Shell Exploitation At The Yerba Buena Site (CA-SFR-114), San Francisco: A Multi-dimensional Perspective

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Recent excavations at CA-SFR-114 documented a rich Native American settlement occupied primarily from 1530 to 685 cal BP. Shellfish remains dominate the cultural assemblage, primarily represented by clams, mussels, and oysters, all of which were harvested from San Francisco Bay. Several analyses were conducted to understand relative species importance, change in their exploitation over time, and their dietary contribution. Striking differences in relative frequency are discerned based on analytical technique (notably tied to screen size, and the reliance on weight or minimum number of individuals (MNI) data). Moreover, shell size measurements are synthesized to provide baseline insight into population data on gathered shellfish.

Recently Far Western Anthropological Research Group, Inc., conducted archaeological investigations for the Moscone Center Expansion Project. This investigation revealed a previously undocumented southwestern expansion of CA-SFR-114 (Yerba Buena site). Site SFR-114 was originally discovered during pre-construction testing for the Moscone Center in the 1980s (Archeo-Tec 1988). Data recovery excavations by Archeo-Tec revealed a substantial Middle Period residential site with well-preserved stratigraphy, features, and human burials (Byrd et al. 2018). Rich assemblages of artifacts, shellfish, and fauna were also recovered during the original excavations, which were used to research resource intensification in the San Francisco Bay Area (Byrd et al. 2018).

A dense quantity of shellfish was recovered during the recent excavations at SFR-114. Shell was collected from both the well-preserved archaeological midden deposit and an offsite natural shell concentration (Figure 1 and Figure 2). The midden samples selected for analysis were column samples from control unit (CU) two (dune crest) and CU five (dune slope). One column sample from CU 20, the offsite natural shell concentration, was also analyzed. These samples were selected to explore spatial and temporal variation in shellfish species representation both within the site and in natural context adjacent to the site. The range of shellfish categories identified from these analytical contexts is presented in Table 1.

Considerable debate exists as to the best method of quantifying shellfish remains (Mason et al. 1998; Glassow 2000). Some do not consider weight to be an accurate measurement for addressing questions of relative taxonomic abundance because vertebrate faunal analyses use number of identified specimens (NISP) or the minimum number of individuals (MNI; Mason et al. 1998). On the other hand, strictly using NISP or MNI to assess the variability of a shellfish collection can also be problematic due to fragmentation and identification of non-repetitive elements (Glassow 2000).

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WEIGHT RESULTS

More than 220 pounds of shell were recovered during the recent data recovery excavations, and approximately 15 percent of the collection was subjected to shellfish species identification. Sampling varied within the size categories; all shellfish larger than 1/4 inch and 25 percent of shellfish remains between 1/4 and 1/8-inch in size was weighed and tabulated according to species. The 25 percent sample from the 1/8-inch screen size was the used to calculate the species presentation for the entire 1/8-inch sample. Finally, both the 1/4-inch and 1/8-inch shell were combined to provide the overall representation by species

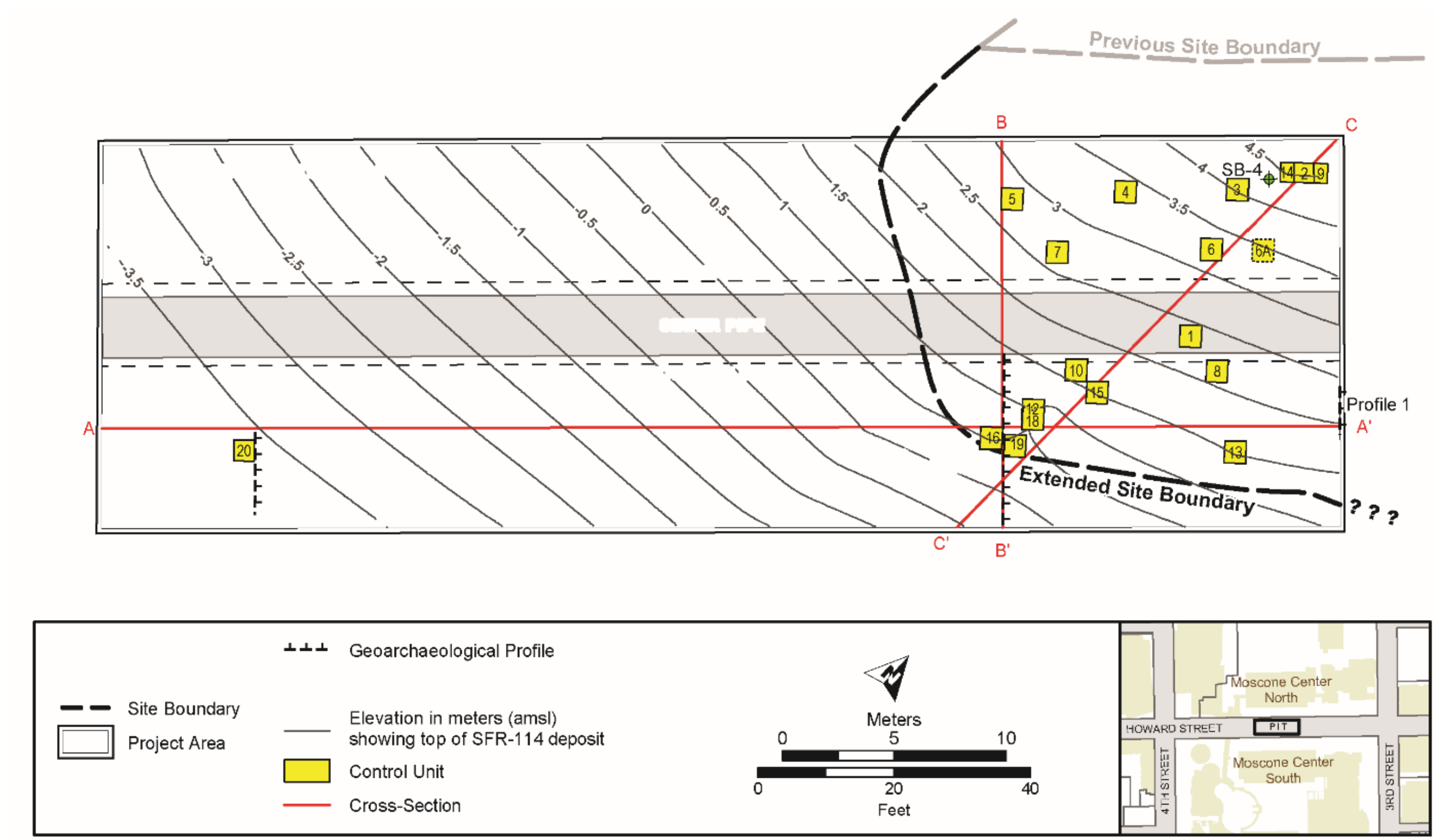

Figure 1. Map of Excavations and Geological Profiles with Mean Sea Level Contours Depicted.

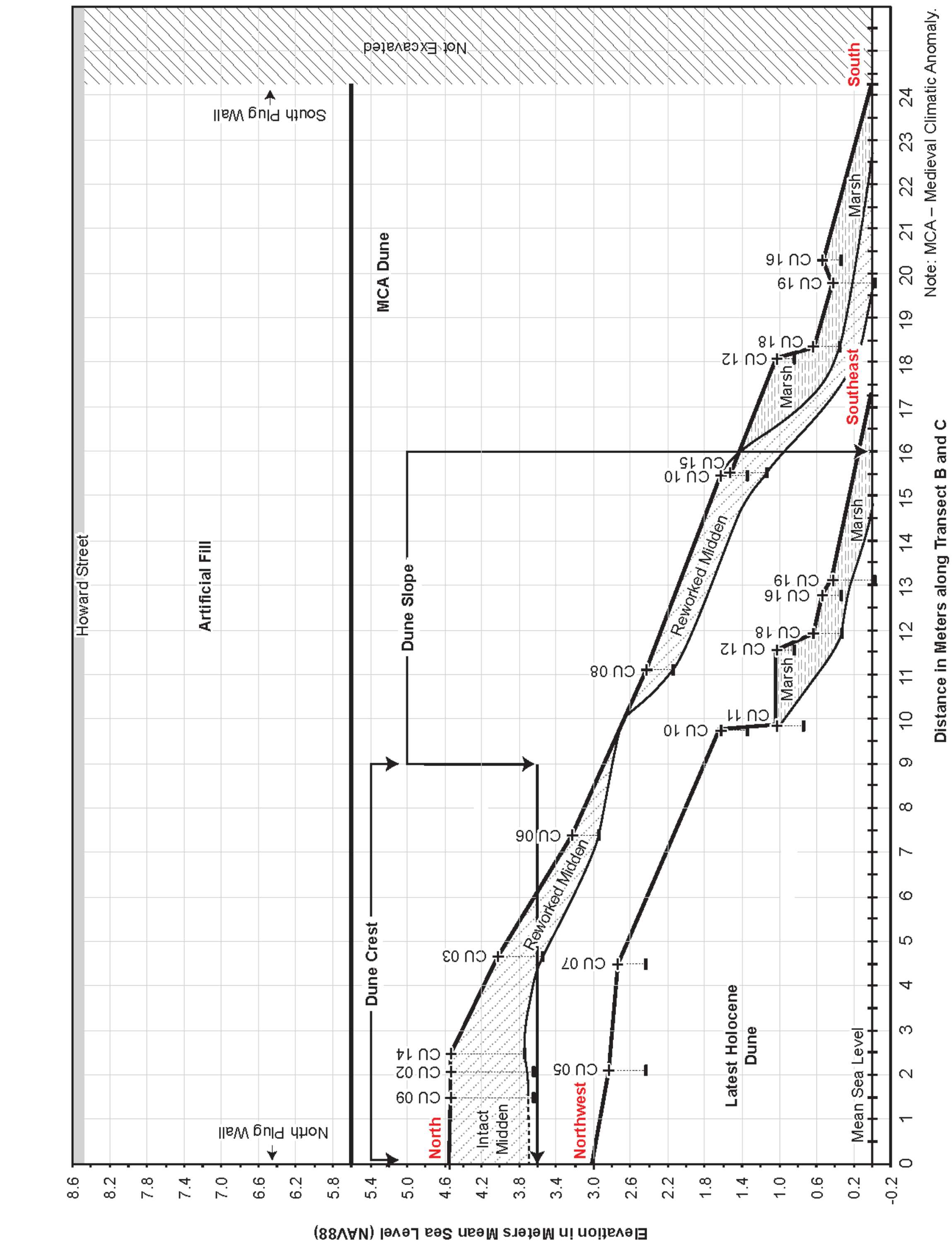

Figure 2. Geological Cross-sections.

Table 1. List Shellfish Taxon Categories by Control Unit.

COMMON NAME	ACCEPTED SCIENTIFIC NAME	CA-SFR-114		OFFSITE
		CU 2	CU 5	CU 20
Barnacle	*Balanus* spp.	x	x	x
Barnacle, Acorn	*Balanus glandula*	x	-	x
Chiton	Polyplacophora (Amphineura)	x	-	-
Clam	Bivalvia	x	x	x
Clam, Bent-nose	*Macoma nasuta*	x	x	x
Cockle, Basket	*Clinocardium nuttallii (Cardium orbis)*	x	x	-
Crustacean	Crustacea	x	x	-
Invertebrate, Fossilized	Non-Vertebrata, Fossilized	x	-	-
Invertebrate, Indeterminate	Non-Vertebrata, Indeterminate	x	x	x
Limpet	*Lottia* spp.	x	-	-
Mother of Pearl	Nacre	x	-	-
Mussel, Bay	*Mytilus trossulus (Mytilus edulis)*	x	x	x
Mussel, California	*Mytilus californianus*	x	-	-
Oyster, Native Pacific (California Oyster)	*Ostrea lurida*	x	x	x
Piddock	Pholadidae	x	-	-
Slippersnail	*Crepidula* spp.	x	-	-
Snail, Frilled Dogwinkle	*Nucella lamellosa*	x	x	-
Snail, Terrestrial	*Helminthoglypta* spp.	x	-	-
Snail/Slug	Gastropoda	x	-	x

Note: x indicates presence of species in the unit.

for each sample. The midden shellfish subjected to analysis is dominated by bay mussel. In contrast to the midden, the off-site shell concentration was dominated by barnacle. Table 2 presents the distribution of the predominant shellfish by major context. For the midden samples, bay mussel (*Mytilus trossulus*) dominates the sample with 61.2%, followed by bent-nose clam (*Macoma nasuta*) at 21.9%, with barnacle (*Balanus* sp.) at 6.8%, Native Pacific oyster (*Ostrea lurida*) at 4.3% and frilled dogwinkle (*Nucella lamellose*) at 4%. The remaining 1.8% of the sample includes California mussel, clam, cockle, piddock, limpet, slippershell, acorn barnacle, chiton, crustacean, terrestrial snails, and indeterminate invertebrates.

Shellfish (by weight) data from temporally distinct components at the site indicates an increase over time for bent-nose clam with a corresponding decrease in bay mussel, which is consistent with wider patterns in the bay area. The analysis from CU 2 shows notable differences in the proportion of the major species by weight throughout time (denoted by upper and lower midden context). There is an increase over time in the weight of bent-nose clam (from 16.1% to 28.4%), and a corresponding decline in bay mussel (from 68.7% to 52.8%; Figure 3). This trend reflects wider patterns in the Bay Area where shellfish

Table 2. Relative Frequency of Major Shellfish Weight by Context.

Species	Common Name	CU 2 (Dune Crest) Upper Midden (%)	CU 2 (Dune Crest) Lower Midden (%)	CU 2 (Dune Crest) Total (%)	CU 5 (Dune Slope) Total (%)	Midden Total (%)	CU 20 Offsite Total (%)	Total (g)
Balanus spp.	Barnacle	6.2	8.2	7.0	2.3	6.8	83.1	4,336.3
Macoma nasuta	Bent-nose clam	28.4	16.1	23.1	1.4	21.9	0.01	2,608.8
Mytilus trossulus	Bay mussel	52.8	68.7	59.7	86.4	61.2	5.7	7,517.8
Nucella lamellosa	Frilled dogwinkle	4.9	2.5	3.9	5.6	4.0	0.0	471.1
Ostrea lurida	Native Pacific oyster	6.1	2.4	4.5	1.8	4.3	11.0	982.6
All others		1.6	2.0	1.8	2.6	1.8	0.3	231.4
Total (%)		100.0	100.0	100.0	100.0	100.0	100.0	-
Total (g)		6,406.0	4,824.3	11,231.2	665.8	11,897.0	4,251.0	16,148.0

Note: Upper Midden 0–40 centimeter levels; Lower Midden 40–90 centimeter levels.

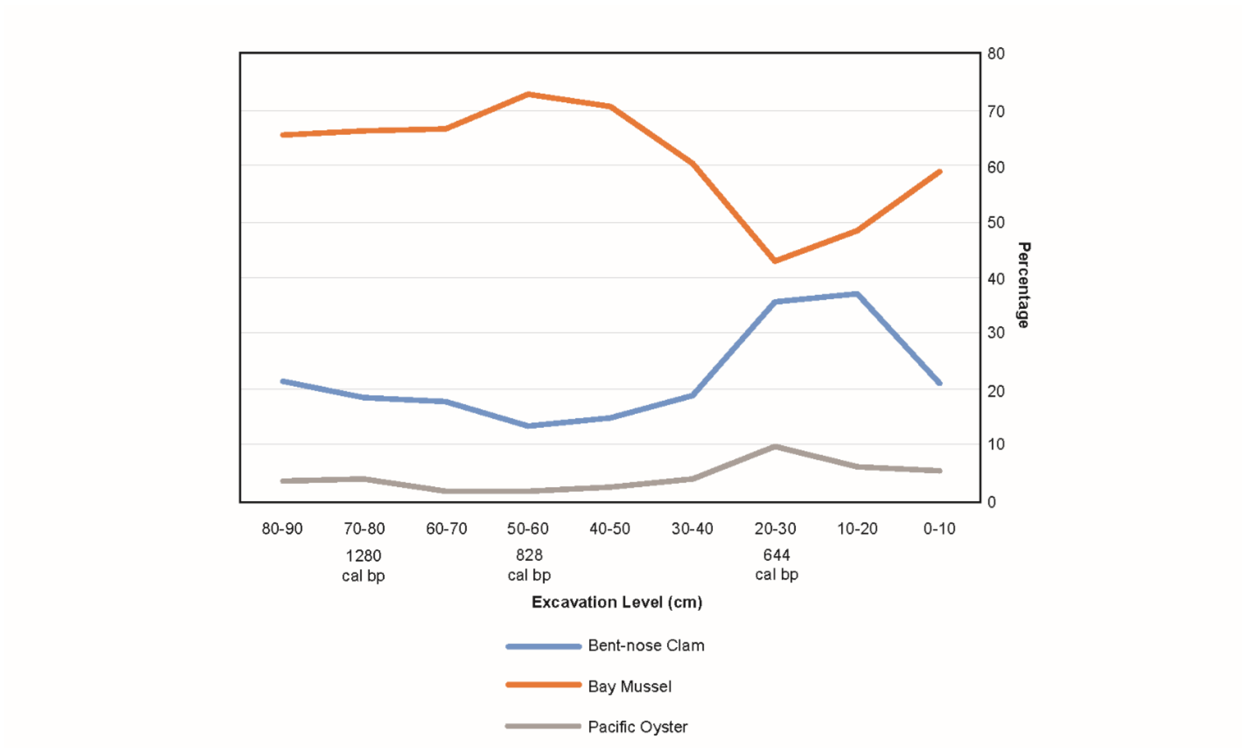

Figure 3. Major Species Weight Percentages by CU 2 Excavation Level.

reliance shifts over time from oyster-dominant to bay mussel-dominant to bent-nose clam-dominant (e.g., Bickel 1978; Gifford 1916; Hylkema 2002:252, 2007:349–352; Milliken et al. 2007:109). In contrast, the Native Pacific oyster increases between the upper and lower midden (2.4% to 6.1%) and this pattern is not consistent with prior findings. When comparing the CU 2 lower midden samples to the CU 5 (dune slope) samples, CU 5 has a much higher frequency of bay mussel (86.4%) and a lower frequency of bent-nose clam (1.4%). It is uncertain if the spatial differences are due to sample size or variation in processing or discard techniques.

The non-site sample from CU 20 has a much different frequency of shellfish. This sample is mostly made up of barnacle (83.1%), Native Pacific oyster (10.9%) and bay mussel (5.7%). The CU 20 shellfish assemblage is not consistent with the midden assemblage recovered from SFR-114 or any of the documented archaeological midden assemblages in the San Francisco Bay area. Therefore, the shellfish collection from CU 20 was interpreted as being a natural deposit rather than a cultural deposit.

MINIMUM NUMBER OF INDIVIDUAL RESULTS

This aspect of the study focused on the dune crest midden deposit of CU 2. All hinges (non-repetitive elements) were counted for the three predominant species (bent-nose clam, bay mussel and Native Pacific oyster) to obtain MNI values by species and level (Figure 4, Table 3). This was done to provide an alternative perspective to weight calculations regarding species representation. Results shows bay mussel dominates the assemblage, ranging from 91% to 72% of the total number of individual shellfish identified. Native Pacific oyster is the second most common species representing 5 to 19% of the analyzed assemblage and bent-nose clam represent 2 to 9% of the sample. Bay mussel declines over time while Native Pacific oyster increases over time and bent-nose clam remains steady throughout time.

MEASUREMENT RESULTS

All whole to nearly complete bent-nose clams and Native Pacific oysters shells from the heavy residue of flotation samples and unit levels of CUs 2, 9, and 14 were measured to obtain size information, including the shell length, height, width, length of the hinge axis, and hinge width. Whole mussels are largely absent, so they could not be studied in the same manner. Approximately twice the number of Native Pacific oyster shells (n=446) than bent-nose clam shells (n=282) were sufficiently intact for size measurements (Table 4.) Clam height is variable—stable in the lower midden, with size increasing in the upper midden then has a sharp decline. Reasons for the strong decline in final level are uncertain. In contrast Native Pacific oyster heights increase over time with the largest mean value from the 20–30-centimeter excavation level.

SUMMARY

There are notable differences in the total proportions between results by MNI and by weight (Table 5). The proportions of bay mussel and Native Pacific oyster is higher when MNI's are considered (with Native Pacific oysters being much more prevalent than bent-nose clams) while the proportion of bent-nose clam is larger when weight is examined. The scale of changes between the upper and lower midden differs by analytical technique. Based on MNI, the increase in bent-nose clam is muted. In contrast, the relative increase in Native Pacific oyster is constant regardless of the method. More work is needed to ascertain which method is more appropriate to assess the relative dietary contribution of different species.

Beyond using shell weights, which is highly fragmentary in nature and can vary based upon mesh size and field collection procedures, MNI statistics and shell measurements can help account for shifts in shell procurement across space and time. Shellfish size analysis can provide insight to shellfish collection patterns which can be used to model the nature of shellfish populations. When these analysis procedures are combined with isotope data, it may give more insightful conclusions on shellfish seasonality collection procedures.

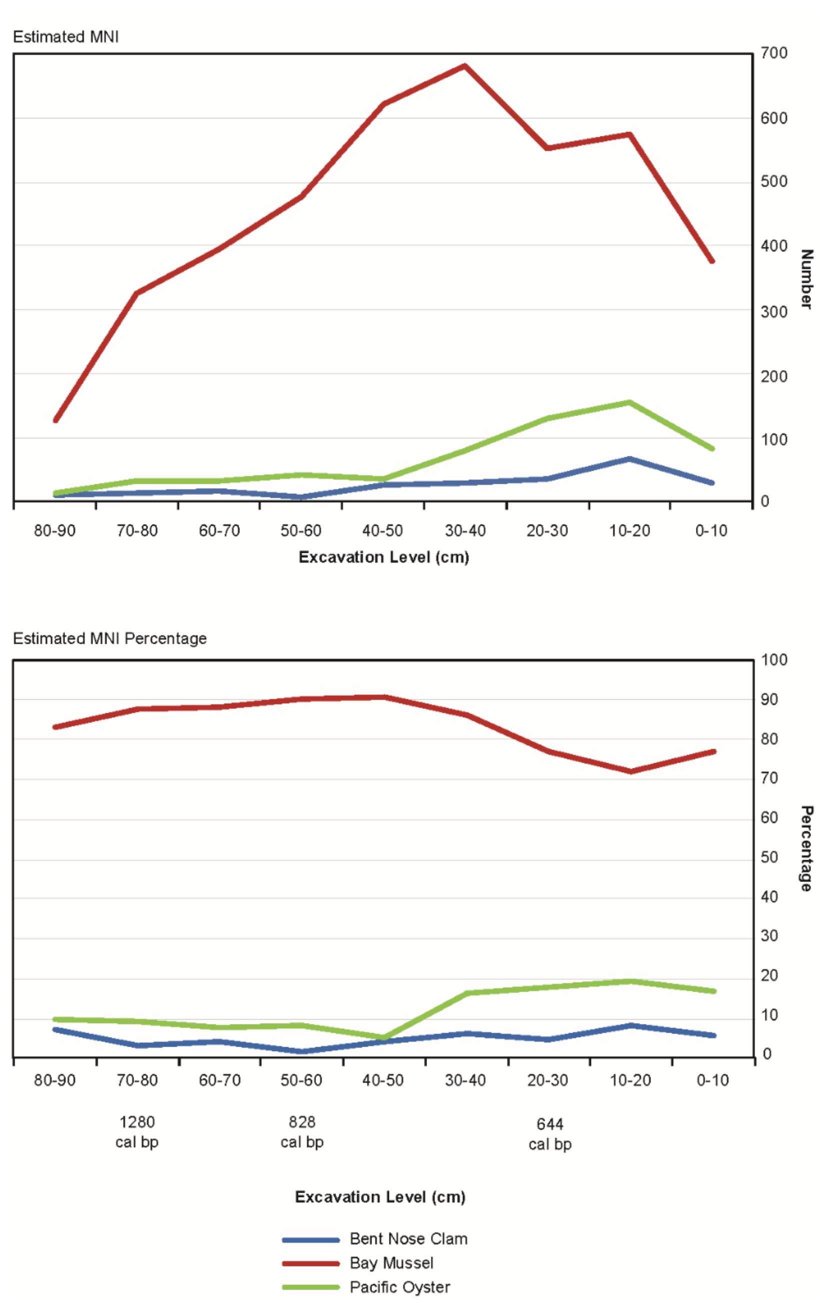

Figure 4. Major Shellfish Minimun Number of Individuals by Excavation Level on Dune Crest.

Table 3. Estimated Shellfish Minimum Number of Individuals by Excavation Level on the Dune Crest Midden.

	Excavation Level (cm)									Total
	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80	80–90	
Count (MNI) [a]										
Bent Nose Clam	29	68	35	30	28	8	18	13	11	240
Bay Mussel	377	574	553	683	621	477	396	327	128	4,136
Native Pacific Oyster	83	155	130	80	35	43	34	34	15	609
Total (n)	489	797	718	793	684	528	448	374	154	4,985
Percentage										
Bent Nose Clam	6	9	5	6	4	2	4	3	7	5
Mussel	77	72	77	86	91	90	88	87	83	83
Native Pacific Oyster	17	19	18	16	5	8	8	9	10	12

Note: [a] MNI includes estimated counts from 1/8-inch-screened column samples from CU 2

Table 4. Height Statistics for Complete Bent-nose Clam and Pacific Oyster Shell Individuals from Dune Crest Midden.

	Excavation Level (cm)									
	Upper Midden					Lower Midden				
	0–10	10–20	20–30	30–40		40–50	50–60	60–70	70–80	80–90
Bent-nose Clam Height										
Mean	26.7	44.0	42.5	41.3		39.5	40.5	40.8	40.9	39.9
Standard Deviation	10.0	5.3	6.0	5.0		6.7	5.5	6.0	5.1	7.1
Maximum	41.1	51.0	56.4	52.6		52.4	51.3	52.5	48.4	53.8
Minimum	12.2	28.2	27.5	31.6		22.0	25.7	23.1	27.6	25.9
Variation	99.7	27.8	36.3	24.9		45.1	30.3	36.3	26.1	51.1
n	12	35	43	48		36	33	28	26	21
Pacific Oyster Height										
Mean	28.4	27.5	33.1	29.7		27.4	26.5	25.5	25.9	25.1
Standard Deviation	8.4	10.8	7.5	8.9		7.7	7.5	8.9	7.9	8.8
Maximum	50.7	49.5	52.2	54.0		43.0	46.5	53.2	41.3	45.4
Minimum	11.5	8.0	13.0	12.5		10.5	12.0	12.7	11.3	15.6
Variation	70.6	116.7	56.1	78.5		58.9	55.8	79.2	62.4	77.4
n	44	86	53	54		71	47	35	36	20

Table 5. Relative Frequency of Major Shellfish by Weight versus Minimum Number of Individuals from Dune Crest Midden.

Shellfish	Upper Midden (%)	Lower Midden (%)	Total (%)
By MNI			
Bent Nose Clam	6	4	5
Bay Mussel	78	89	83
Pacific Oyster	16	7	12
Total (%)	100	100	100
Total (N)	2,797	2,188	4,985
By Weight			
Bent Nose Clam	33	18	27
Bay Mussel	61	79	68
Pacific Oyster	7	3	5
Total (%)	100	100	100
Total (g)	5,594.4	4,210.0	9,804.4

Note: Upper Midden 0–40 centimeter levels; Lower Midden 40–90 centimeter levels.

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