COBBLE MORTARS/BOWLS: EVIDENCE OF PREHISTORIC FISHERIES IN THE SOUTHERN CALIFORNIA BIGHT

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ABSTRACT

The most common type of artifact described from the 110 prehistoric underwater sites recorded in the Southern California Bight is a small, portable mortar/bowl. Manufactured from water-worn cobbles that underlie beaches and erode from wave-cut terraces, the source materials include felsitic and scoriaceous volcanics, plutonics, and sandstones, depending on island or mainland locality. Methods of production are evidenced by partially worked specimens and manufacturing tools. Hammerstones, picks, and abraders were used for pecking, percussion flaking, and grinding to create the mortar interior concavity and shape the exterior. The relatively great labor investment in manufacture from dense materials and the large number of mortars at some sites suggest that mortars were important elements of subsistence strategies. Although mortars are often considered plant-processing tools, the proveniences of these nearshore artifacts suggest a different use. Mortars are found in shallow rocky reefs, kelp beds, and along the rims of submarine canyons. Since the Middle Holocene, these habitats have supported the most diverse and accessible fisheries of the Bight. We propose that the mortars described here were part of prehistoric fishing strategies, possibly involving chumming and/or fish trapping in conjunction with the use of watercraft.

Keywords: San Clemente Island, San Miguel Island, San Nicolas Island, Santa Catalina Island, Santa Barbara Channel, San Diego, La Jolla, Point Loma, kelp beds, rocky reefs, quarry sites, production sites.

INTRODUCTION

One of the most distinctive artifacts in coastal archaeological sites both above and below mean sea level is the portable stone mortar/bowl (Glassow 1993, 1996; Hudson and Blackburn 1981:103-108; Masters 1983, 1985). In upland and inland sites dating from the middle Holocene, mortars are often interpreteted as being processing tools for acorns, other hard nuts and large seeds, and a variety of other substances. Along the lower Colorado River and in other areas of southern California with extensive mesquite groves, wood mortars (together with long stone pestles) are known ethnographically to be used to process mesquite pods (Schneider 1994). It is unlikely that mortar/bowls of the Southern California Bight were used for processing acorns, especially the mortar/bowls found at the margins of the ocean and lagoons and in underwater sites. Glassow (1996:18) proposed that mortars and pestles from sites near coastal marshes may have been used to process root products such as bullrush. Schroth (1996) reviewed ethnographically documented uses of mortars in southern California, and the diversity of applications included pulverizing meat and fish. Jones (1996) related the appearance of mortars and pestles among prehistoric California gatherers of the central coast to increases in diet breadth and gender specific division of labor.

This paper examines the mortar/bowls of the Bight, proposes models for their production based on quarry sites from the mainland and the islands, and presents labor-expenditure estimates derived from replication experiments. Due to their association with kelp beds and rocky reefs at many localities in the Bight and their prevalence in ground stone assemblages from the islands, we propose that small mortars were used for fishing activities, in addition to the plant processing and gender associated activities previously ascribed to mortars.

PRODUCTION

Production of stone mortars is a labor-intensive activity, as is evident from production trajectories derived from examples of abandoned incipient mortars, mortars-in-progress found archaeologically, and reports of replication experiments. We are excluding steatite bowls from this discussion as steatite is a very soft stone and easily carved (see Williams and Rosenthal 1993 for a recent discussion). The mortar/bowls we discuss in this paper are made from stone that is much more difficult to work: metavolcanic, volcanic, and lithified sedimentary materials. That stone was used, rather than wood, may be because suitable wood was not available or because of intended function. The energy invested in the production of stone mortar/bowls suggests that the items must have had important economic or ideological returns for those who made them. Mortar/bowls vary greatly in size, from less than 10 cm to well over 50 cm in diameter. Mortars sometimes have been separated from bowls using characteristics of wall thickness (thinner, uniform-thickness walls classify as bowls), shape of the interior concavity (conical classified as mortars), and shape (rounded, straight-sided, flat-bottomed, convex-bottomed). Discussion of the validity of various classifications is beyond our scope. It is likely that production methods were similar for this entire range of vessel types. The sizes of mortar/bowls found archaeologically tend to be related to available raw material.

All locations discussed below appear to be at or near sources of raw material. Debris from production and, at one site, the sheer number of completed mortars suggest that these artifacts were produced in far greater quantity than can be attributed to use at those particular sites and may have been exported items.

Examples of incipient stone mortars/bowls have been described for several of the Channel Islands: San Nicolas Island (Bryan 1961, 1970), San Clemente Island (Boyer et al. n.d.; Schumacher 1880), San Miguel Island (George Kritzman, pers. comm. 1990; Rozaire 1983); for the mainland Santa Barbara Channel region (Harrison and Harrison 1966; Hudson and Blackburn 1981:106-108, Figure 111-4); and for coastal San Diego (Masters 1994). The tools found nearby and the scars of work efforts suggest how they were made.

Three hypothetical models of production, based on the characteristics of locally available raw material, are proposed. Artifacts studied include the Allanson collection at the San Diego Museum of Man and the mortars curated by the Marine Archaeology Program, Scripps Institution of Oceanography, University of California, San Diego, representing underwater localities of the San Diego County shoreline; San Miguel and San Nicolas Island materials at the Southwest Museum; surface materials at the Lost Point site on San Clemente Island and San Clemente Island collections stored at the Center for Public Archaeology at California State University, Northridge; materials from San Nicolas Island stored at San Nicolas Island Archaeological Laboratory; and observations made at the sandstone bowl quarry on San Nicolas Island.

Production Model Based on the Allanson and the MAP/ SIO Collections

Both collections contain artifacts from underwater sites off the San Diego coast with the vast majority of the mortars coming from the submerged Beach and Tennis Club Site. Radiocarbon analyses for the onshore component, CA-SDI-39, range from 1160 ± 50 to 4770 ± 160 radiocarbon years before present (RYBP) (Beta-63826, -827, -828, LJ-385, -386, -449, -512), and there is a date of 4230 ± 200 RYBP (LJ-208) on subtidal peat at -2 m for the underwater locus which is a cobble spit that formed across the mouth of an ancient lagoon at lower sea level (Inman 1983). According to Allanson's records (on file, San Diego Museum of Man), over 200 mortars were retrieved from exposed cobble patches off CA-SDI-39 at depths of one to six meters during 1951 and 1952. All are produced from cobbles (size range 64 to 256 mm in diameter), and more than 90% of the mortars (Figure 1A and B) are made on cobbles of subrounded tabular sandstone derived from Eocene and Cretaceous age seacliff exposures and intertidal reefs. Some exteriors are irregular and unabraded, indicating the source cobbles have not been transported far from their origins. The few granitic mortars are made on well-rounded material originating from the bathylith of the Peninsular Range (Santiago Peak Volcanics).

The predominant cross-section is ellipsoidal; rims are rounded or flat; and the concavity is usually circular although conical or ovaloid interiors occur. The base has been broken or worn through some of the mortars. These mortar/ bowls are remarkably uniform in size, ranging between 13 and 22 cm maximum diameter, and compare with a range of about 5 to 30 cm in diameter for associated unmodified cobbles in the remnant cobble spit that forms the subtidal component of CA-SDI-39. The San Diego underwater mortars are small when compared to specimens from San Clemente Island, San Nicolas Island, and San Miguel Island.

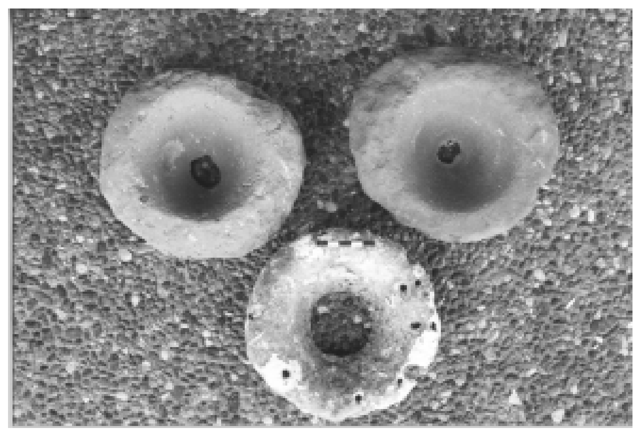

Figure 1A. Sandstone cobble mortars from the underwater locus of CA-SDI-39, La Jolla, California. Scale in centimeters.

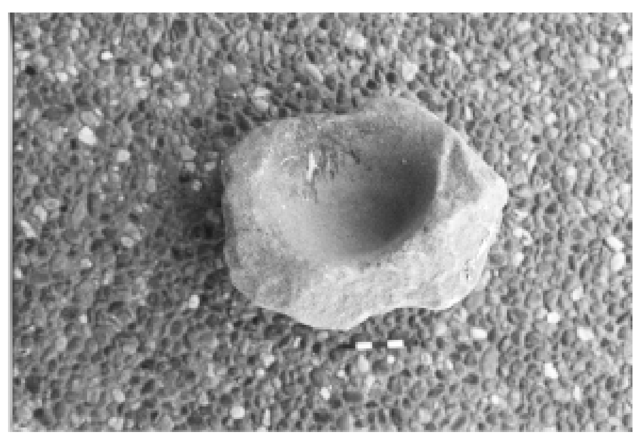

Figure 1B. Sandstone cobble mortar from the underwater locus of CA-SDI-39, La Jolla, California. Scale in centimeters.

Judging from several mortars in early stages of production, suitable subrounded cobbles were chosen, a concavity pecked into a relatively flat surface, and some marginal shaping carried out by percussion technique. There is no evidence of circular incising or preparation of an isolated plug, but the sandstone is easily worked. A granitic mortar-in-progress was started from an ellipsoidal cobble, which would have been difficult to work without a pecked platform or incised plug. The interior surface shows no evidence of incising, but there are three concentric zones exhibiting various degrees of grinding on a pecked surface (Figure 2). Percussive techniques may have been responsible for the cross-sectional fracture of the preform.

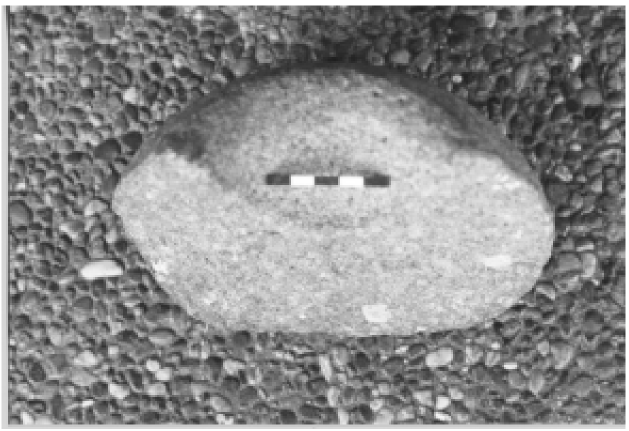

Figure 2. Incipient mortar fashioned on a granitic cobble from the underwater locus of CA-SDI-39.

Production Model Based on the Lost Point Site, San Clemente Island

Considerable data are available from the Lost Point site (CA-SCLI-970); radiometric determinations on matched pairs of shell and charcoal from the site range from 630 ± 90 to 3020 ± 110 RYBP (Beta 48993, -994, -995, -996). Preliminary work was carried out at this site by Christine Boyer, when a graduate student at California State University, Northridge, who identified 50 mortar/bowls at the site, many of them in production stages. The Lost Point site is located on the lowest marine terrace just above a boulder beach where a great deal of raw material in the form of large rounded cobbles or boulders (>256 mm in diameter) of local volcanic materials (vesicular basalt and andesite) are available. The surface of the site is littered with fragments of mortars broken in various stages of production, fragments of used mortars, hammerstones, picks, and large percussion flakes of local materials (Figure 3). Preliminary observations indicate that large, irregularly shaped cobbles and boulders were first selected, extraneous protuberances and material removed by percussion flaking, and then a central concavity created for the interior of the mortar (Figure 4). In most cases, the central concavity was prepared before final finishing of the exterior of the mortar.

The central concavity was created by at least two methods and the method actually used may be determined by the

Figure 3. Lost Point site (CA-SCLI-970) with broken mortar fragments, pestles and picks.

Figure 4. Lost Point site, San Clemente Island. Abandoned mortar-in-progress showing rough shaping of the exterior and initial concavity.

natural shape of the boulder. One method involves girdling the cobble or boulder with a pecked groove (Figure 5). The area above the groove, because it is isolated, is easily removed by stone-hammer percussion; a flat rim and surface was thus created. In this case, the section removed should be present at the site of manufacture. According to field notes (Boyer, et al. n.d.), these “lid spalls” are present at the Lost Point site. Schumacher (1880:264-265) formerly described the use of this technique by early peoples of San Clemente Island. Isolation and then removal of large sections by hammer is also described for mortar production on San Nicolas Island (Bryan 1961, 1970) and San Miguel Island (CA-SMI-504) (George Kritzman, pers. comm. 1990; Rozaire 1983). The technique was used widely in ancient times for production of many stone items (e.g., see Holmes 1897a, b). The advantages of the technique include control over amount and shape of section removed and economy of labor (see below).

The same or similar technique was probably used to create the concavity in some cases. A few examples of this stage of production are available (Alvarez 1978; Schneider and Osborne 1996:29, Figure 1). In other cases, the central

Figure 5. Small boulder with pecked groove from San Nicolas Island (collections of the Southwest Museum).

concavity was simply pecked into the mortar preform using pick-like hammerstones. Mortars were finished by pecking and polishing the rim and exterior, a lengthy process.

Production Model Based on the Sandstone Bowl Quarry and from Archaeological Collections on San Nicolas Island

San Nicolas Island is composed entirely of sedimentary formations, mostly sandstone. Within the sandstone formations are concretions that are more strongly cemented or represent inclusions of sandstone boulders from other sources. As the wave cut terrace of sandstone has weathered by water, wind, and sand, globular concretions relatively resistant to weathering emerge from the surface as spherical and hemispherical raised protuberances (Figure 6A). Further weathering exposes the globular concretion more completely, leaving a narrow neck connecting it to the shelf. Nature has created the preform of a mortar, ready to be “picked” from a “field” of mortar preforms (Figure 6B). Only the creation of a central concavity remains to be accomplished. When one of the naturally formed preforms is removed from the sandstone shelf, it breaks off at the base. A globular form with a flat surface for the rim of the mortar is available with no labor investment except that necessary to separate the form from the sandstone shelf.

Observations at the sandstone mortar quarry failed to identify hammerstones or other stones used to pry the spheres from their attachment to the shelf. The sandstone shelf however, is washed by surf during high tides and any tools present may have been removed. That the globular or spherical forms sometimes naturally separate is also evident at the quarry. In deep crevasses of the sandstone shelf, sandstone boulders are present along with cobbles of other materials, all of which have weathered out from the basal sandstone. The spherical and globular forms so readily available at San Nicolas Island most certainly would have presented aboriginal dwellers on San Nicolas an opportunity to produce mortar/bowls with much less effort than necessary in environmental situations elsewhere. Whether this opportunity was exploited in terms of production and trade has yet to be studied.

Figure 6A. Wave-cut terrace on San Nicolas Island. Quarry site showing concretions eroding from surface and scars where concretions already have been removed.

Figure 6B. Naturally shaped mortar preforms at the quarry on San Nicolas Island.

LABOR-EXPEDITURE ESTIMATES FROM REPLICATION EXPERIMENTS

The purpose of describing the production of mortar/bowls in the context of this paper is to establish that the labor investment in production was considerable and the economic “payback” must have been sufficient to warrant this investment. A number of experiments have been conducted to acquire data on the time and effort necessary to create central concavities and to produce a well-shaped exterior surface.

Experiment A

A mortar from the Big Sur region was replicated using a stream-cobble hammerstone on metamorphic material (Leventhal and Seitz 1989). It took 17.2 hr and approximately 46,000 blows to make a shallow concavity.

Experiment B

Small concavities were created in two boulders, one of sandstone and one of granite, using basalt and quartzite pick-shaped hammerstones (Schneider and Osborne 1996:33-35). For the sandstone boulder, a 215 cm^3 capacity concavity was created in 3.84 hr of actual time delivering blows (12.75 hr of work time) and 37,200 blows. In this experiment, a central plug was created using the grooving technique outlined above, and the plug was removed by a single blow. A somewhat smaller concavity (11 cm-diameter by 3.5 cm-deep, 140 cm^3 capacity) was created in the granite boulder without using the grooving technique in 8 hr of actual labor and 67,200 pecking blows. Evidently, the grooving technique was a labor-saving method, but the hardness of the stone also played a part in the difference in labor investment.

Experiment C

Replication of large stone pestles (Schneider 1993, Appendix A; Schneider et al. 1993) provided data indicating that pecking was, by far, the most labor-intensive portion of the production. An average of 11.5 hr were required for finishing by pecking, while percussion flaking to the final preform stage took about one-tenth of this time.

Experimental data suggest that the creation of a mortar/bowl concavity and the shaping and finishing of the rim and exterior of mortar/bowls (when necessary) was a relatively great labor investment. The amount of the investment varied according to shape and hardness of the raw material that was available.

DISTRIBUTION OF MORTARS

Mortar/bowls are the most common type of artifact reported from submarine localities within the Southern California Bight. From Point Conception south to the international border, 110 submerged prehistoric artifact sites have been recorded; a density unparalleled elsewhere in North America (Masters 1985). The frequency of mortar/bowls within one locality ranges from a single artifact to hundreds. Along the San Diego County coastline, 42 underwater artifact localities have been mapped; 36 were identified by mortar finds and 2 by bowls. Hudson's (1976) summary of submarine artifact localities listed 32 sites in the Santa Barbara Channel and the northern islands plus one off San Nicolas Island. Twenty-seven of these 33 sites were identified on the basis of mortar or bowl discoveries. Of the 92 artifacts recorded from these 33 localities, 81 are mortars or bowls. Although 45 of these vessels were not classified by shape, among the 30 typed mortars, 24 fall within the range of sizes and shapes seen in the San Diego County marine mortars. By contrast, in mainland coastal sites, mortars are rare along the southern coast (Shumway et al. 1961) but more common in sites along the Santa Barbara Channel coast after about 6,000 years ago (Glassow 1996).

The distribution of sites by depth and habitat along the nearshore shelf off San Diego County (Figure 7) provides important information concerning not only the possible functions of these mortars but the use of watercraft as well. The clustering of finds in the intertidal zone and nearshore rocky reefs to a depth of 5 m was discussed in Masters (1983, 1985). The second cluster of sites, the focus of this paper, occurs between depths of 10 to 20 m. These localities are predominantly kelp beds with a rocky, exposed substrate and a few occur at the heads of the submarine canyons at La Jolla. The sites recorded at 25 m and greater are all on ledges within the submarine canyons. In the Santa Barbara Channel, mortars were found in the intertidal zone and out to depths of 27.5 m with bottom conditions characterized by sand, boulders, and reefs (Hudson 1976). Eleven of the 24 cobble mortars came from depths (6 to 20 m) where kelp beds grow.

DISCUSSION

The frequent occurrence of mortars in kelp bed and rocky reef habitats of the San Diego and Santa Barbara coasts implies some use in fishing activities. Both habitats are productive nearshore fisheries (Salls 1988) that are populated by the same species of fish (Allen 1985). The remains of kelp bed and rocky reef fishes in the coastal middens at La

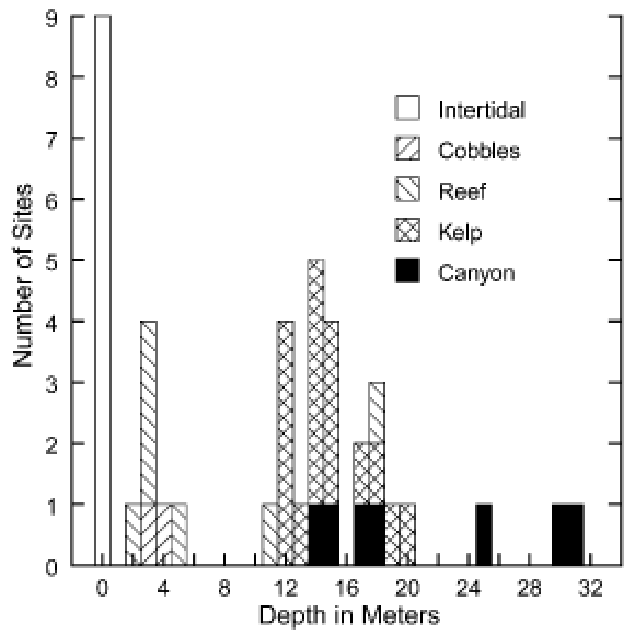

Figure 7. Distribution of underwater sites by depth and habitat for San Diego County, modified from Masters (1985).

Jolla (Shumway et al. 1961; Hubbs et al. 1965:107), Penasquitos Lagoon (Salls 1988:301), Ballast Point on San Diego Bay (Christenson and Roeder 1998), and elsewhere in the Bight (Salls 1988) confirm that fishing took place in offshore localities requiring the use of watercraft. The kelp bed sites, at distances offshore ranging from 0.5 to 1.7 km, cannot represent deposition by erosion from onshore sites (Masters 1983:202-203). Off La Jolla, a number of mortars were found at 17 to 20 m depths on the tops of two small seamounts near the La Jolla Submarine Canyon. These seamounts would have been located only by the kelp growing on them. Clearly, implements weighing 2 to 4 kg could be transported out to these localities only by means of watercraft.

The mortar's function as a fishing implement remains conjectural, but possible uses include grinding chum and weights for basketry fish traps. It has been suggested that a chum pot (a bait mortar suspended in basketry or cord netting from a canoe) would be an efficient method to attract fish in the kelp beds, and they could then be dip netted or speared from the boat (W. J. Howard, pers. comm.). Alternatively, the chum pot could be used to attract fish to a gill net suspended at the edge of the kelp. Grooved stones thought to be net or line weights are also found in kelp bed and rocky reef habitats (Hudson 1976; Masters 1983).

The prevalence of mortars (to the exclusion of milling stones) on the California Islands also is consistent with some role in a maritime economy. Prehistoric sites on the islands reflect a subsistance based on shellfish, fish, and sea mammals (see Raab 1997). Little Harbor on Santa Catalina Island (Meighan 1959) is an example of a specialized maritime fishing camp with 53% of fish elements from pelagic tuna (Salls 1988) and a tool assemblage including small mortars. The quarries and mortar production sites on San Clemente Island and San Nicolas Island also imply some vital function for small mortars on the islands where terrestrial fauna and plants offered few resources. The cost in labor and transportation to fashion these tools suggests a prominent role in subsistence or social strategies.

Therefore, we are proposing a marine fishing function dependent on the use of watercraft in addition to the plant processing functions already attributed to these small mortars. Given their distribution in nearshore habitats of the Bight, we believe the mortars played some role in the procurement of fish from rocky reefs and kelp beds. Mortars may have been used for shellfish and fish processing and consumption as well. Processing in the form of smoking, drying, and grinding to a powder (Heizer and Elsasser 1961; Schroth 1996:65, 67) can facilitate storage and exchange of high protein seafood that would have provided a buffer against food shortages due to seasonal, climatic, or populational stresses. This greater reliability of food resources in turn can promote residential sedentism and the cultural elaboration that characterized later time periods in the Southern California Bight.

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