SON-159: FACTORS AFFECTING SHELLFISH SELECTION

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ABSTRACT

This paper explores working hypotheses concerning factors affecting the selection of _Saxidomus nuttalli_ and _Tresus nuttalli_ clam shell for use at inland shell midden sites where disc beads were manufactured. The particular site in question is a prehistoric archaeological site, Son-159, located in Sonoma County in the Santa Rosa Valley, about 15 miles inland. This site is near the ethnographic boundary between speakers of Southern Pomo, to the north, and Coast Miwok, to the south.

BACKGROUND

Son-159 was excavated by field classes from Santa Rosa Junior College and Sonoma State University in four different seasons between 1972 and 1977. This site has a Middle Period component, as evidenced by olivella beads and Napa Valley obsidian hydration readings of up to 5.4 microns. There is also a predominant assemblage of Late Period items, such as small, corner-notched arrow points with Napa Valley obsidian hydration readings ranging from 1.0 to 2.2 microns, and a total of 297 clam disc beads and bead blanks of all species.

An ethnographic account by Samuel Barrett (1952) discusses the stages of clam disc bead manufacture, as practiced by the Pomoan peoples. Step 1 was to rub off the outer surface of the shell; step 2 was to break the shell into fragments; step 3 was to chip the pieces down into rough-edged discs; step 4 was to drill each individual disc; step 5 was to sort the beads for size; step 6 was to string the beads on wire grass; and, step 7 was to grind several strands on a flat, fine-grained sandstone slab using water until the shell formed a paste which acted as a grinding medium. Edwin Loeb (1926), in his work on Pomo folkways, mentions a final step of polishing the beads on a deer skin. In the different levels of Son-159 we find clam shell, bead blanks, partially drilled beads, chert drill bits, and finished beads. It is apparent then that most, if not all, stages of clam disc bead manufacture which would be identifiable archaeologically were taking place at Son-159.

Clam shell disc beads were used as a medium for exchange in precontact times, and have been found in archaeological sites as far away as the Great Basin (Bennyhoff and Heizer 1958). Clam disc beads functioned in a way similar to money and Loeb (1926) reports that informants say clam disc beads were like silver in value.

In the Santa Rosa Valley, most of the clam disc beads and blanks were made from what appears to be Tresus nuttalli or Saxidomus nuttalli shells. The Tresus nuttalli clam, once known as Schizothaerus nuttallii, has several common names, the gaper, the horse-neck clam, the summer clam, the rubberneck clam, the big-neck clam, and the otter-shell clam. The shell may measure up to eight inches in length and the clam can weigh up to four pounds. It lives in soft muck or in fairly loose sand in the low tide horizon at a depth of 18 to 36 inches. The clam is easily located by its siphon hole in the sand or mud, from which, at fairly regular intervals, it shoots jets of water 2 or 3 feet in the air.

Most of the edible part of the Tresus nuttalli clam is contained in the long muscular siphon, which protrudes from the easily broken shell, which cannot be closed around it. Of the larger clams, Tresus nuttalli is the least used for food today partly because its gaping shell cannot retain moisture and therefore makes it unfit for shipment (Ricketts and Clavin 1968).

The Tresus nuttalli clam ranges from Alaska to San Diego, and, although it decidedly prefers quiet bays, it may be found on the outside coast. It is found in middens from Puget Sound down to the Ventura County coast.

Saxidomus nuttalli is commonly known as the Washington clam, butter clam, money shell, or rock clam. This last name, rock clam, is probably derived from the fact that the clam commonly resides in coarse gravel, however the name is misleading because the clam thrives in mud flats as well. It is found in the same habitat as Tresus nuttalli, but at a depth of only 8 to 10 inches. Its shell length averages between 3 and 5 inches and is elongate with conspicuous, well spaced, heavy concentric ribs. Although the literature says that its range extends from Bolinas Bay to San Diego, it's also found in abundance at Bodega Bay.

Saxidomus nuttalli appears in markets today, but is not common except in the Puget Sound region. The siphon of this clam is not nearly as large as that of Tresus nuttalli, and therefore does not contain as much meat. According to the literature this clam was used to a lesser extent aboriginally for food than some other clam species.

Omar Stewart (1943) notes that Cordium corbis (Clinocardium nuttalli), Saxidonus nuttallii, and Saxidomus giganteus were obtained especially for the manufacture of bead money, and that the main source of supply was Bodega Bay, in Coast Miwok territory.

Loeb (1926) also identifies Bodega Bay as the main place that clam shell for bead manufacture was obtained. He notes in his section on beads, that two well-known clam shells abounded at the bay, Saxidormis gracilis and Cardium corbis.

Nowhere in the ethnographic literature, that I could locate, does it mention that Tresus nuttalli was used in the manufacture of clam disc beads in central California; but the occurrence of these beads is documented archaeologically in several Sonoma County sites (Son-159, Son-455, & Son-518). This occurrence may only be a local phenomenon, however.

LIMITATIONS

There are certain limitations in this study. First, I was not in the field or involved with lab work until recently and did not observe the site or methods used first hand; second, there are level records but no field notes as to why or exactly how things were done; third, the material was used for projects by lab classes over the years leading to possible loss of material or provenience information; fourth, rodents contributed heavily to the bioturbation of the site; fifth, only some of the units were excavated to sterile soil; sixth, of the seven units that were, only one unit did not have house floors in it. The presence of house floors, which are intrusive from upper levels, renders useless the strict use of the data by levels to establish time sequence (Table 1). Clam shell disc beads, which are a Late Period time marker, are found in abundance in all levels, demonstrating the mixture of materials; obsidian hydration data supports the lack of artifact stratification. The one deep unit which did not have any house floors, did have clam disc beads and blanks only in the top 40 cm; no obsidian hydration has been done for this unit.

METHODS

For the present study, shell from a single 1 x 2 m unit, S8/W1, was speciated in the lab. This unit was excavated in 10 cm levels and 1/4" dry screened. "Select" shell, apparently hinge pieces, was collected from the first 50 cm. However, a 30 x 30 cm "control corner" was also excavated in each of these 10 cm levels, in which all shell was kept. Below 50 cm, to a depth of 120 cm, it appears that all shell was kept.

RESEARCH DESIGN

To make the best use of the available data, Dave Fredrickson and I formulated a research design for studying Son-159 in terms of factors affecting the selection of shell for transport inland to clam disc bead manufacturing sites. The factors to be considered are, first of all the naturally occurring ratios of molluscan species at Bodega Bay, secondly, ease of procurement, taste preference, preservation properties, and distance of transport, and lastly, meat to shell ratios.

DISCUSSION

First, I attempted to determine the naturally occurring ratios of the two clam species at Bodega Bay so that these results could be compared with the ratios observed at the inland site of Son-159. This was done to see if the ratios differed,

TABLE 1

COUNT OF ALL COMPLETE AND FRAGMENTED CLAM DISC BEADS,
BLANKS, AND PARTIALLY DRILLED BEADS FROM DEEP UNITS

Unit No. Unit Size	U-1 2x2m	S6/W1 1x2m	S8/W1 1x2m	S12/W1 1x2m	S14/W1 1x2m	S10/E0 1x2m	N10/W12 2x2m	Total
Level								
0-10cm	9	0	0	12	1	1	4	27
10-20cm	7	2	0	1	0	0	3	13
20-30cm	0	2	2	1	1	0	1	7
30-40cm	2	4	3	*6	5	1	2	23
40-50cm	8 ---	4	0	*0	4	2	0	18
50-60cm	9	*2	*31	*1	0	*8	0	51
60-70cm	*1	*0	*9	*5	*1	3	0	19
70-80cm	*0	0	*10	4	*0	4	0	18
80-90cm	*1	0	*2	1	0	0	0 ---	4
90-100cm		0	*5	3	1	1	0	10
100-110cm			0	0	0	1		1
110-120cm			4 ---	0 ---	0	0		4
120-130cm			0					0
130-140cm			0					0
Auger				0				0
Total	37	14	66	34	13	21	10	195

* = House floor encountered
--- = Less than entire unit excavated below indicated depth
0 = Unit excavated, no beads found
= Levels not excavated

and if so, to explore factors involving differential selection of shellfish for transport. While ratios of shellfish are apparently available for San Francisco and Humboldt Bays, no reliable data could be located for Bodega Bay (Packard 1918; Sasaki 1967). Even if the data were available, unless they were gathered before 1943 they may not be representative because the bay has been periodically dredged since then. Dredging brings up silt from the bottom of the bay and places it on the shore, therefore radically altering the previously more sandy beach habitat.

Next, marine biology books and soil maps were consulted in an attempt to define the two clams' habitats and corresponding soil types. The two species were found to occur on the same beaches, as evidenced by habitat descriptions and shellfish collection data from the Department of Fish and Game gathered between 1972 and 1982. The Fish & Game data are probably not reliable for ratios though, because the object of the survey was to record size and age ranges for species encountered. Since the Saxidomus nuttalli clam is found at a depth of 8-10 inches, and the Tresus nuttalli clam at a depth of 18 to 36 inches, the deeper clams may not be thoroughly represented in their samples. At any rate, the total number of Saxidomus nuttalli predominated heavily, with a count of 148 Saxidomus nuttalli and 49 Tresus nuttalli.

An attempt was made to get at the naturally occurring ratios in another way. Shell ratios from an ethnographic Late Period Bodega Bay shell midden, Son-321, where clam beads were presumably not manufactured, were compared to Son-159 in Table 2. Son-321 has not been excavated, but soil samplings were taken by Isabel Kelly (Greengo 1951). It is assumed that Son-321 is composed of dietary refuse, and "that the species in a mound reflect the molluscan fauna of the vicinity" at that time period (Gifford 1916:7). It can be seen in the table of species from Son-321, that in terms of total shell weight, the three mollusks most represented are mussel, then Tresus nuttalli, followed by Saxidomus nuttalli. The latter two species are similar in terms of total weight, but fluctuate in importance through time. At Son-159, Tresus nuttalli predominates, then mussel, followed by Saxidomus nuttalli. These data suggest that Tresus nuttalli, rather than mussel, was selected as the preferred molluscan species for transport inland to clam disc bead manufacturing sites.

Another factor affecting selection of shellfish is ease of procurement. Mussels are the easiest to obtain and can be pulled from the rocks at low tide, Saxidomus nuttalli must be dug from the sand at a depth of 8 to 10 inches, and Tresus nuttalli at a depth of 18 to 36 inches. However, Tresus nuttalli is easy to locate because of the jets of water that it shoots up. Judging from Son-321 data, it appears that when shellfish was being selected for consumption only, and not being transported very far, the ratios more or less follow this order, assuming that the ease of locating Tresus nuttalli, and the larger total size, may off-set the greater effort required to dig it up. At Son-159 where the ratios are very different, ease of procurement does not seem to be the deciding factor involved in selection of shellfish to transport.

TABLE 2

SHELL PERCENTAGES FROM SON-159 AND SON-321

Levels	Tresus	Saxidomus	Mussel
Son-159			
0-10cm*	67%	18%	15%
10-20cm*	62%	13%	25%
20-30cm*	48%	13%	39%
30-40cm*	77%	6%	17%
40-50cm*	73%	6%	21%
50-60cm	71%	9%	20%
60-70cm	72%	12%	16%
70-80cm	69%	11%	20%
80-90cm	72%	11%	17%
90-100cm	73%	8%	19%
100-110cm	67%	12%	21%
110-120cm	72%	8%	20%
Son-321			
0-1'	7%	19%	74%
1-2'	21%	3%	76%
2-3'	30%	1%	69%
3-4'	9%	41%	50%

* = Shell from control corner only

Assuming that the meat, as well as the shell, was being transported inland, a factor to consider in the selection of shellfish species is taste preference, as well as preservation properties. Ethnographic references do not mention which molluscan species were preferred as food, but only that all three were eaten. The gaper clam, or Tresus nuttalli, is not found much in the markets today because it does not preserve well due to the gaping quality of the shell. However, this species represents 48 to 77% of the three major shell constituents at Son-159. It is conceivable that the clam could have been procured, transported 15 miles, and eaten in a relatively short period of time, though. Transporting the shellfish in the shell would also keep it alive and fresh longer than if it were not kept in the shell.

The third significant factor to consider when transporting shellfish inland is the meat to shell ratio by weight. Data are not available for Bodega Bay clams, but were recently compiled for the Elkhorn Slough project in Monterey County, and will be utilized in this study; the ratios are undoubtedly very similar (Dietz, Hildebrandt, Jones 1988). The meat to shell ratio for Saxidomus nuttalli is much lower than for Tresus nuttalli.

Saxidomus nuttalli has about half as much meat per unit of weight as Tresus nuttalli. This means that much of the weight of the Saxidomus nuttalli clam is in the shell, however, the entire shell is thick and all of it can be used for bead material. As documented by Loeb (1926), the hinge area was used for clam cylinder beads (none of which were found at Son-159), while up to 40 clam disc beads could be made from the remainder of the shell.

The meat to shell ratio for Tresus nuttalli is twice that of Saxidomus nuttalli because the shells are thinner and the protruding siphon is larger, but there are no ethnographic accounts of Tresus nuttalli being used as bead material and it is unknown if all of the shell can be used for the manufacture of beads. To test this, I first measured the thickness of all Tresus nuttalli beads and bead blanks from Son-159 and calculated the range and mean of each. Table 3 shows that the range is much wider for the blanks, probably due to the larger sample size, but the means are almost identical.

TABLE 3

RANGE AND MEAN OF CLAM DISC BEADS, BLANKS AND SHELL DEBRIS FROM SON-159

Object Measured	Range	Mean	Sample Size
Beads	1.2 - 2.5mm	1.9mm	6
Blanks	0.9 - 3.1mm	1.95mm	49
Hinge	1.4 - 3.6mm	2.35mm	110
Non-Hinge	0.5 - 2.85mm	1.35mm	110

I next, arbitrarily chose 10 pieces of Tresus nuttalli shell debris from each of the first 11 levels of the Son-159 study unit, and measured this selection of 110 specimens for thickness in non-hinge portions of the shell; another 110 specimens, 10 from each of the same levels, were measured near the hinge to determine if the shell is thicker in that area, as I suspected it would be. These two ranges and means, also shown on Table 3, were calculated to see how they correspond with that of the beads.

Results show that many non-hinge pieces are too thin to have been used as bead material, and that all edge pieces near the hinge, which are thicker, could have been used. Using the lower range of 1.2 mm, for a total of 6 finished disc beads definitely identifiable as Tresus nuttalli, all 110 hinge pieces could have been used for beads, and only 69 could have been used from the non-hinge portions of the shell. When utilizing the same method with the more numerous Tresus nuttalli bead blanks, totaling 49, similar results were obtained. Using the lower range of 0.9 mm for thickness, all 110 hinge portions could have been used for beads and 95 could have been used from non-hinge portions.

Using the means, the results are much more dramatic. The mean of 1.9 mm for finished beads shows that 91 hinge pieces are as thick, or thicker, than the mean, but only 16 non-hinge pieces are. The similar mean of 1.95 mm for bead blanks, shows that 82 hinge pieces are as thick, or thicker, than the mean, and only 13 of the non-hinge pieces are. The mean for the hinge pieces is larger than that of the beads or blanks, and would be able to accommodate the thickness needed to manufacture a durable bead, while the non-hinge mean is much smaller than that of the beads or blanks.

If we assume "thick" beads were preferred, and that all of the shell was not employed for Tresus nuttalli beads, we would expect more of the area by hinge of Tresus nuttalli would be used as raw bead material, and that the use of Saxidomus nuttalli shell would be more arbitrary. We would then predict a higher proportion of Saxidomus nuttalli hinges, in relation to Tresus nuttalli hinges, compared with overall ratios of the two shells found at Son-159. Table 4, using the "control" and "select" shell data available from levels 0-50 cm of the study unit, shows the results of all shell, versus hinge shell, for the two species by percentage of weight. The data show that when the weight of all shell from the control corners for both species, is compared to the weight of the "select" hinge shell for both species, that the proportion of Saxidomus nuttalli hinges does increase in the lower three levels, but not in the top two levels. The upper levels are heavily disturbed, and the data from them would not be as reliable as the deeper, less disturbed levels.

TABLE 4

PERCENTAGES OF TRESUS AND SAXIDOMUS -
ALL SHELL VS HINGE WEIGHT (SON-159)

	"Control" = All		"Select" = Hinge	
	Tresus	Sax.	Tresus	Sax.
0-10cm	79%	21%	95%	5%
10-20cm	82%	18%	92%	8%
20-30cm	78%	22%	61%	39%
30-40cm	93%	7%	62%	38%
40-50cm	92%	8%	69%	31%

Table 5 data shows count and weight of Tresus nuttalli and Saxidomus nuttalli hinges from Son-159, and depicts a few large pieces of Saxidomus nuttalli, and many very small pieces of Tresus nuttalli. This suggests that Tresus nuttalli shell, while it would undoubtedly break up smaller than Saxidomus nuttalli due to its thinner quality, was probably utilized along the edges right up to the actual hinge. As noted in a draft report on Sonoma County clam disc beads, Tresus nuttalli beads are often wedge-shaped compared to Saxidomus nuttalli beads (King 1986). This fact is further evidence that Tresus nuttalli beads may have been made from a small thick portion of the shell.

TABLE 5

COUNT AND WEIGHT OF TRESUS & SAXIDOMUS HINGES FROM SON-159

	Tresus	Saxidomus
0-10cm	116 / 203.1g	4 / 10.8g
10-20cm	63 / 122.3g	2 / 10.0g
20-30cm	33 / 114.6g	3 / 71.8g
30-40cm	112 / 225.4g	4 / 138.3g
40-50cm	97 / 203.5g	8 / 93.0g

SUMMARY

In summary, since pre-1943 ratios of shellfish apparently do not exist for Bodega Bay, data from a Bodega Bay shell midden, Son-321, were contrasted with data from the inland site of Son-159. These data show that the Bodega Bay site constituents may reflect naturally occurring shellfish ratios, or possibly ease of procurement. The Bodega Bay site, which is composed of predominantly mussel shell, does contrast sharply with the inland shell midden site which favors *Tresus nuttalli*, rather than mussel shell. Further, preservation properties of *Tresus nuttalli* do not favor it for transport, but meat to shell ratios do.

One may conclude that *Tresus nuttalli* was the preferred mollusk selected for transport inland to Santa Rosa Valley shell midden sites where clam disc bead manufacture was a major activity. When considering the two species of clam, if we assume energy output optimization in relation to energy input, we can conclude that the energy cost of obtaining *Tresus nuttalli*, that is digging deeper, is less than the energy cost of transporting *Saxidomus nuttalli*. Data shows that only portions of the *Tresus nuttalli* shell were used for bead manufacture whereas almost the entire *Saxidomus nuttalli* shell could have been used to obtain equally thick beads. It can be assumed that the combination of a high meat to shell ratio, and its partial use as raw material for beads, made *Tresus nuttalli* the best choice for transport.

There are two major areas in which further research could be conducted to enhance this study. First, for confirmation of the data reported on in this paper, other Santa Rosa Valley and Bodega Bay shell midden sites could be compared to see if similar results would be obtained. Second, beads from local, and non-local sites could be speciated to compare results, in order to test the hypothesis that *Tresus nuttalli* beads were used locally, while the presumably superior quality *Saxidomus nuttalli* beads were exported.

NOTES

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