10

An Interpretation and Comparison of Column Samples from San Clemente Island Middens

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Introduction

With few indigenous land mammals or birds and almost no edible plants, the Indians on San Clemente Island solved unique food procurement problems by exploiting the ocean for the protein provided by shellfish, fish, and sea mammals. Their success as hunters and gatherers is reflected in the archaeological record of the middens of San Clemente that reveal a successful series of adaptations to a limited faunal assemblage, which met the nutritional needs of the indigenous Indians for almost ten thousand years.

In this report, the nutritional residue of the middens of San Clemente, excavated in 1983, is analyzed to determine what the Indians were eating and whether there were any changes in their diet over time. An attempt will be made to determine the reasons for their choice of food and whether changes in their diet, if any, were produced by choice or by necessity. The nutritional basis of the San Clemente diet will then be contrasted to that of the Indians at Little Harbor on Catalina Island (another island site), and to that of the Indians at Malibu (a mainland coastal site). The comparisons will permit inferences to be drawn about aboriginal adaptations to similar and contrasting food procurement situations and should enhance our knowledge of prehistoric hunting and gathering techniques in Southern California.

In addition, the three sites noted above will be compared in a cultural sense. Since an inadequate food supply or a procurement strategy that is too time consuming normally leaves little room for economic or esthetic progress, evidence of technological or cultural progress or the lack thereof at these sites will provide further insight as to whether or not nutritional needs were being met.

Background

In preparing this report, certain background information proved useful. Basic to the understanding of the economic adaptations of the Indians on San Clemente were site reports from other Channel Islands and large coastal settlements by Axford and Meighan (1983), Glassow (1977 and l980), McKusick (l959), McKusick and Warren (l959), Meighan (l959), Orr (l968), and Tartaglia (1976). A survey of the cultural resources of San Clemente, prepared by Chambers in l981, provided a broad assessment of foods that might have been available to the Indians.

Midden analysis is an important tool in understanding the ecology of prehistoric peoples, especially in California where hunters and gatherers left few artifacts for clues to their cultural adaptations. As with any archaeological tool, midden analysis has problems both in the interpretation of the data and the methods by which the data are determined. If it were possible to excavate an entire midden site and screen the total volume of excavated material to permit expert analysis of all the faunal remains, the archaeologist would have an unassailable basis for his conclusions. The reality is that in most situations total site excavation is not possible and one is forced to make compromises. The archaeologist must sample sites selectively and is forced to make educated guesses about whether or not his samples are truly reflective of the site as a whole. The nature of such compromises, unfortunately, leads to inconsistencies in the interpretation of site use and in the comparison of one site to another. Since one cannot analyze the faunal components of an entire midden, one must take column samples and infer from them the probable makeup of a site. The question then arises of how many column samples are needed to account for areal variability. Small bones and fragments of friable shell may be lost in the screening process and the sample will be skewed. Even if a consistent and reliable sample is available the problem of faunal identification remains since archaeologists are rarely biological experts. Shell-bone/meat ratios are used to determine the amount of meat available from faunal remains, but experts are not in agreement about which figures constitute acceptable ratios of shell to meat in various shellfish. There are no consistent standards (Fredrickson 1972, Glassow 1972, Meighan 1972, Weide l972; Koloseike l970); hence, it is difficult to make comparisons between sites.

In this report, I have contrasted the results of column samples taken on San Clemente Island to those taken at Little Harbor on Catalina Island (Meighan l959) and to Tartaglia's (1976) analysis of maritime adaptations at Malibu. Since Meighan based his meat weight indices on Cook and Treganza (l950), and Tartaglia devised his own, it is necessary to translate them into comparable figures where possible. This lack of standard methods has required the author to make an educated guess, at times, about meat-weight indices, but an educated guess is better than none at all and is the best that can be done at the moment. (It should be noted in passing that a standardization of the methods of collecting and interpreting faunal remains would contribute to understanding the prehistory of California.)

Data Base and Methods

The data base for this report consists of six column samples, five of which were taken during midden excavations on San Clemente Island during the summer of l983. Two of these five columns are from Ledge (SCLI-126), two from Eel Point C (SCLI-43C), and one from Eel Point B (SCLI-43B). The sixth column sample, previously collected by L. Michael Axford at Eel Point B, permits my conclusions to be based upon two columns from each of the three excavations. Because of the differences in the concentration and depth of each midden, the columns vary and it is not always possible to correlate their constituents closely even when two column samples are from the same site.

The two column samples collected at the Ledge Site are fairly consistent. Both were comprised of levels measuring 10 by 10 by 15 cm which were sufficient in volume for samples of 2,000 grams per level. Unit T-22 Sample B, had six levels measured from 0 cm to 60 cm. Unit U-30 extended one more level to 75 cm, but as the only shell in the last level consisted of 0.1 gm of *Haliotis*, the last level was not considered for comparative purposes, although it was included in the column samples.

At Eel Point C, columns were collected in Unit 3 and Unit 6. While these units were contiguous and became part of the same large excavation pit, there are important differences in the size and depth of the two samples. The column from Unit 3 was taken in 10 cm levels (surface area of 10 by 10 cm) starting at a depth of 95 cm and extending nine levels to l85 cm. The limited midden material in Unit 3 permitted separation of only 1500 grams per level to define its components instead of the standard 2,000 gram sample. The column from Unit 6 was also collected in 10 cm levels but the volume (surface area of 10 by 15 cm and depth of 10 cm) of each level made it possible to separate 2,000 grams per level to be analyzed. The Unit 6 column started at 130 cm and reached the floor of the excavation at 220 cm. The difficulty of comparing or combining these columns is two-fold. First, the volume of the samples is not the same and, more importantly, the levels cannot be correlated. Level 4 (125 cm to 135 cm) of Unit 3 would be the rough equivalent of Level 1 (130 cm to 140 cm) in Unit 6. There are, therefore, six levels (levels 1, 2, and 3 in Unit 3 and levels 7, 8, and 9 in Unit 6) which have no counterparts. These problems at Eel Point C exist because of the overburden of sterile aeolian sand which made the normal practice of collecting a column from surface to sterile impractical.

At Eel Point B, Axford collected samples in Unit 3 (Axford) from volumes of 10 by 10 by 15 cm in four levels of 15 cm each beginning at 0 cm and ending at 60 cm. Madden and Roe's samples also came from a Unit 3 (UCLA) but were derived from a larger volume (15 by 15 by 15 cm) and included seven levels to a depth of 109 cm. As at Eel Point C, the column samples of Axford cannot be directly compared to those of Madden and Roe since the volume of the two collections is not the same, and Madden and Roe's samples continue 49 cm deeper than Axford's.

Analysis of the Column Samples

Each column sample was broken down by the gross weight of each constituent within a level and its percentage of the whole level sample, including the residue. Shell found in each level of a column was speciated, weighed, and each species allotted a percentage of the total shell weight for that level. One column sample from the Ledge Site illustrates the method used (Tables 10.1 and 10.2).

The data are the basis of all the information in this report because the shell/bone weights and percentages must be known before variability can be seen or flesh weights estimated. Gross weights alone of shell or bone will yield false figures of food actually consumed. As an example, at Eel Point C, Unit 6, the heaviest amount of shell, 492.1 grams of *Tegula funebralis*, would have represented only 27 grams of meat, less than that represented by one gram of fish bone. In order to present a more reasonable picture of food distribution, the gross shell/bone weights are translated into flesh weights shown in Tables 10.3a, 10.3b, and 10.3c.

The shell/bone to flesh ratios which I have used are based on three sources. For estimating the meat weight of *Haliotis*, I used Rigby's formula of one gram of shell per 0.7422 grams of meat (1:0.7422) since Rigby measured the actual weights of *Haliotis* shells and meat collected on San Clemente. The figures for *Mytilus* (1:0.76158), *Tegula* (1:0.055), and fish (1:27.7) are derived from Tartaglia (1976: 170). Mammal bone to flesh ratios (1:20), based on Cook and Treganza (l950: 250), were used both to make the comparison between San Clemente and Little Harbor more realistic and because Tartaglia's mammal ratio applied to small land mammals and not the sea mammals found on San Clemente and Little Harbor. Table 10.4 lists all shell species found in the San Clemente middens.

Table 10.1. Ledge (SCLI-126), T-22B: Column Sample.

Weight (column per cent)	L1: 0-10	L2: 10-20	L3: 20-30	L4: 40-50	L5: 50-60	L6: 60-70	Total
Residue	1722 (86.1%)	1622.11 (81.11%)	1858 (92.9%)	1734 (86.7%)	1640.04 (82%)	1780 (89%)	10356.15
Rock	96 (4.8%)	232 (11.6%)	52 (2.6%)	116 (5.8%)	300 (15%)	190 (9.5%)	986
Chipping waste	12 (0.6%)	28 (1.4%)	12 (0.6%)	122 (6.1%)	40 (2%)	24 (1.2%)	238
Shell	146 (7.3%)	80 (4%)	66 (3.3%)	24 (1.2%)	12 (0.6%)	6 (0.3%)	334
Vegetal matter	0	0	2 (0.1%)	0	0	0	2
Charcoal	4 (0.2%)	2 (0.1%)	6 (0.3%)	2 (0.1%)	0	0	14
Fish bone	5.68 (0.28%)	4.86 (0.24%)	3.07 (0.15%)	2 (0.1%)	0.96 (0.048%)	0	16.21
Mammal bone	14.32 (0.716%)	31.03 (1.55%)	0.93 (0.046%)	0	7 (0.35%)	0	53.28
Total	2000	2000	2000	2000	2000	2000	12000

Note: sample includes 1 glass trade bead, 1 small *olivella* bead, 1 flake of obsidian. After Janice Young.

Table 10.2. Ledge (SCLI-126) T-22B: Shell Species by Weight and Percent of Total Shell Sample.

Weight (column per cent)	L1: 0-10	L2: 10-20	L3: 20-30	L4: 40-50	L5: 50-60	L6: 60-70	Total (gm)
Haliotis cracherodii	114.9 (78.7%)	51.4 (64.8%)	16.63 (25.2%)	12.86 (53.4%)	9.7 (80.6%)	5.11(85.9%)	210.6
Mytilus californianus	0.73 (0.5%)	1.44 (1.8%)	0.59 (0.9%)	0.55 (2.3%)	0	0.6 (10%)	3.91
Tegula funebralis	28.28 (19.3%)	25.12 (31.7%)	48.31 (73.2%)	10.27 (42.7%)	1.14 (9.5%)	0.24 (4%)	113.26
Laevicardium elatum	0.73 (0.5%)	0	0	0	0.28 (2.3%)	0	1.01
Balanus sp.	0.44 (0.3%)	0.72 (0.9%)	0.2 (0.3%)	0.38 (1.6%)	0.28 (2.3%)	0	2.02
Tube worm	0	0.48 (0.6%)	0.2 (0.3%)	0	0.66 (5.5%)	0	1.34
Unidentified	0.88 (0.6%)	0.16 (0.2%)	0	0	0	0	1.04
Total weight	145.86	79.32	65.93	24.06	12.03	5.95	333.18

Note: shell equals 2.78 per cent of overall sample.

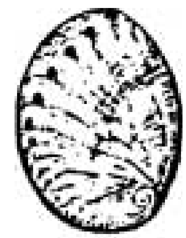
Figures 10.1a & b, 10.2a & b, and 10.3 show the distribution of flesh weight by unit and level for the three species, which together represent almost all of the shellfish portion of the Indians' diet: *Mytilus californianus* (mussel), *Haliotis cracherodii* (abalone), and *Tegula funebralis* (black top). Figures 10.4 and 10.5 treat the temporal and resultant size changes in shellfish exploitation and will be discussed later in that context.

Interpretations and Conclusions

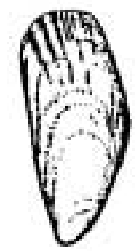
The archaeology of San Clemente gives us an opportunity to study the inhabitants of three sites who were, in spite of trade webs, less influenced by other cultures than the peoples of mainland communities because of their geographic location. Not only is the island relatively isolated, but the three sites also represent a long time span in which cultural and

Table 10.3a. Eel Point B: Shell/bone weights translated to flesh weights.*

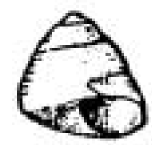
Column Unit 3 (Axford), Eel Point B (8,000 gm sample, levels 1-4, 0-60 cm)			
Component	Shell/bone weight (grams)	Flesh Weight of column (grams)	Flesh Weight of 1 cubic meter (kg)
Shell			
Haliotis	746.2	553.83	156.7
Mytilus	547.3	416.81	118
Tegula	190	10.45	2.96
Bone			
Fish	0.7	19.93	5.5
Mammal	10.4	208	58.9
Total	1494.6	1208.48	342.06
Column Unit 3 (UCLA), Eel Point B (10,000 gm sample, levels 1-5, 0-75 cm*)			
Shell			
Haliotis	703.1	521.84	118.2
Mytilus	843.4	642.32	145.5
Tegula	424.5	23.35	5.9
Bone			
Fish	6.6	102	41.4
Mammal	6.1	182.82	23.1
Total	1982.7	1472.33	334.1
Total flesh weight for both column units, Eel Point B (two cubic meters):			
		Kilograms	
Shell		547.26 (81%)	
Bone			
Fish		46.9 (6.9%)	
Mammal		82.0 (12.1%)	
Total		676.16	



Haliotis



Mytilus



Tegula

*Not all levels of this column were considered because they contained inclusions which would have biased the sample.
Note: Flesh weight to shell/bone weight ratios were derived as follows:

Ratio:	*Haliotis*	Jeff Rigby (personal communication)	1:0.742
	Mytilus	Tartaglia (1976:170)	1:0.76158
	Tegula	Tartaglia (1976:170)	1:0.055
	Fish	Tartaglia (1976:170)	1:27.7
	Mammals	Cook and Treganza (1950:250)	1:20.0

Table 10.3b. Eel Point C: Shell/bone weights translated to flesh weights.*

Column Unit 3, Eel Point C (10,000 gm sample, levels 6-11, 136-205 cm)			
Component	Shell/bone weight (grams)	Flesh Weight of column (grams)	Flesh Weight of 1 cubic meter (kg)
Shell			
Haliotis	47.3	36.11	8
Mytilus	30	22.85	5.2
Tegula	61.1	3.36	0.8
Bone			
Fish	1.43	8.78	8.8
Mammal	1.73	4	7.7
Total	1494.6	1208.48	342.06
Column Unit 6, Eel Point C (12,000 gm sample, levels 2-7, 140-200 cm*)			
Shell			
Haliotis	373.2	276.99	52.3
Mytilus	59.3	46.16	8.5
Tegula	478.8	26.33	5
Bone			
Fish	28	775.6	146.4
Mammal	30	600	113.2
Total	969.3	1724.08	325.4
Total flesh weight for both column units, Eel Point B (two cubic meters):			
		Kilograms	
Shell		79.8 (22%)	
Bone			
Fish		155.2 (44%)	
Mammal		120.9 (34%)	
Total		355.9	

*Not all levels of this column are considered because they contained inclusions which would have biased the sample.

Table 10.3c. Ledge: Shell/bone weights translated to flesh weights.*

Column Unit T-22B, Ledge (8,000 gm sample, levels 1-4, 0-60 cm)*			
Component	Shell/bone weight (grams)	Flesh Weight of column (grams)	Flesh Weight of 1 cubic meter (kg)
Shell			
Haliotis	200.9	149.1	42.2
Mytilus	3.31	2.5	0.7
Tegula	111.88	6.2	1.7
Bone			
Fish	13.25	367	103.9
Mammal	46.28	925.6	263
Total	375.62	1450.4	410.5
Column Unit U-30, Ledge (8,000 gm sample, levels 1-4, 0-60 cm)*			
Shell			
Haliotis	235.7	174.89	49.5
Mytilus	35.5	27.03	7.7
Tegula	143.9	7.9	2.2
Bone			
Fish	12.1	336.17	94.9
Mammal	14	280	79.3
Total	441.2	824.99	233.6
Total flesh weight for both column units, Eel Point B (two cubic meters):			
		Kilograms	
Shell		104.0 (16%)	
Bone			
Fish		198.8 (31%)	
Mammal		341.5 (53%)	
Total		644.1	

*Not all levels of this column are considered because they contained inclusions which would have biased the sample.

Table 10.4. Shell species represented in two San Clemente Island middens. (Most common food species tagged by *)

Species	Common Name	Ledge (SCII-126)	Eel Point (SCII-43B. 43C)
Haliotis cracherodii *	Black abalone	x	x
Haliotis fulgens	Green abalone	x	x
Haliotis corrugata	Pink abalone	x	x
Mytilus californianus *	California mussel	x	x
Tegula funebralis *	Black turban	x	x
Tegula eiseni	Banded turban		x
Tegula gallina	Speckled turban		x
Astraea undosa	Wavy Turban	x	x
Lottia gigantea	Owl limpet	x	x
Megathura crenulata	Giant keyhole limpet	x	x
Septifer bifurcatus	Platform mussel	x	x
Norrisia norrisii	Norris's top snail	x	x
Olivella biplicata	Olive shell	x	x
Amiatis callosa	Pacific white venus	x	x
Mopalia muscosa	Mossy chiton	x	x
Acmaea sp.	Various limpets	x	x
Laevicardium elatum	Giant egg cockle	x	
Hinnites multirugosus	Giant rock scallop	x	
Cyaraea spadica	Chestnut cowry	x	
Pecten circularis	Speckled pecten	x	
Codakia californica	California lucine		x
Opalia insculpta	Sculptured wentletrap		x
Mitra idae	Ida's miter		x
Kelletia kelleti	Kellet's whelk		x
Acanthina spirata	Angular unicorn		x
Trigoniocardia biangulata	Strawberry cockle		x
Polinices lewisii	Lewis's moon snail		x
Fissurella volcano	Volcano limpet		x
Strongylocentrotus sp.	Sea urchin		x
Conus californicus	Cone		x
Fusinus barbarensis	Santa Barbara spindle		x
Olivella baetica	Little olive		x
Chama pellucida	Agate chama		x
Oceanebra interfossa	Sculptured rock snail		x
Gemma gemma	Gem clam		x
Tivela stultorum	Pismo clam		x

subsistence changes can be delineated. Each stage represents a distinct period in the development of food procurement techniques and it is from this aspect that Eel Point B and C and the Ledge Site will be discussed.

Eel Point B has C^{14} dates extending back 5,600 to 8,000 years for column samples recorded by Axford, and the midden refuse indicates a subsistence heavily reliant upon shellfish. Warren and Pavesic (l963), in discussing the early coastal gathering complexes of the San Diego County coast, wrote:

> A simple gathering people arrived on the littoral area of San Diego sometime prior to 7,500 years ago. They apparently came from the interior desert and brought with them a way of life where a greater dependence was placed on gathering of vegetable foods and hunting and trapping small mammals. Such an economy was not readily adaptable to the ocean resources; however it appears to have been easily adapted to the lagoons (which) supported abundant supplies of easily gathered shellfish. The use of shellfish resulted in a food supply capable of supporting a relatively large population for a gathering economy.

Warren also postulated that some of these people lived on the islands off the coast as long ago as 6,000 years (now known to date as far back as 10,000 years). Table 10.3a indicates that 8l per cent of the meat consumed at Eel Point 43B was shellfish consisting mostly of mussels and abalone, both of which are large shells and yield a good amount of flesh for the effort involved. The Indians' even-handed shell choice implies that both species were abundant and easily available. Actually the 81 per cent figure for shell meat is probably low because, while it includes a small percentage of *Tegula*, isolated pockets of the large snail *Astraea undosa* (wavy turban) are not represented since its appearance in the midden samples was too sporadic to be included in an overall assessment of diet. Gathering of shellfish is time-consuming but not arduous. The midden remains at Eel Point B indicate a community of primarily gatherers with fishing apparently secondary.

The midden at Eel Point C contains constituents indicative of a much later occupation based on both artifactual and faunal remains. Analysis of the midden components is difficult because the site is also a cemetery for both humans and dogs and thus greatly disturbed. It can be stated, however, that only 22 per cent of the meat consumed by the inhabitants consisted of shellfish, 76 per cent of which was abalone and 17 per cent mussel. Since this shows a sharp decline in mussel gathering, indications are that in the time between the occupations of Eel Point B and C the mussels, which had been a staple food, may have been over-exploited. On the other hand, while shellfish represented only 22 per cent of the diet at Eel Point C, fishing and hunting had flowered; of the total flesh weight, 44 per cent was fish and 34 per cent was sea mammal. It is obvious that the Indians were better able to exploit all of the marine fauna and shellfish had become a dietary supplement rather than the preferred food.

The Ledge Site was occupied into the historic period and yielded post-contact artifacts. Unlike the two middens at Eel Point, Ledge is inland and may have been chosen for a village site because its population would have been less vulnerable to sporadic raids by the Spanish. Although they did not live on the coast, the people at Ledge were still quite dependent on the ocean's resources. It is difficult to estimate what part of their diet was vegetable because, unless burned, seeds are not preserved and many of the grinding tools left at the site were probably removed by collectors. Even if the diet at Ledge did include a fair amount of plant foods, the Indians still required protein. Because Ledge is two miles from the coast, simple gathering of protein became more labor intensive. It was more

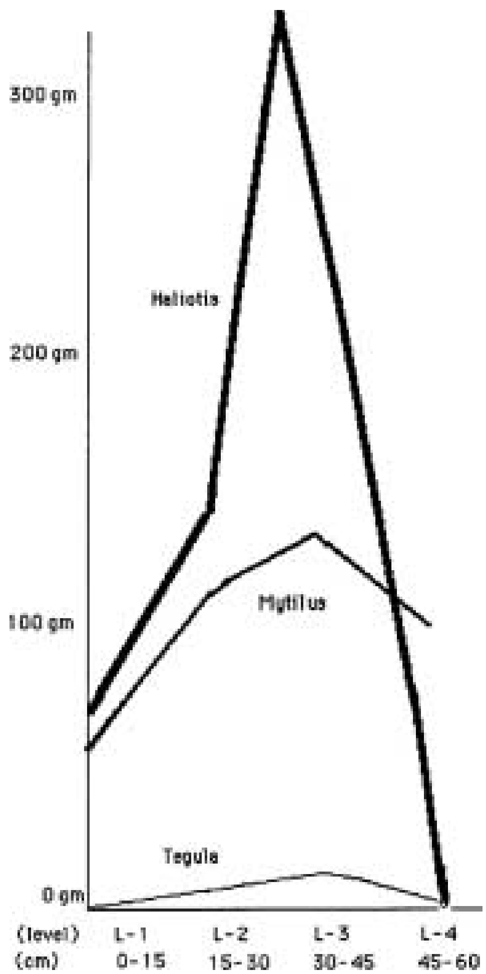


Fig. 10.1a. Eel Point B (SCLI-43B), Unit 3 (Axford): shell flesh weight (grams).

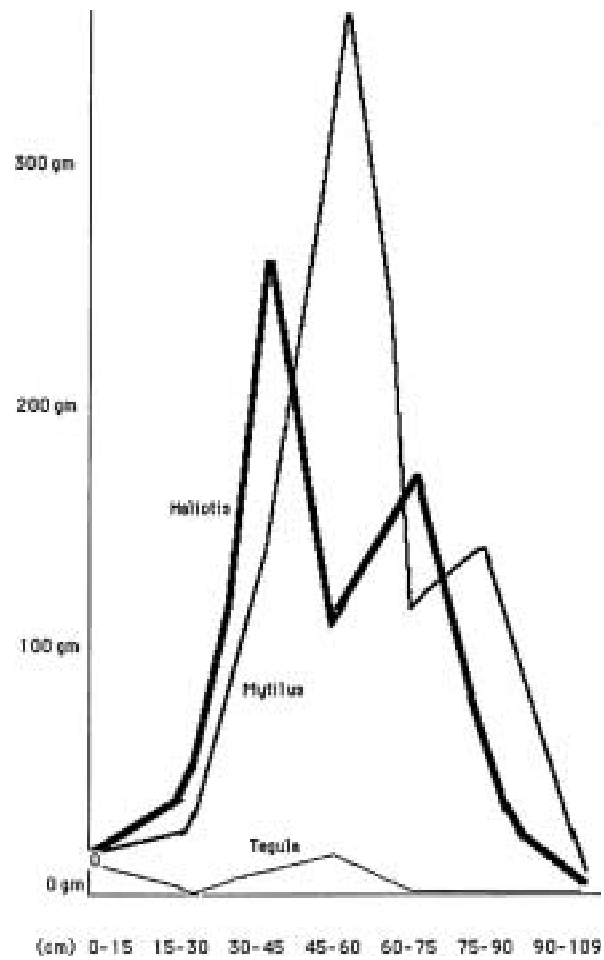


Fig. 10.1b. Eel Point B (SCLI-43B), Unit 3 (UCLA): shell flesh weight (grams).

efficient to bring back to the settlement the type of sea life whose flesh outweighed its shell or bone. Table 10.3c shows an increase in the exploitation of sea mammals (53 per cent of the protein diet), a consumption of fish roughly similar to Eel Point C (31 per cent), and a consequent decrease in shellfish consumption (16 per cent).

Figures 10.3a and b indicates that 88 per cent of the shell present was *Haliotis.* Figure 10.4 shows a steady increase over time in the exploitation of *Haliotis*, with the decrease of *Mytilus*, almost a mirror image. I believe that this result was due to over-exploitation which affected both the mussel and the abalone populations. Abalone shells from all sites were measured (Fig. 10.5) and these data show a marked decrease in the size of the shell over time until, by the time of contact, almost all of the *Haliotis* collected were immature specimens, many of very small size.

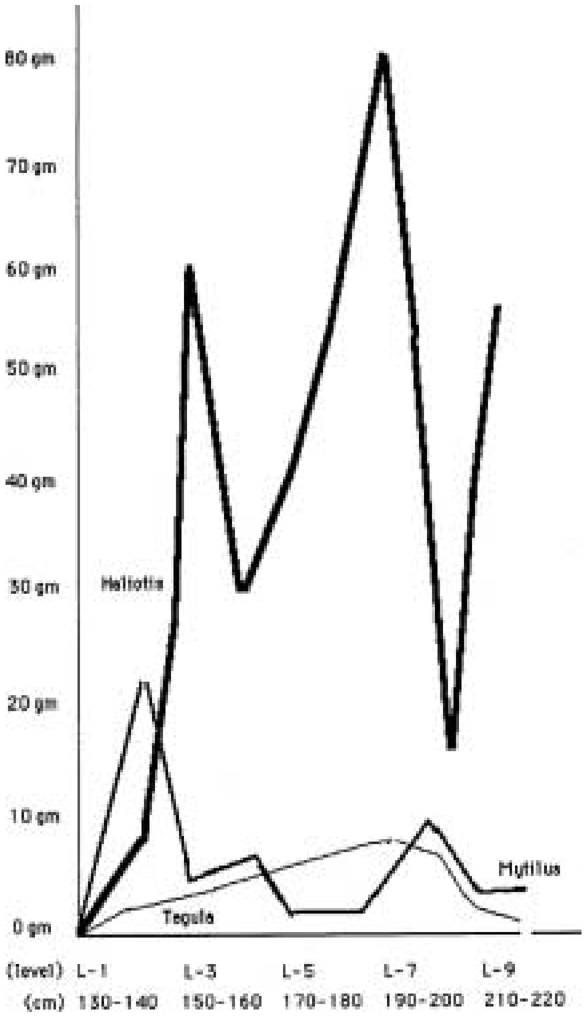


Fig. 10.2a. Eel Point C (SCLI-43C), Unit 6: shell flesh weight (grams)

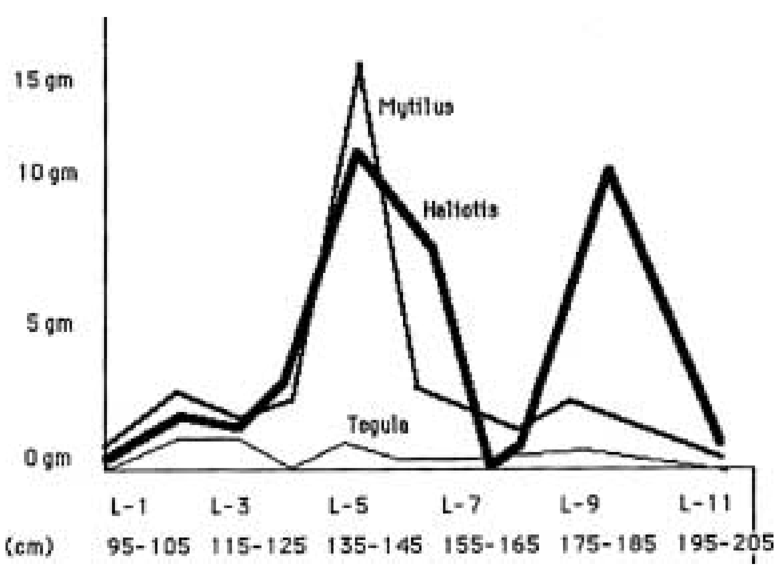


Fig. 10.2b. Eel Point C (SCLI-43C), Unit 3: shell flesh weight (grams)

Comparisons with Little Harbor and Malibu

The subsistence patterns of the three San Clemente sites were compared to those of Little Harbor on Catalina Island and a mainland coastal midden at Malibu. The Little Harbor Site was selected because its food procurement problems were similar to those of San Clemente, and Malibu because of the contrast provided by a true midden site with different food resources.

The Little Harbor Site was excavated between 1953 and 1955 by Clement Meighan (1959). Meighan dates the site at just under 4000 BP, which would place Little Harbor in the middle of the 8,000 year time span suggested for San Clemente (Axford, 1984:11). By using Meighan's figures of flesh weight in kilograms per cubic yard and converting my cubic meter calculations to cubic yards, I was able to compare the data (Table 10.5). Since Meighan combined his fish and mammal weights, I did the same and used his shell/bone to flesh ratios.

None of the San Clemente middens are as rich in flesh as the one at Little Harbor, but with the exception of Eel Point B (the oldest site), the predominance of fish and mammal exploitation is similar and even exaggerated at the historic site of Ledge. Meighan (l959:402) reported that, as on San Clemente, the shellfish resources at Little Harbor were "predominantly *Mytilus* (mussel) and *Haliotis* (abalone)," but my data show that the use of these species is the reverse of that on San Clemente because his column samples show "a four to one predominance of *Haliotis* over *Mytilus* in the lower levels and a shift …to one *Haliotis* to four *Mytilus*…in the top levels." Tartaglia (1976:134) wrote that "abalone and mussels have similar temperature limits." Because neither of these species could have survived a sudden temperature shift, intensive collecting must have caused the change in the choice of species. Presumedly the Indians on each island

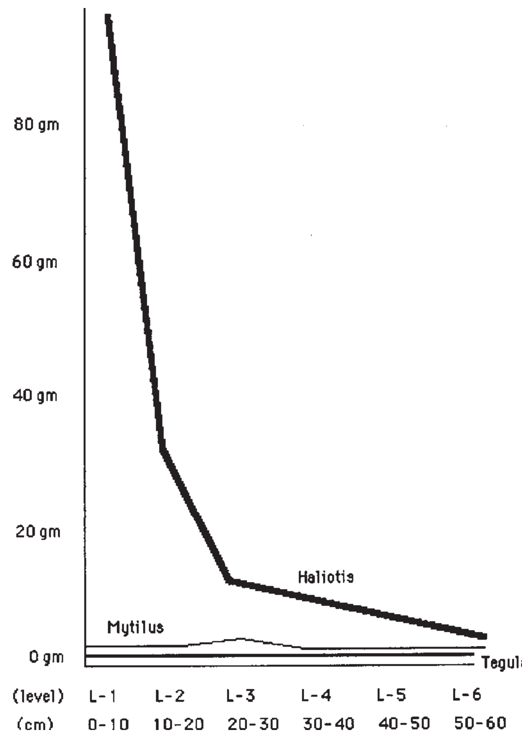


Fig. 10.3a. Ledge (SCLI-126), Unit T-22B: shell flesh weight (grams).

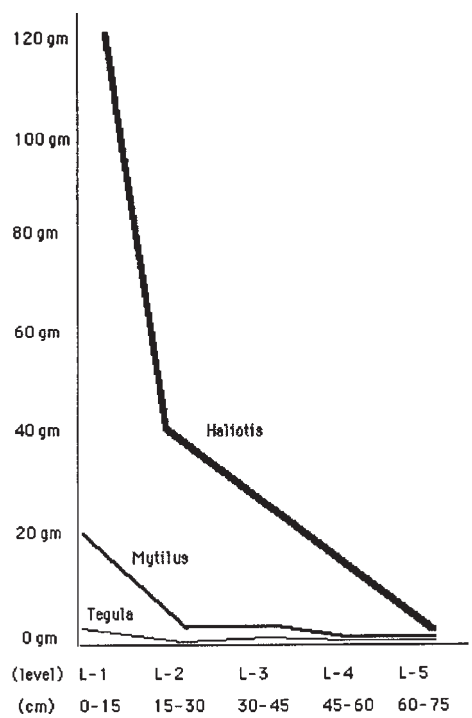


Fig. 10.3b. Ledge (SCLI-126), Unit U-30: shell flesh weight (grams).

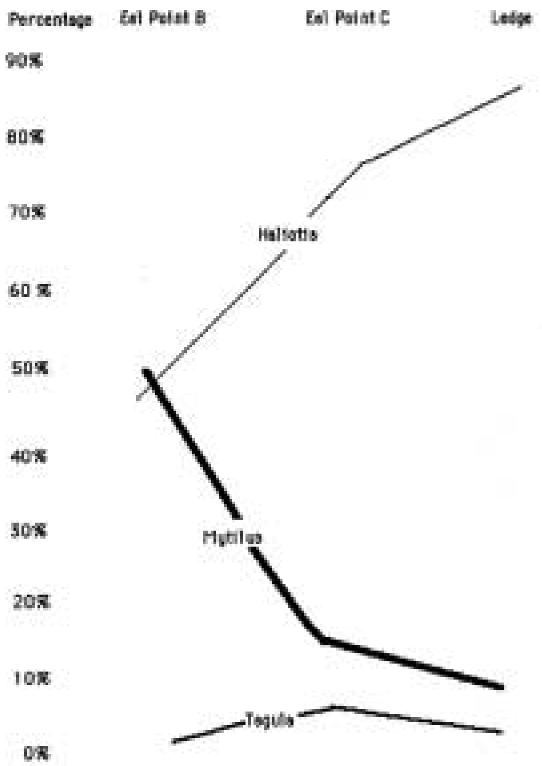


Fig. 10.4. Per cent of shell to flesh weight in three San Clemente Island sites.

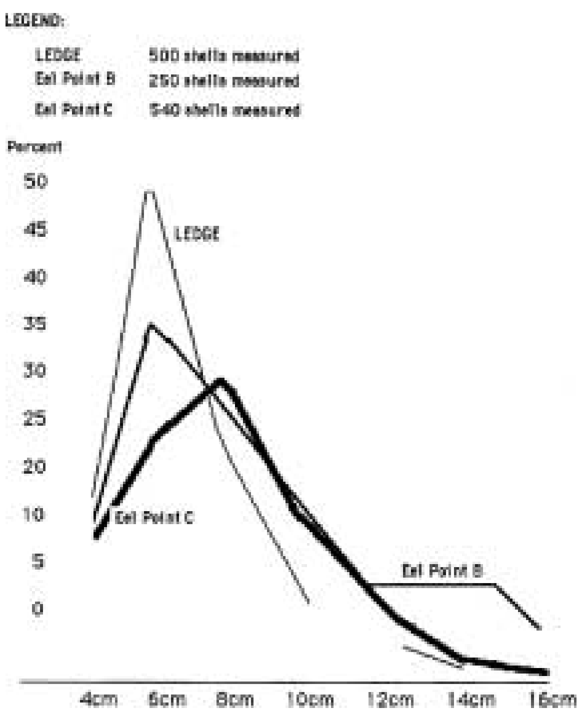


Fig. 10.5. Comparison of the size of *Haliotis* shells.

Table 10.5. Comparison of subsistence data.

Per Cubic Yard	Little Harbor	Eel Point B	Eel Point C	Ledge
Shell Flesh Wt. (Kg)	92.40	120.00	17.48	22.81
Fish /Mammal Wt.(kg)	139.47	44.30	90.18	185.90
Total:	231.87	164.30	107.66	208.71

over-gathered their preferred shellfish, but the preferred species were not the same.

The Malibu Site excavated by Meighan was discussed in Tartaglia's doctoral dissertation in l976. This dissertation has not been published but the reader is advised that the Malibu Site data used for comparison to the San Clemente data are derived from it. Tartaglia excavated one macro-column sample (Unit D-4) from which he concluded that at Malibu "a mixed maritime subsistence orientation (marine mammal, fish, and shellfish) existed. A distinct trend of increased molluscan exploitation and a decreasing frequency of fish bone in the total marine meat diet is evident: the diachronic increase in molluscan resource consumption demonstrates that shellfish constituted the major marine subsistence resource." (Tartaglia 1976:177). At Malibu the Indians were not restricted to a marine diet, but their reliance on shellfish at this site can be shown. When there was a great decrease in midden shell the "total meat resources consumed diminish[ed] substantially… Therefore the prehistoric resident population size may be indirectly determined by the amount of molluscan resources locally consumed." (Tartaglia 1976:178). The preferred shellfish at Malibu were *Mytilus* and the clam *Protothaca staminea* (Pacific Littleneck). The choice was possible here (as it was not on either San Clemente or Catalina Islands) because at Malibu there is, in addition to the open rocky shore inhabited by mussels, a lagoon and a sandy beach which are the habitat of clams. A study of

Tartaglia's (1976:184-188) midden analysis of 25 levels reveals that in all but the five most recent levels more mussels were consumed than clams. In the levels from 0 to 30 cm the trend is reversed and clams represent the larger part of the diet. Clams are unlikely to have been the food of choice for the Indians for two reasons. First, they are buried six inches in the sand and are not easily found and collected and, second, they have less meat than mussels, a ratio of meat to shell of 1:0.48 for *Protothaca* versus 1:0.76 for *Mytilus*. I assume that the forced change to a less economical shellfish species may have caused the site to become less important as a source of food, particularly as the major part of the diet at Malibu was shellfish.

The comparisons between San Clemente, Little Harbor, and Malibu treat two aspects of marine subsistence. They concern changes over time, as shown in the temporally separated middens on San Clemente and the adaptations that arose because of increased sophistication in fishing and hunting techniques and the decimation of shellfish populations. The pressures of a limited and changing fauna caused the island populations to adapt to new exploitation patterns. At Malibu, while the harvesting of shellfish provided the largest part of their diet, the Indians did not choose to increase sea mammal hunting and fishing to compensate for the diminished shellfish supply. Unlike the island people their food base was broader and included both a varied vegetable diet and large and small land animals. Therefore, the Indians at Malibu were not as dependent upon a marine subsistence.

Suggestions For Further Study

A study based on as small a sample as six columns cannot be as convincing as I would wish, but this must be considered a preliminary report. In future excavations on San Clemente, more column samples should be taken and particular care given to weighing the entire sample before extracting the 2,000 gram samples per level which are to be analyzed. Additional column samples were obtained in work done since 1983; these are not analyzed in this report. A final report should include a more complete faunal analysis, especially of fish bone). The list of fish species in Salls (Salls 2000) gives us valuable clues to both seasonality and fishing techniques. It also allows for comparison of the amount of shellfish in the diet relative to other marine resources.

Other kinds of studies are also important for overall assessment of prehistoric diets. Column samples give good quantitative evidence of what is present in the sample, but cannot be considered a precise reflection of the total diet. Some food resources do not appear in the column samples (particularly plant foods), and large food remains (such as sea lion bones) cannot be included in column samples and must be estimated from other collecting strategies (e.g. bones collected in level bags). Goldberg's Ph.D. dissertation (1993a) presents isotope analysis of human bones (reflecting some aspects of diet) has somewhat different conclusions about the importance of various resources in the prehistoric diet on San Clemente Island. Overall evaluation of prehistoric diets therefore requires a combination of diverse studies. Midden analysis remains a central method, however, in view of the intensive use of shellfish by coastal and island peoples of California.

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