bundles lashed together at the bow and stern. The smaller bundles were reinforced with willow poles to give them additional stiffness (Hudson et al. 1978: 28-29). In the five-bundle balsa, two additional bundles were added to the sides, raising the height of the gunwales further. Once the basic form of the boat was finished, the builders coated the outside with asphaltum, using bone or wood caulking tools to ensure complete coverage. These balsas required little maintenance to stay seaworthy when constructed and stored properly. An important aspect of that maintenance was keeping the balsas on beaches and out of the water when not in use, in order to prevent rot (Hudson et al. 1978: 30).

Along with a few other steps in the process of building reed boats, such as manufacturing tools to cut the reeds, people living in Laguna had most of the materials required to make boats locally. Unlike the reeds, however, they needed to import high-grade asphaltum. While there is no reliable source of asphaltum currently recognized on Santa Cruz, the material was commonly transported across the channel in cakes or chunks by means of trade, due to its utility as a waterproofing and binding agent required for the production of watertight water bottles, the hafting of chert drill bits, and general artifact repair (Arnold and Bernard 2005; Hudson and Blackburn 1987; Salwen 2011).

Specialized craftspeople labored in the island bead industry, whereas balsas could be built without specialist skills. The types of labor involved differed in a fundamental way: bead making required an investment in training and time that boat production did not. The assemblage of tools in Laguna does not have known equivalents in nearby canyons, although large coarse-grained tools do occur with limited frequency in later Middle-period sites SCRI-474 and -191 (Arnold et al. 2001). So far, the Laguna assemblage does not exhibit any of the hallmarks of specialists, such as morphological standardization, high volume of production, or production for export. The availability and low cost of the material inputs required for balsa construction in Laguna Canyon may have provided an incentive for those living there to focus more of their energy on producing boats than those living in nearby areas of Santa Cruz, but a real specialized craft may or may not have emerged.

Methods

My field project, conducted during the summer of 2012, followed by excavation of a test unit in 2013, extended from the mouth of the canyon to its upper reaches. This work included pedestrian survey in transects spaced 5 m apart, and investigation of an area approximately 200 m wide at its maximum width over a total length of 3.5 km, based on the models established by previous researchers (Glassow 1977; for example). As well as examining the canyon bottom, I explored all accessible rock shelters. I used soil discoloration and artifact presence as the most reliable indicators of sites, recording the size and nature of all such phenomena by exposing soil (even when covered by vegetation) every two to three meters during the survey, which has been shown in previous research to be a reliable indicator of site locations (Glassow 1977). When a site had been recognized, I then assessed its size, shape, and location on the landscape, using the same technique to reveal small portions of the surface in order to create a sketch map of its extent. After recording these data, I used a bucket auger to test the contents of the site and determine site depth and density. This process included taking samples in 10 cm levels to sterile soil. I arranged the augers in transects based on the maximum dimensions of each site, in order to achieve a representative sample of the sites at their fullest extent. At larger sites, each tested location was 10 m apart; at smaller sites this interval was as close as 5 m to improve sampling resolution. I placed two transects perpendicular to one another at each site locus of sufficient size, one running north-south and the other running east-west, generally crossing as near to the observed center of the site as possible.

My 2013 fieldwork centered on a single 1m x 1m unit in the wall of the apparent house depression at LC-3. I needed an expanded sample to better assess the canyon’s most intensively occupied site, to get a larger sample of tools, to see site stratigraphy, and to pull C-14 samples. After subsurface testing, I floated the samples and sorted all recovered material in the UCLA Channel Islands Laboratory. This process is focused on identifying food sources exploited by those living in Laguna Canyon, recovering diagnostic artifacts related to bead and boat production, and providing a general characterization of the size and occupation of sites throughout the canyon. At present I have sorted some material from LC-10, LC-1, LC-2, LC-3, LC-7, and LC-6, and can characterize their occupational history at a broad level.

Project Results

I identified and tested 10 sites throughout the canyon. Among these ten sites, six are concentrated within 0.75 km of the beach, and the remaining four are 1.2 km farther inland (see Figure 2). Overall, there is minimal bead-making detritus, especially when compared with the large amounts of bead detritus in neighboring canyons. Instead, local igneous lithic flakes and shatter are present throughout site deposits in Laguna (most notably at LC-3), part of the volcanic Blanca formation limited to a narrow zone on the south side of the island. This constitutes simple, clear evidence for informal local tool production based on widely available, low-quality cobbles within the Laguna drainage.

The overall assemblage recovered from sites in Laguna indicates a dietary emphasis on shellfish species found in rocky intertidal zones and a surprisingly small amount of fish. The bulk of the archaeological shell material from the sites is *Mytilus californianus*, though limpets, barnacles, crab, chitons, and sea urchin are present as well. There are also hints of bead production at some sites in the form of chert microdrills, as well as scattered Olivella bead manufacturing refuse (detritus). The relative amounts of each material type from LC-3 and LC-7 are illustrated in Tables 2 and 3.

Lower Canyon

Two of the sites from the lower canyon, LC-3 and LC-7, are significantly larger than the rest and represent the best-preserved archaeological contexts in the canyon. A third, LC-6, is also reasonably large but the cultural deposit there has a maximum depth of 40 cm. I have sorted a significant amount of material from each of these three sites, but much less from the remainder in the lower canyon, which are badly eroded and less than 30 m^2 each in area (see Table 1 for number of augers and maximum depth at each site).

LC-3

LC-3 is situated directly above the beach, close to the marshy mouth of the stream in which a significant stand of reeds grows today (Figure 5). It is the only site in the canyon with a discernible house depression. This site is ideally placed in the canyon for both boat-construction and bead-making, equidistant from the present-day marsh and the beach (marsh location noted on Figure 2). Though it is not necessarily possible to project minor features of the current terrain of the canyon far back in time, geologists suggest that the mouth of this canyon has long been marshy. This favorable location would have given those living at the site access to both shell and reed resources in less than five minutes' walk. No other large site is as close to the marsh as LC-3. At this site, I placed a single 1m x 1m excavation unit and six augers in two transects: four augers in 10 m intervals running north to south, and two augers at the same distance apart running east to west (for complete listing of deposits, see Table 2). The maximum depth of cultural material at the site is 110 cm in Auger 4S, with other augers reaching depths between 30 cm and 50 cm. Unit 1 reached a depth of 80 cm, below which we encountered bedrock.

These deposits comprise domestic refuse (for details about specific artifacts, see Table 4). The deepest auger at LC-3, 4-South, recovered almost exclusively *Mytilus californianus*. I have also identified some scattered bone, a few Olivella wall beads, and minor amounts of other artifacts. Auger 3-South, placed directly in the wall of the house depression, yielded more total artifacts than auger four despite having a lower food shell/midden density in each 10 cm level and half the overall depth of deposit. 2-South produced larger amounts of Olivella, unlike augers 3S and 4S (mostly devoid of the shell). Also present in this auger are SCRI chert shatter and a single flake drill. Despite this evidence of their manufacture and the fact that bead-making produces high densities of detritus that are frequently recovered via augering, there were no beads in this auger. The fact that the flake drill in this auger was recovered from the 0-10 cm level suggests that LC-3 was occupied during the Middle period, but abandoned thereafter.

The presence of a bone barb in the 10-20 cm level of auger 3-South and a reamer in the 30-40 cm level of 4-South suggest exploitation of fish and the production of fishhooks. The small amount of fish that was recovered in the augers is uniform only in its high degree of fragmentation (a wide range of genera and elements are present). Most of the bone at LC-3 has been crushed nearly to meal, and few diagnostic specimens exist. During the excavation of Unit 1, however, I recovered three *in situ* examples of articulated fish vertebrae, as well as more bone overall than in any of the augers (which suggests that some of the lack of bone in the latter is due to sampling methods). The bulk of the recognizable bone comes from various fish species, both bony and cartilaginous, and includes sheephead, surf perch, and bat ray. I also recovered a very small amount of bird and mammal remains, the latter mostly restricted to sea lion. This material has only been analyzed by weight, but future work will include more intensive species identification. Overall, bony material composes a miniscule fraction of the overall assemblage from Laguna Canyon, especially when compared to the overwhelming amounts of *M. californianus*.

Unit 1 produced a variety of objects that collectively indicate a range of economic activities. Fish hook blanks and in-production fragments of hooks suggest a more robust history of fish exploitation and permanent occupation than the augers alone indicated. The unit also yielded ochre, a possible bone whistle (see Figures 6a and 6b), and two lithic points (most likely harpoon points). This wide range of domestic material suggests that this site represents more than a simple camp or seasonal occupation, with a more complete assemblage that typifies locations that were permanently used, rather than focused on a single resource or season.

With regard to this project, however, the most important class of material from Unit 1 is undoubtedly the lithics. I recovered a variety of types of toolstone, notably local igneous material and chert types from both the island and the mainland. The igneous material was pervasive throughout the unit, ranging in size from tiny flakes to large, straight-edged pieces suitable for heavy work. Every auger at LC-3 contained fragments of ground-stone tools. These range from small, pebble-sized pieces to large chunks of igneous rock or sandstone.

LC-7

LC-7 possesses a unique mix of primary/secondary deposits and significant erosion (Figure 7). The site was originally two distinct loci: a lower site, most likely housed underneath a rock overhang, and an upper site located atop the overhanging bedrock shelf, midden (including shell) from which is still present on the upper bedrock. At some point, that shelf broke off and the upper site collapsed. Part of the site fell outward and now forms a slope upon which the bedrock rests, suggested by the presence of diagnostically distinct artifacts at the same depths in Augers 4E and 2E from this part of the site. The rest of the material slipped through the crack that formed as the bedrock shelf broke, and came to rest on top of the lower deposit, and artifacts that date from the Middle (900 A.D. – 1150 A.D.), Transitional (1150 A.D. – 1300 A.D.), and Late periods (1300 A.D. – 1782 A.D.) occur at the same depth in the upper levels of the site. Below 40 cm, however, there is no such mixing of material. I placed four augers at LC-7, one of which reached a depth of 160 cm, the deepest from any site in Laguna Canyon (for complete listing of deposits, see Table 3). The maximum depth of the site is most likely greater than 160 cm, because the density of the midden did not decrease significantly between 90 cm and 160 cm, but it was not possible to auger more deeply due to the looseness of the soil. This auger produced a large number of artifacts (for details about specific artifacts, see Table 5). The upper levels, from the surface to 90 cm, contained both drilled Olivella and SCRI chert microdrills suggesting manufacture of beads. Below 90 cm there is a change in the midden. The amount of soil decreases and the relative density of archaeological material increases.

LC-7 is a multi-component site that was abandoned sometime during or just after the Middle period. Auger 3-East at LC-7 yielded 3 beads and 8 drills, from its lowest levels almost to the surface, and 4-East yielded a further 6 drills. I used the diagnostic microdrills and beads to help characterize the occupational history of the site based on the established, well-dated artifact typologies (Arnold 2001; Perry and Jazwa 2010). The presence of both Middle period and Late period artifacts suggests that people lived at LC-7 during both periods, though not necessarily continuously, unlike LC-3 across the canyon.

LC-6

LC-6 is located on the end of a small ridge between two drainage channels, about 150 m from LC-7. It is composed of two loci situated approximately 10 m apart, both generally round areas of midden without observable house depressions. The southern locus is partially cut by the eroding bank of the stream adjacent to it, and the northern locus is marred by a bedrock channel formed by runoff from the ridge above. None of the seven augers I placed at either locus extends beyond a depth of 30 cm. LC-6 is primarily domestic refuse, from which the most significant artifacts identified are the fragments of ground-stone implements recognized in the field. Due to this, I checked all of the exposed bedrock near the site for bedrock mortars, but found no evidence of any.

LC-6 may be related to LC-7, but the lack of diagnostic artifacts and the poor preservation of the site as a whole make a connection tenuous at best. Some material from this site has not yet been analyzed, but based on the preliminary analysis I believe that LC-6 is too badly eroded to provide a significant amount of data for this project. While it is possible to characterize the deposits at the site, it is unlikely that anything more specific than the identification of a domestic occupation of unknown duration and date can be gleaned from it due to the specific nature of its preservation.

Lithic Material in Laguna Canyon

LC-3 and LC-7 yielded the highest densities of debitage — composed of a number of different materials—and the rest of my discussion focuses on the samples from these sites. These assemblages vary in their composition and size, and there are two primary categories: a coarse- to medium-grain, dense, gray-brown igneous material; and a variety of finer toolstone types in small quantities, particularly Monterey chert and fine-grained igneous. The coarse igneous material is locally abundant, acquired from Laguna Canyon stream bed cobbles. At present it cannot be linked to a specific bedrock formation.

The high availability and low quality of this stone led to a large amount of local production, resulting in an assemblage characterized by morphologically informal /heterogeneous tools with sharp cutting edges (Andrefsky 1994; 2005). I propose that, in Laguna Canyon, these informal potential tools may have been well suited to vegetation processing.

For ease of reference, I call this raw material "Laguna igneous." Laguna igneous stone constitutes the majority of the lithic material, both by number of pieces and by weight. I have compared the totals by density from augers across Laguna (see Table 6). From twelve auger units at three sites, I recovered 60 specimens of Laguna igneous stone in the form of flakes and shatter, weighing a total of 146.33 g, and 43 examples of all other types of lithic materials (including 30 flakes [both broken and complete] and 12 microdrills of SCRI chert, and 1 flake of Monterey chert), weighing a total of 21.1 g.

Laguna Igneous Stone

The lithic material from cobbles local to Laguna Canyon lacks the homogeneity and fine grain of a material such as obsidian or the island chert and is unsuitable for producing precision tools or points. This type of toolstone, however, would have been well-suited to heavier work that required a sharp but durable edge, making it ideal for vegetation processing. Those living in the canyon produced tools composed of this material from cobbles present in the conglomerate bedrock and the stream channel of Laguna Canyon. Though the flakes and tools produced from Laguna igneous material vary in size, they share a few important features. Alongside their coarseness, one of the most salient of these characteristics is the presence of asphaltum. While most appear to be clean to the naked eye, under the microscope blobs and spots of asphaltum appear regularly along the edges of these flakes, sometimes associated with retouched or worn edges. Four of the 23 identified tools have asphaltum along the retouched edges, and 18 of 23 have some asphaltum elsewhere on the tool. The presence of asphaltum splatters suggests that they were used frequently in close proximity to that substance. In 12 of 14 levels in Unit 1 (all but the surface and deepest level; see Table 7), I recovered 252 flakes and 23 tools composed of Laguna igneous material. The tools that fall into this material category have either convex or straight cutting edges (some of which are characterized by retouch). Within the assemblage of Laguna igneous tools I identify two main tool forms: one on a core or thick flake with a long convex sharp edge (eight examples in Unit 1, see Figure 8) and the second with straight, sharp working edges (see Figures 9 and 10). Both seem to have been manufactured expediently (see descriptive details below, under Tool Types from LC-3).

Unlike the large tools, the smallest pieces of the Laguna igneous stone recovered from archaeological deposits are irregular in shape, lack cortex or discernible flake features (platform, termination, etc.), and fall into the categories of shatter and broken flakes, which are most likely the byproducts of tool manufacture or maintenance rather than core preparation (Andrefsky 2005). The igneous material from these sites presents an interesting, though ambiguous, picture of tool use in Laguna during their occupation. This type of material appears throughout the deposits at LC-3, suggesting that it was used continuously at that site. At LC-7, however, the fact that it does not appear above deposits dated to the Middle period based on artifact typology, from a depth of 70-80 cm to the lowest excavated level, 150-160 cm (see Table 3), indicates that its use fell off after ca. A.D. 1150. Without further excavation at LC-7, however, it is difficult to assess what changes may have taken place there afterward.

SCRI Chert Flakes and Other Types of Toolstone

In addition to this stone, a few other types of lithic materials are present in the canyon. In augers from the lower canyon there are finer types of toolstone: a single flake made from an unidentified gray igneous material; two worked pieces of quartzite; and 30 SCRI chert flakes. The two quartzite objects are shaped, but do not appear to have been used as tools due to a lack of wear (both macroscopically and microscopically). Though the flakes recovered from augering and excavation are similar in size and dimensions, 5 of the SCRI chert objects (a total that includes three flakes along with two projectile points, the latter because they were manufactured from SCRI chert as well) from Unit 1 also showed signs of extensive heat damage, including a single flake exposed to such high heat that it appears partially vitrified. These flakes are generally complete, in contrast to the broken Laguna igneous material, but by mass are significantly smaller (from the previously discussed augers at LC-3, LC-7, and LC-10: Laguna igneous flakes are on average 2.44g/flake, whereas SCRI chert flakes are 0.49g/flake). The small chert flakes appear to be linked with projectile point manufacture and repair or other tasks related to formal tool production.

Tool Types from LC-3

It appears that canyon populations invested significantly more time in stone tool production than in bead-making, working available cobbles into fairly large ad hoc tools useful for rough tasks, perhaps including processing vegetation. The question is, given the proximity of the marsh at the mouth of the canyon, do these tools suggest exploitation of local reed resources?

The range of material that I recovered from the 1 x 1 m Test Unit 1 best represents the total lithic assemblage at LC-3. While the source of all of most of the tools is the conglomerate bedrock of the canyon, the Chumash produced them from individual cobbles that varied greatly in the fineness of their grain sizes, the hardness of their material, and their suitability for tool use. As a result, it is impossible to categorize them based solely on material type. Material types do not seem to be correlated to the finished tool forms. The flakes (not the worked tools themselves) can be broken down into broad categories of fine and coarse grain, the latter outnumbering the former in the assemblage by a ratio of 2:1 (see Table 7). Despite its drawbacks discussed in detail elsewhere, I use Sullivan and Rozen’s “intepretation-free” typology of debitage as a guideline because of its simplicity and clarity as a typology (see Andrefsky [2005] and Ensor and Roemer [1989] for critique).

I separated the flakes into simple replicable categories to make the range of variation within the excavated Laguna igneous material apparent (Andrefsky 2005: 128-129; Sullivan and

Rozen 1985). The flakes from Unit 1 can be divided into their four categories as follows: 126 (50.0%) are shatter (no single interior surface discernible; this category was referred to as "debris" by Sullivan and Rozen); 58 (23.0%) are flake fragments (no point of force present); 55 (21.8%) are broken (flake margins are not intact); and 13 (5.2%) are complete (for definitions of divisions, see Sullivan and Rozen [1985: 759]; for totals, see Table 8; for images of examples of each category, see Figures 11a through d). While the flakes of Laguna igneous material are much larger than those of fine-grained materials, the overall assemblage of the Laguna igneous stone is mainly thin and non-cortical. Just 30 flakes from Unit 1 [11.9%] possess cortex, and all of these have less than 10% cortical material on their dorsal surface. On the other hand, the tools themselves do, in some cases, possess significant cortical material. This fact, coupled with the dearth of complete flakes (5.2% overall) and flakes with cortex (11.9% overall) in the LC-3 material, suggests that the cobbles were tested and much surface material was removed before the modified specimens were brought back to the site. Tool manufacture took place in Laguna Canyon itself, but there is no indication of any specialization.

Based on the overall assemblage, there are two important categories (that can be divided into two sub-categories each) of tools apparent at LC-3. The first category are convex-edge tools, and the second are straight-edge tools; within these types, the presence or absence of cobble cortex is an important organizing factor. Tools with cortical material are both thicker and larger than those without it, both among the convex-edge tools and the straight-edge tools. The thickest tools most likely represent earlier stages of removal from the original cobble core due to the significant amount of cortex present on them. The non-cobble tools are thinner and have more dorsal scarring, which suggests that they were produced later in the sequence than the cobble tools (Andrefsky 2005).

Despite the relative thinness of the latter tools and their lack of cortex, they are still quite thick relative to the non-tool Laguna igneous material. Because of these attributes, the production of Laguna igneous tools likely took place early in the process of cobble core reduction, after which tools were finished or re-sharpened at sites like LC-3 (producing small shatter byproducts typical of this type of tool manufacture). Therefore I have separated the recovered material into the following categories of tools: convex-edge cobble tools (CECT), which are thick and have cortex from the original cobble surface (Figure 12a); convex-edge tools (CET), which are thinner and lack cortex (Figure 12b); straight-edge cobble tools (SECT), which have the same properties as CECTs but with straight edges (Figure 12c); and straight-edge tools (SET), which have the same properties as CETs but with straight edges (Figure 12d). In Table 7, I have separated these tools by type and depth. Of these four tool types, the most common are CECTs, 12 of which were recovered from Unit 1. They are followed by SETs and SECTs (4 each), and then by CETs (3). The presence of these tools throughout Unit 1 is striking because of the absolute dearth of bead-making material, and suggests significant use and production of local igneous tools in Laguna Canyon. Identifying these tools provides a framework for understanding informal tool production on Santa Cruz Island.

Patterns in the Lower Canyon

The search for evidence for production detritus of all kinds in Laguna Canyon reveals a strikingly low intensity of bead making in the canyon. When compared to other drainages on the south side of the island, the density of Olivella and SCRI chert in Laguna is negligible. Small sites in the mid- and upper reaches of Coches Prietos canyon have far more bead-making refuse (Peterson 1994: 220-221). On the other hand, Laguna igneous material, and tools made from it, are consistently present throughout LC-3. The prevalence of this type of stone in the assemblage, alongside the dearth of bead-making refuse, suggest production oriented away from the island bead industry.

Upper Canyon

The upper canyon, divided from the sites clustered at the mouth by more than a kilometer, presents a different problem. Of the four identified sites, there are no clear undisturbed deposits. All of them have slumped into runoff channels to some degree, and most are being washed away relatively quickly. These sites possess “tails” of midden, in which the bulk of the site is located on a slope, but at least part of the deposit is being undercut by water and carried away each time it rains. Two of the four sites in the upper canyon have relatively stable deposits. LC-1 is nearly as large as the sites near the mouth of the canyon, with midden as deep as 80 cm. LC-2 is a rather unspectacular midden on a short promontory, with little material other than shellfish and a few grinding implements recognized in the field. LC-10 is very heavily eroded, but produced a large number of artifacts relative to its size. LC-11, a rock shelter on a steep slope, is both particularly shallow and heavily eroded, but it is located in a prominent, widely visible position in the canyon.

LC-10

Despite the significant erosion at LC-10 there was a high density of artifacts. The site is composed of two loci: one is a thin veneer of midden, 25 cm deep, located precariously on a bedrock slope; the other is a mound reaching a depth of 95 cm held in place by a large *Baccharis pilularis*. The former locus produced a projectile point, island chert fragments, and exceptionally sandy midden. The latter was significantly more dense and produced more chert flakes than the first, though no microdrills. The density of non-local lithic material (especially SCRI chert) recovered from augers at LC-10 is higher than at any other site in the canyon (see Table 6), but during field sorting and preliminary lab work I discovered no evidence of bead manufacture. The lithics here, however, are not the same as those recovered in the lower canyon. Whereas much of the lower canyon material is composed of heavy igneous material local to the canyon, LC-10 possesses a wide range of finer types of toolstone, including some Monterey chert and a point made from a dark, unknown material. This range of stone types seems to indicate usage of an entirely different nature than that of LC-3 or LC-7, which focused on the Laguna igneous material available in the canyon. Aside from the isolated examples of non-local stone, lithics from LC-10 are mainly very small fragments of SCRI chert rather than the types of shatter and flakes produced from the material discussed earlier in this paper. This suggests that activity at LC-10 was oriented differently than other sites in Laguna. Without further excavation at LC-10, however, it is difficult to assess the specific nature of production there. Unlike LC-3, LC-10 has a very different range of material that does not include significant amounts of local igneous material.

LC-11

LC-11 is a midden slope associated with a cave, located approximately 30 m above the canyon bottom on the western hillside. The view from the mouth of the cave is spectacular, giving a bird’s-eye view of everything in the middle third of the drainage. The cave itself is quite small, but composed of two chambers: an antechamber with fire-marks on its roof that overlooks the midden-covered slope and the canyon, and a low back chamber that is significantly larger, but which lacks evidence of human use. Though the midden outside the cave indicates that some activity took place here, the deposit is mostly superficial. No diagnostic artifacts were recovered and no significant amount of carbon was found, making any determination of the age of this site difficult without further sampling. Based on its present association with the cave, the midden may have originally been located inside the rock shelter, but if so it was likely pushed out by sheep or pigs at a later date (Arnold 2001: 33; Rick et al. 2006: 577-579). LC-11 is important to understanding settlement patterns in Laguna because it is located on a steep slope and associated with a cave, unlike most of the other sites recognized in the drainage. Like LC-10, significant erosion is occurring here, evidence of which includes exposed bedrock from water cutting through the bottom of the midden. More complete surface collection may yield diagnostic artifacts to help date the site, but due to its precarious location LC-11 is difficult to access and subject to significant destruction each time it rains.

Patterns in the Upper Canyon

It is much more difficult to interpret the occupation of upper Laguna than it is to interpret sites near the mouth of the canyon. There are fewer diagnostic artifacts, less undisturbed context, and midden deposits there are generally less dense than those near the coast. Due to these complications, it is no wonder that most researchers have chosen to focus on coastal sites. Even so, the upper canyon provides interesting evidence of broader processes of occupation. Most of the site locations in the upper canyon suggest the same type of settlement pattern observed in the lower canyon relative to the canyon bottom and canyon sides. In future work, I hope to draw a comparative sample from other drainages nearby, in order to better assess the unique attributes of the small sites recognized in the interior of Laguna Canyon.

Conclusions

There are striking differences among Laguna Canyon, Coches Prietos, and Posa Creek Canyon resource-extraction practices and levels of participation in craft production activities. The record in Laguna, unlike that recognized in previous research in the other drainages, reveals a long tradition of informal production, maintenance, and use of tools made from cobbles of widely available and low-quality Laguna igneous stone. This material produces a robust edge suited to heavy work, possibly including the task of harvesting and processing of strong-fiber plant resources in the marshy areas close to the canyon walls. Uncarbonized plant parts do not, of course, survive in site deposits, but evidence of their processing may be detected on tools made from a material like those found in Laguna. The informal production of these tools in Laguna Canyon presents an opportunity to investigate the nature of resource exploitation on Santa Cruz Island in a manner previously unexplored. Specifically, the difference between the lithic material at inland (LC-10) and coastal (LC-3) sites suggests that those living closer to the sea had easier access to a different suite of resources, and that those living inland may have had closer ties to trade systems or other areas of the island. This suggests that proximity to resources and toolstone availability varied among those living in Laguna Canyon. Understanding the differences between sites within drainages such as Laguna is essential to understanding the nature of Island Chumash resource exploitation, especially with regard to locally available materials. By identifying this tool assemblage, I aim to provide a system by which future researchers can recognize tools that might otherwise go unnoticed and provide a comparative sample for the study of small sites and drainages with similar occupational histories and settlement patterns. In order to fully analyze the material from Laguna and better understand the nature of production there, future research is necessary.

As part of the next phase of this project, I have begun replicative experiments with reed material and similar (reproduction) igneous tools, compared against both chert and obsidian, in order to test the wear patterns and edge damage caused by this type of work and to provide baseline data for comparison to the excavated material from Laguna. Results of that work are pending.

The large number of tools I recovered from Unit 1 at LC-3 suggests a long-term exploitation of Laguna igneous material for processing local resources. I suggest that these tools may be linked with the harvesting and/or processing of reeds. This prevalence of lithic tools is especially striking when compared with the nearly nonexistent evidence for bead-making. Dense midden deposits in Posa Creek and Coches Prietos canyons yield significantly more bead-making detritus, which would be expected at many sites. The difference in production investment between Laguna and other areas of Santa Cruz suggests that the local idiosyncrasies of its water supply, marsh, and toolstone access offered unique opportunities there. Cobble-tool production appears to be linked with exploitation of a unique suite of locally available resources, both organic and inorganic, and solving the challenges that the inhabitants of this canyon faced.

Bringing together data on occupational history and resource investment across multiple canyons helps to illuminate details concerning the nature of Chumash life during a critical period of technological, social, and political change in the Santa Barbara Channel region. In order to address these questions, I must take a few important steps to test both the exploitation of reed resources and responses to environmental shifts.

It is essential to do more excavation in Laguna. Understanding the relationship between LC-3 and LC-7, providing firmer context for the material recovered from both sites, will allow a better comparison between Laguna and Posa Creek Canyons. Further survey work in Posa Creek will provide essential comparative data to form the foundation of any analysis of the canyons together, especially in order to compare local lithic assemblages across canyons.

Second, absolute dates from Laguna will clarify interpretations of settlements there. A more complete chronology will help to establish the occupational history of Laguna. I have submitted two samples for radiocarbon dating, the results of which are pending (Jazwa et al. 2013; citation provided for calibration background and interpretation of eventual results).

Third, complete survey and augering of inland sites in Posa Canyon, and further subsurface testing of sterile areas in Laguna for subsurface site deposits, will allow a comparison of settlement patterns. While the potential connections between SCRI-474/475 and LC-3/7 are interesting, understanding the occupations of both canyons as a whole will clarify the relationship between broader environmental processes and local settlement patterns. Further testing of the present-day extent of the marsh with pollen core samples will provide evidence of its ancient extent, which will help to confirm the relationship between the site and local resources that drove the tool production in Laguna.

Finally, it is necessary to compare patterns of erosion and landscape use in the canyons to better understand the formation of the archaeological record. The difference in water supply in the past may have had a significant impact on how the canyons were occupied. Learning more about the hydrological regimes and the nature of erosion and flooding in both canyons will make comparisons more meaningful and will clarify the impacts of human choice and post-depositional processes on the observed archaeological record.

Appendix: Figures and Tables

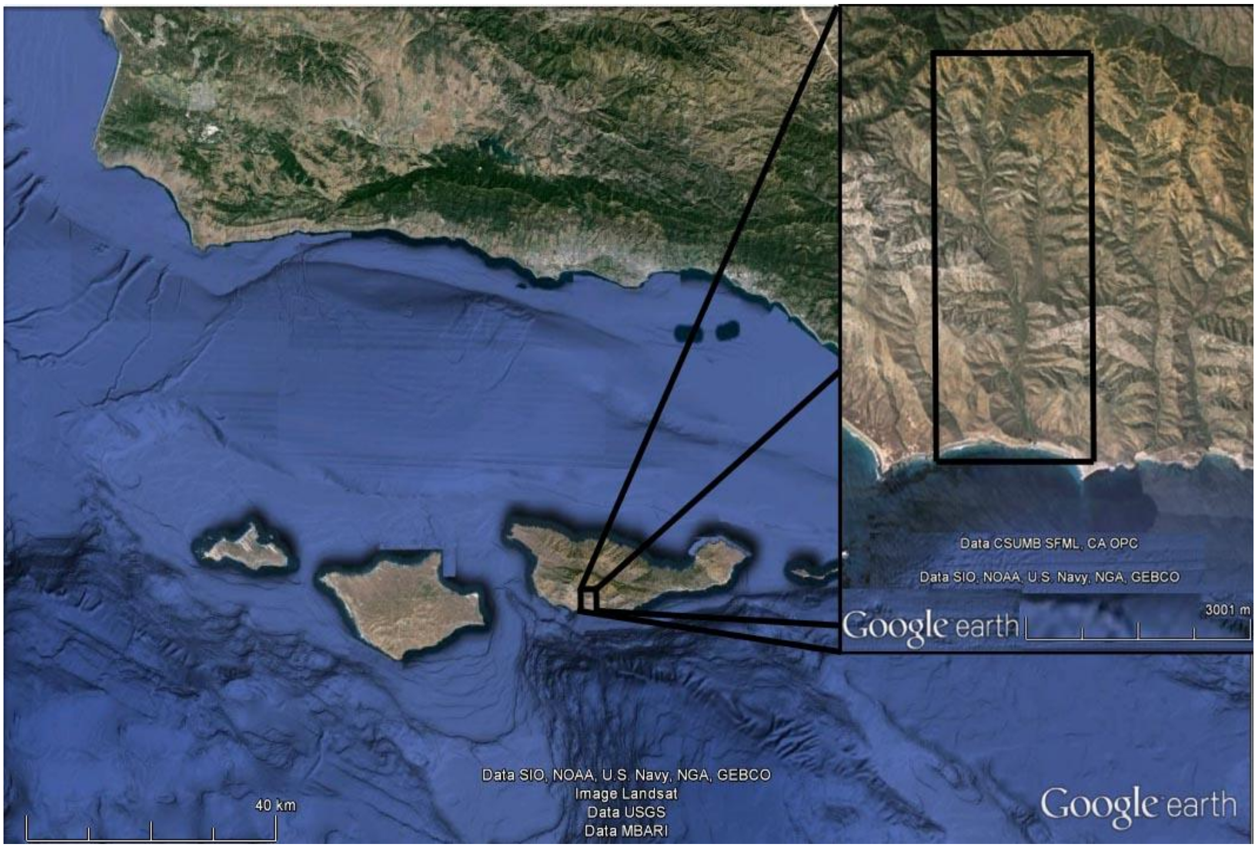

Figure 1: Satellite image of the Santa Barbara Channel region, centered on the northern Channel Islands (Santa Cruz is centered); Laguna Canyon is located within the black rectangle inside the inset (Source: SIO, NOAA, U.S. Navy, NGA, GEBCO, CSUMB, SFML, CAOPC via USGS/MBARI/TerraMetrics/CNES Spot Image/Landsat/Google)

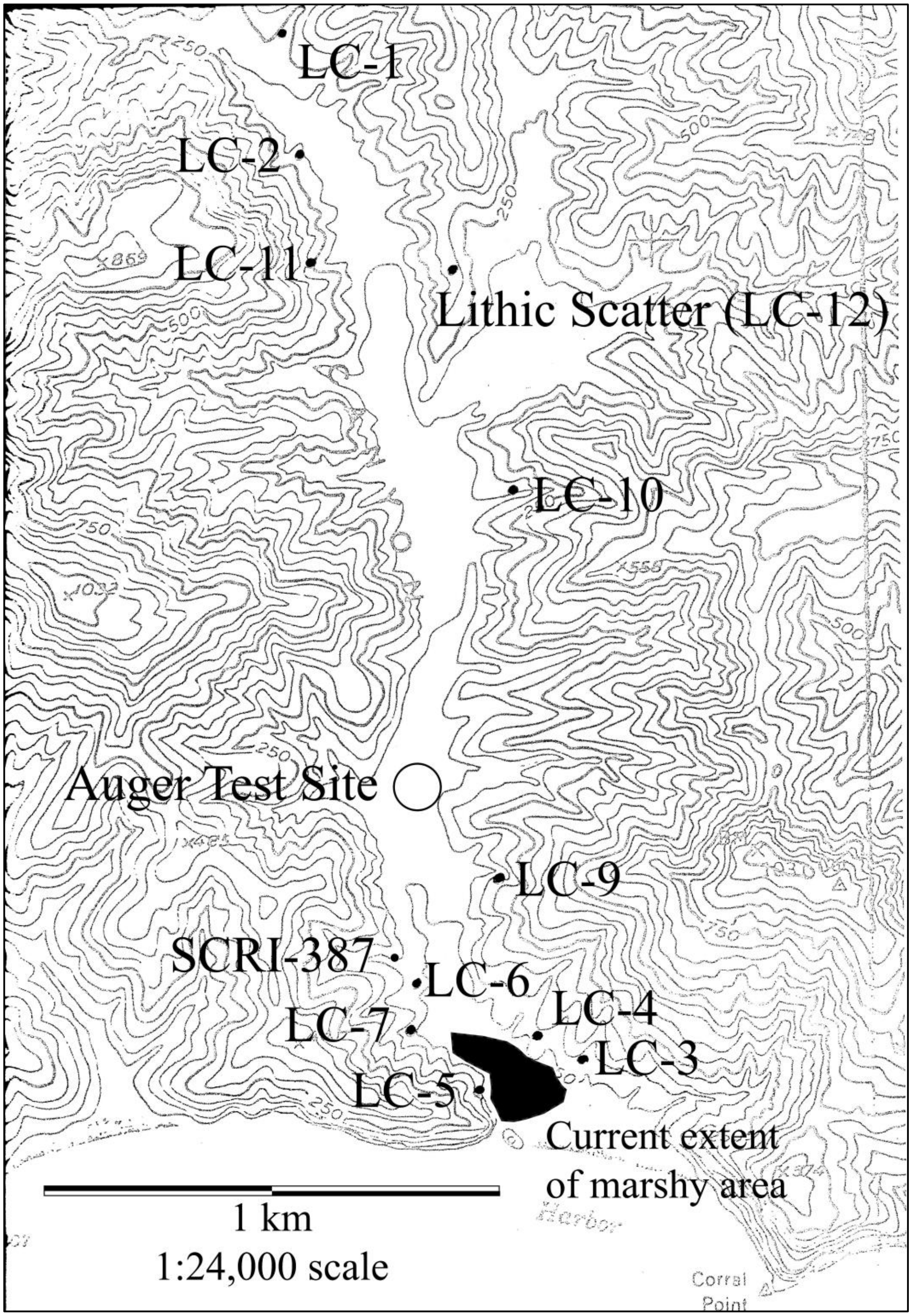

Figure 2: Map of Laguna Canyon with identified sites; the large circle represents the area tested for subsurface deposits

Figure 3: View of the canyon bottom, illustrating the heavy vegetation in the canyon bottom (right of image) and the sparse growth on the canyon sides (left of image)

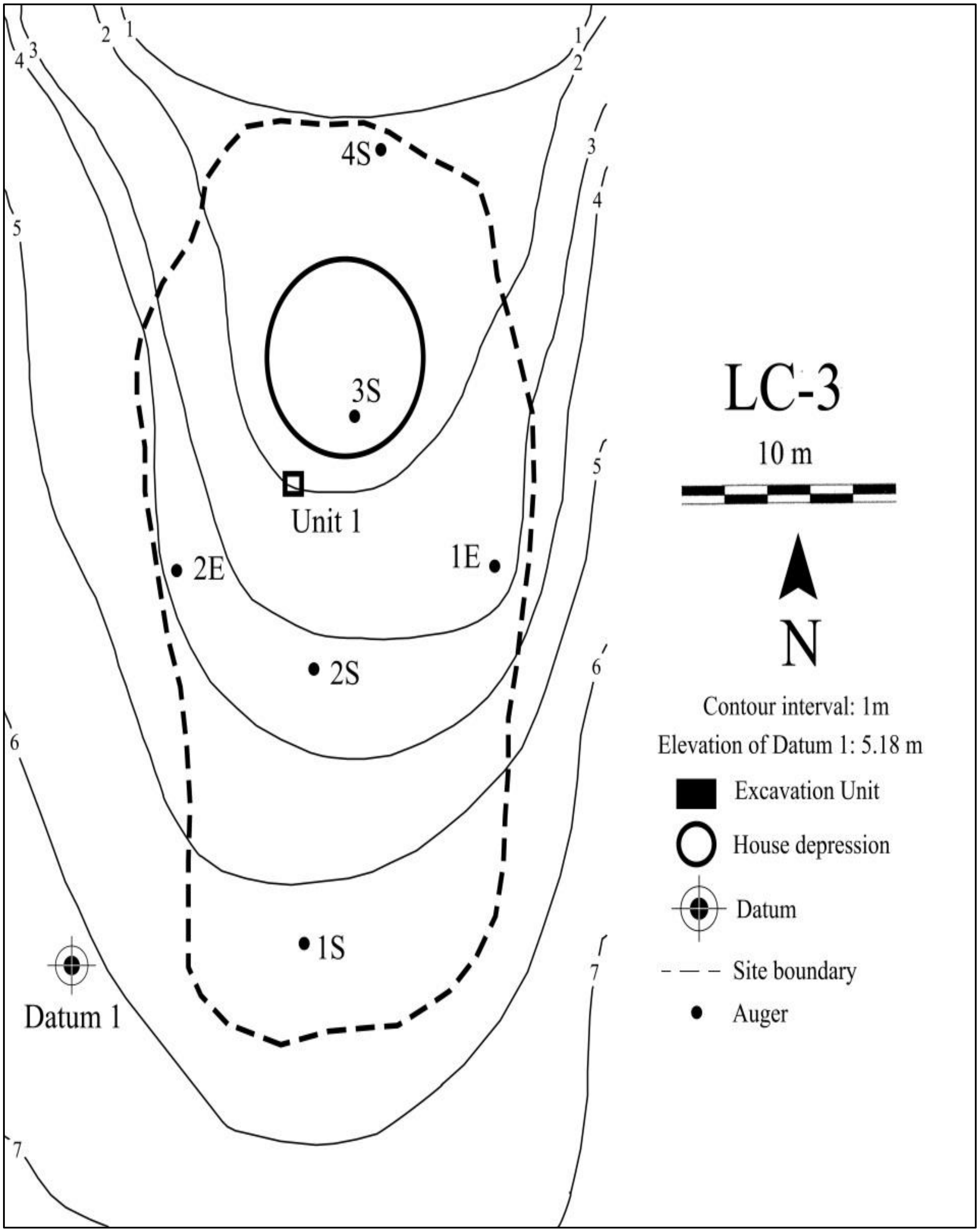

Figure 4: Map of LC-3, with locations of augers and Unit 1 marked

Figures 5a (above) and 5b (below): Dorsal views of possible bone whistle recovered from Unit 1, LC-3

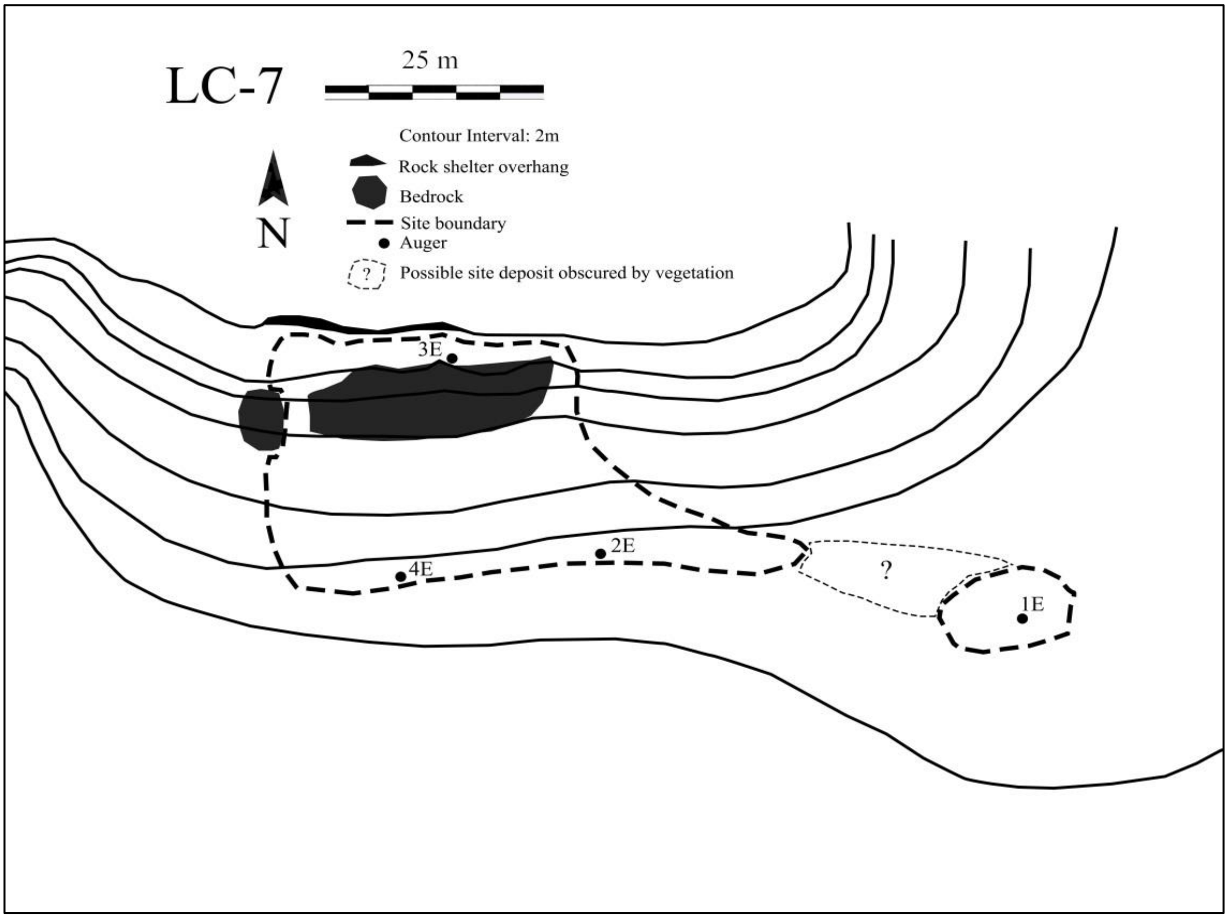

Figure 6: Sketch map of LC-7, showing locations of augers

Figure 7: Convex edge cobble tools from Unit 1, LC-3 (presumed working edges oriented to the left)

Figure 8: Straight edge tool from Unit 1, LC-3 (presumed working edge oriented to the left)

Figure 9: Straight edge cobble tool from Unit 1, LC-3 (presumed working edge oriented to the left)

Figure 10a: Laguna igneous shatter

Figure 10b: Laguna igneous flake

Figure 10c: Laguna igneous broken flake

Figure 10d: Laguna igneous complete flake

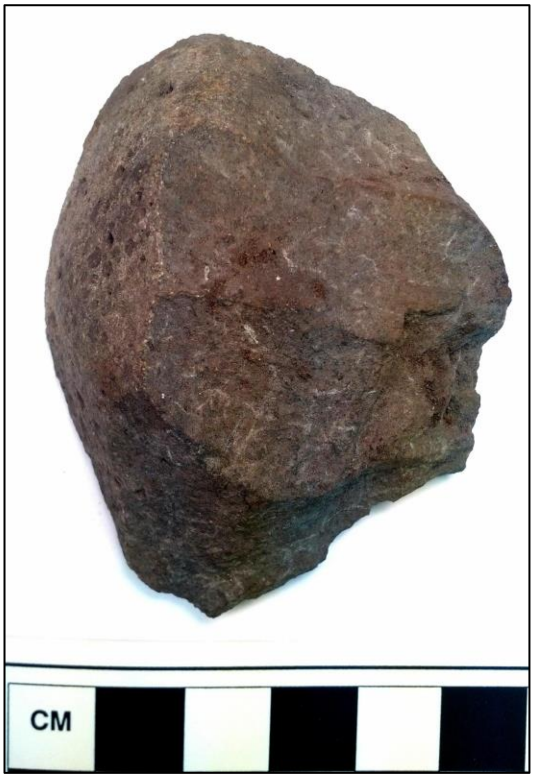

Figure 11a: CECT (presumed working edge oriented to the left)

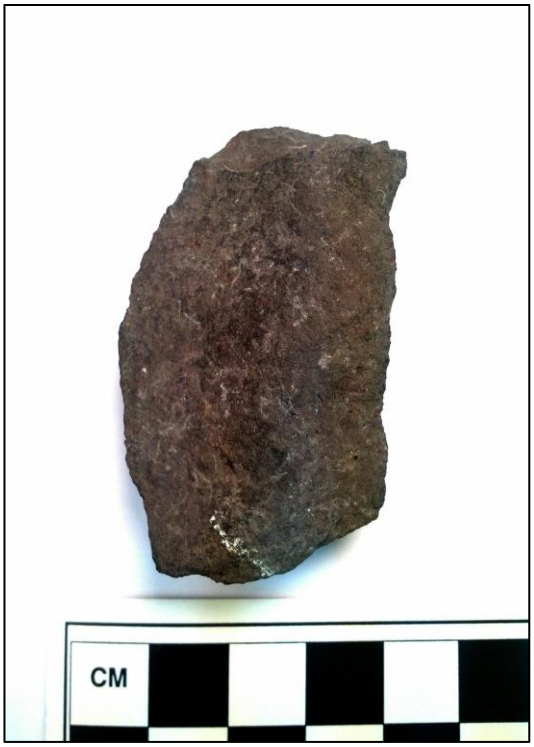

Figure 11b: CET (presumed working edge oriented to the left)

Figure 11c: SECT (presumed working edge oriented to the left)

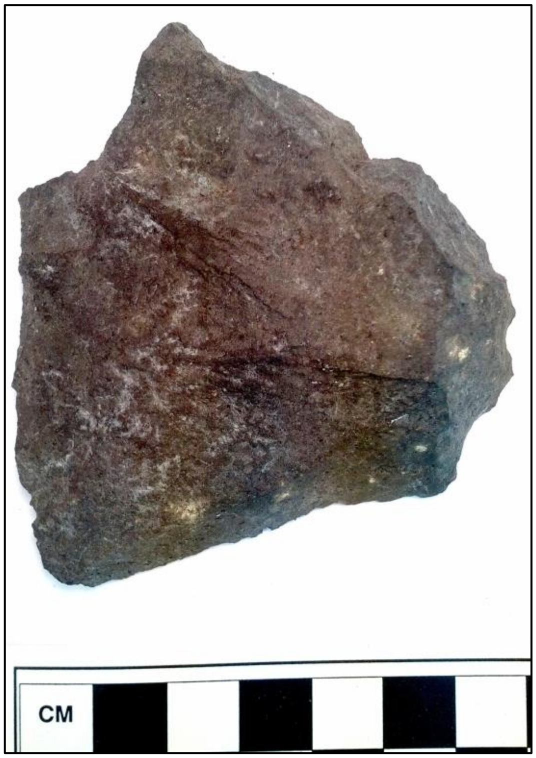

Figure 11d: SET (presumed working edge oriented to the left)

Table 1: Number of augers and maximum site depths in Laguna canyon

Site	Number of Augers	Maximum Depth
LC-1	5 augers	80 cm
LC-2	5 augers	92 cm
LC-3	6 augers	110 cm
LC-5	3 augers	Superficial deposits only
LC-6	7 augers	40 cm
LC-7	4 augers	160 cm
LC-9	Surface collection	Superficial deposits only
LC-10	2 augers, 1 surface	95 cm
LC-11	Surface collection	Superficial deposits only

Table 2: Material types and weights (in grams) from LC-3

Level	Food shell	Rock	Charcoal	Bone	Olivella	Igneous	Groundstone	Chert	Asphaltum
1S 0-10	263.02	32.00	0.25	1.34	0.38	0.25	1.13		
1S 10-20	103.89	55.50	0.08	0.22	0.06		0.76		
2S 0-10	325.74	65.70	0.01	1.13	2.64	0.13		2.03	
2S 10-20	135.73	34.00	0.01	0.31	1.25	0.60			
3S 0-10	292.05	32.08	0.03	1.35	2.37	2.53			
3S 10-20	389.79	35.67	0.44	0.68	1.87	92.08			
3S 20-30	287.71	30.83	0.87	0.44		1.77			0.10
3S 30-40	125.68	32.90	0.34	0.78	0.20		10.84		5.90
3S 40-50	78.05	172.26	0.96	0.13	0.07				1.30
4S 0-10	717.71	39.12	0.30	0.65	0.07	0.67			
4S 10-20	516.99	36.78	0.27	1.66	0.22	28.79	1.60	0.35	
4S 20-30	565.16	29.29	0.31	0.16	0.10				
4S 30-40	584.01	24.64	0.38	0.32					
4S 40-50	885.30	26.33	0.34	0.87	0.05	1.72	3.75	0.41	
4S 50-60	771.30	33.03	0.35	5.64	0.28	1.91	16.67		
4S 60-70	567.02	56.44	0.24	1.44	0.24				0.06
4S 70-80	1787.40	66.50	0.89	13.02	0.26	3.95			
4S 80-90	909.40	117.91	0.51	2.02	0.35	3.84	44.35		0.05
4S 90-100	597.44	240.09	0.36	1.17	0.08				
4S 100-110	595.68	584.62	0.28	1.92	0.05	6.54	1.00+(123.72)		0.26
1E 0-10	383.07	53.36	0.30	7.10	0.42	0.39	9.13	0.27	1.04
1E 10-20	189.14	569.08	0.35	1.68	0.19	0.16		0.05	0.02
2E 0-10	227.69	19.89	0.03	1.06	0.58				
2E 10-20	285.20	28.04	0.19	0.69	0.35				0.11
2E 20-30	380.80	42.00	0.50	2.32	0.81	0.85		0.39	0.46
2E 30-40	412.42	49.20	0.43	3.25	0.12	0.80	43.54		0.13

Table 3: Material types and weights (in grams) from LC-7

Level	Food shell	Rock	Charcoal	Bone	Olivella	Igneous	Groundstone	Chert	Asphal.
1E 0-10	34.47	274.22			0.21				
1E 10-17	45.41	372.77	0.07						
2E 0-10	517.77	83.48			0.30			2.30	
2E 30-40	391.50	61.03	0.08	0.23	0.15				
3E 0-10	312.02	27.55	0.66	0.22		0.14		0.10	
3E 10-20	308.21	23.23	0.39	0.80					
3E 20-30	341.36	39.97	0.84	0.78	0.82			0.31	
3E 30-40	384.46	25.22	0.60	0.36	0.37			0.35	
3E 40-50	548.21	48.65	0.92	1.33	0.52	4.89			
3E 50-65	1006.50	65.73	0.68	1.61	0.22				
3E 65-70	333.66	31.89	1.58	0.63	0.50			4.40	
3E 70-80	725.14	65.96	2.68	1.61	0.51	0.21		0.21	
3E 80-90	547.53	56.73	2.67	1.71	1.09	0.28		1.25	
3E 90-100	659.30	64.18	3.18	1.84	0.40	0.16		0.36	
3E 100-110	910.49	69.75	2.73	3.08	0.56			0.12	0.27
3E 110-120	553.60	54.06	3.35	3.55	0.13				
3E 120-130	407.55	40.31	2.88	5.10		10.88		0.57	1.53
3E 130-140	363.30	75.37	1.99	4.23	0.68			0.22	
3E 140-150	434.75	57.20	1.34	2.17			0.68	0.39	0.01
3E 150-160	1004.50	124.81	2.48	4.20	1.21	0.21			1.23
4E 50-60	1537.60	98.89	1.92	2.29	3.16	0.08		0.34	4.15
4E 60-70	1360.60	95.83	1.00	1.56	1.03	2.05		0.39	0.12
4E 80-83	747.71	47.90	0.54	0.75	0.87	1.16		0.09	

Table 4: Other Artifacts at LC-3

Level	Artifact Type	Description
2S 0-10	Flake drill	Middle period drill
3S 10-20	*Olivella* bead blank (wall), bone barb, tarring pebble	Bead production, fishing, domestic refuse
3S 30-40	*T. stultorum* fragment, asphaltum blob, groundstone	Possible boat production(?), non-diagnostic artifact
4S 50-60	*Olivella* BIP (wall)	Bead production
1E 0-10	*Olivella* BIP (wall)	Bead production

Table 5: Other Artifacts at LC-7

Level	**Artifact Type**	**Description**
3E 0-10	TDR Drill	Late period drill
3E 20-30	Trapezoidal Drill, TDR Drill	Transitional period drill; Late period drill
3E 30-40	TDR Drill	Late period drill
3E 70-80	Microblade (undiag.)	Microblade fragment (SCRI chert)
3E 80-90	Flake drill	Late Middle period drill
3E 90-100	*Mytilus* bead, *Olivella* bead (wall)	Two finished beads, one of *Mytilus* and one of *Olivella*
3E 130-140	Flake drill	Late Middle period drill
3E 140-150	Chert microdrill (undiag.)	Microdrill fragment (SCRI chert)
3E 150-160	*Olivella* bead (spire-chipped)	Finished *Olivella* bead, more common during the Middle period
4E 50-60	Flake drill, Microblade (undiag.)	Late Middle period drill; Microblade fragment (SCRI chert)
4E 60-70	Flake drill, Trapezoidal drill, TDR drill	Late Middle period drill; Transitional period drill; Late period drill
4E 80-83	TDR drill	Late period drill

Table 6: Lithic material from Augers at LC-3, LC-7

Site (type of testing)	Total volume	Igneous count (weight)	Igneous (weight/m^3)	Non-local count (weight)	Non-local (weight/m^3)
LC-3 (6 augers)	0.32 m^3	24 (119.23 g)	372.59 g/m^3	11 (2.79 g)	8.72 g/m^3
LC-7 (4 augers)	0.24 m^3	22 (15.28 g)	63.67 g/m^3	26 (11.2 g)	46.67 g/m^3
LC-10 (2 augers)	0.09 m^3	14 (11.82 g)	131.33 g/m^3	8 (7.11 g)	79.00 g/m^3

Table 7: Tool assemblage from Unit 1, LC-3 arranged by stratigraphic level and type

Level	**Type**	**Count**	**Prevalence (by stratigraphic level)**
Unit 1 totals:	**SECT**	**4**	**35-40, 45-50, 55-60, 70-75**
	SET	**4**	**25-30, 30-35, 55-60, 60-65**
	CECT	**12**	**25-30, 30-35, 35-40, 45-50, 55-60, 60-65, 70-75**
	CET	**3**	**50-55, 70-75**
	Projectile points	**2**	**35-40, 55-60**
	Coarse igneous flakes	**171**	**All levels (except 05-10)**
	Fine igneous flakes	**81**	**All levels (except 05-10, 75-80)**
Per level	**Type**	**Count**	**Material type/description**
05-10 cm	No lithics present	N/A	N/A
10-15 cm	Coarse igneous flakes	6	Laguna igneous
	Fine igneous flakes	6	Laguna igneous
15-20 cm	Coarse igneous flakes	7	Laguna igneous
	Fine igneous flakes	2	Laguna igneous
20-25 cm	Coarse igneous flakes	6	Laguna igneous

Table 7 (continued)

	Fine igneous flakes	5	Laguna igneous
25-30 cm	SET	1	Laguna igneous
	CECT	1	Laguna igneous
	Coarse igneous flakes	22	Laguna igneous
	Fine igneous flakes	10	Laguna igneous
30-35 cm	SET	1	Laguna igneous
	CECT	1	Laguna igneous
	Coarse igneous flakes	23	Laguna igneous
	Fine igneous flakes	13	Laguna igneous
35-40 cm	SECT	1	Laguna igneous
	CECT	2	Laguna igneous
	Projectile point	1	SCRI chert
	Coarse igneous flakes	29	Laguna igneous
	Fine igneous flakes	12	Laguna igneous
45-50 cm	SECT	1	Laguna igneous
	CECT	3	Laguna igneous
	Coarse igneous flakes	23	Laguna igneous
	Fine igneous flakes	12	Laguna igneous
50-55 cm	CET	1	Laguna igneous
	Coarse igneous flakes	19	Laguna igneous
	Fine igneous flakes	10	Laguna igneous
55-60 cm	SECT	1	Laguna igneous
	SET	1	Laguna igneous
	CECT	3	Laguna igneous
	Projectile point	1	SCRI chert
	Coarse igneous flakes	15	Laguna igneous
	Fine igneous flakes	7	Laguna igneous
60-65 cm	SET	2	Laguna igneous
	CECT	1	Laguna igneous
	Coarse igneous flakes	7	Laguna igneous
65-70 cm	Coarse igneous flakes	3	Laguna igneous
	Fine igneous flakes	2	Laguna igneous
70-75 cm	SECT	1	Laguna igneous
	CET	1	Laguna igneous
	CECT	1	Laguna igneous
	Coarse igneous flakes	9	Laguna igneous
	Fine igneous flakes	1	Laguna igneous
75-80 cm	Coarse igneous flakes	2	Laguna igneous

Table 8: Debitage breakdown by type and level from Unit 1, LC-3

Level	Shatter (no interior surface)	Flake Fragment (no point of force)	Broken Flake (incomplete flake margins)	Complete Flake	Total
10-15 cm	6	4	1	1	12
15-20 cm	6	1	1	1	9
20-25 cm	4	2	5	0	11
25-30 cm	13	8	10	1	32
30-35 cm	19	14	3	0	36
35-40 cm	22	10	7	2	41
45-50 cm	18	8	10	0	36
50-55 cm	14	6	5	4	29
55-60 cm	11	4	4	3	22
60-65 cm	4	0	3	0	7
65-70 cm	0	0	4	1	5
70-75 cm	7	1	2	0	10
75-80 cm	2	0	0	0	2
Totals	126	58	55	13	252
% of assemblage	50.0%	23.0%	21.8%	5.2%	100%

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