TIDES OF CHANGE?
SHELL MIDDENS OF THE MISSION BAY AREA, SAN DIEGO, CALIFORNIA

ALETTE VAN DEN HAZELKAMP
LAGUNA MOUNTAIN ENVIRONMENTAL, INC.

Both San Diego Bay and Mission Bay are assumed to have experienced coastal decline differently than the smaller lagoons along the central San Diego County coast. New and existing archaeological marine shell data from La Rinconada de Jamo (CA-SDI-5017) and four other sites (SDI-46, SDI-11,571, SDI-12,556, and SDI-12,557) around Mission Bay show environmental shifts in the Mission Bay area and adaptation of the Native Americans to these changes, mainly by collecting different shell species. However, typical processes mentioned in the Coastal Decline Model, like siltation (or decrease in Argopecten*) or changes in the subsistence pattern have been far less evident or not visible at all compared to San Diego Bay and other nearby lagoons.*

Mission Bay is a shallow depression located in the southern part of San Diego County in San Diego, just north of the hilly peninsula of Point Loma and south of Mount Soledad.

Geologically, the Mission Bay area belongs to the Bay Point Formation, which consists of interfingered beach, estuarine, and colluvial deposits from the Late Pleistocene.

During the Holocene, sea level rose quickly and drowned river valleys, forming bays. After a slowdown of sea level rise (around 6000 B.P.), deposition of sediment accumulated, both transported from the ocean and from the rivers. The eventual accretion of sand beaches in southern California roughly followed a north-to-south pattern and depended on the available sand source, the angle of the coastal platform, and wave refraction (Masters 2006). On a smaller timescale, changes can be tracked by looking at old maps and aerial photographs. In the last 100 years, Mission Bay has undergone some transformations, sometimes human-induced. Old maps of the beginning of the twentieth century show river deltas created by Rose Creek in the north and the San Diego River in the south. On the 1929 aerial map, in only 30 years' time, the Rose Creek outlet can be seen to have shifted eastward, with old sediments being reshaped in the form of dunes. Channelization of the San Diego River has separated the two bodies of water.

RESEARCH ON SHELL MIDDENS IN THE CONTEXT OF ENVIRONMENTAL CHANGE

Since shell species in a midden of an archaeological site represent the main environmental habitats of the time of collection (assuming that the prehistoric inhabitants chose the most readily available resources), environmental changes are reflected in changes in the composition of the midden. Different ratios of species over time can offer insight into changes of habitats. At the same time, they will offer insights into the strategies chosen by the native inhabitants to adapt to these changes.

Shell genera in present-day estuary/bay environments that are commonly found in San Diego coastal sites are *Chione*, *Argopecten* (bay scallop), *Ostrea* (oyster), *Tresus* (gaper clam), and *Saxidomus* (Washington clam). Rocky-shore environments are represented by *Mytilus* (mussel) and *Chiton*. Finally, in a beach environment, common genera are *Donax* (bean clam) and *Tivela* (Pismo clam).

Over the years, some research has been done on coastal shell middens in the context of environmental change (for the southern California coast, see Brodie 2009; Byrd and Reddy 2002; Gallegos 1987; Pigniolo 2005; Warren 1964). In 1964, Warren connected environmental change with archaeological data in his Coastal Decline Model. This model was mainly based on data from the lagoons of the central coast of San Diego County, and states that through the siltation of the lagoons, shellfish population decreased around 3000-4000 B.P. Human population responded by moving away from the lagoon and focusing on other means of subsistence, like seed collection and small game (Warren 1964). Both San Diego Bay and Mission Bay have always been open to the ocean, and they are thought to be exceptions to this model. While at Batiquitos Lagoon a gap of dated sites is related to siltation of the lagoon (Gallegos 1987), Byrd and Reddy (2002) show that along the northern San Diego coast, settlement during the Late Holocene was relatively stable. There are still shifts visible in the subsistence pattern, though; there was "a shift toward increased reliance on smaller, less 'optimal' resources (such as nearshore-schooling fish and small shellfish) and a more thorough exploitation of the littoral zone" (Byrd and Reddy 2002:42). Explanations mentioned in that study are not related to environmental shifts, but focus on changes in hunter-gatherer communities influenced by population pressure, increased territoriality, and greater settlement permanence (Byrd and Reddy 2002:42).

Although research at San Diego Bay does not show a strong decline in shellfish population, it does show a shift in the collection of different species, indicating environmental shifts (Pigniolo 2005). Also at La Jolla Shores, inhabitants changed to exploiting other shellfish species (Brodie 2009). The Mission Bay area is expected to be similar to San Diego Bay in this sense, but there has not been a study performed yet to support this idea.

In this paper the following research questions are addressed to examine the position of Mission Bay compared to the other coastal sites in terms of local environmental shifts and the population response, with the Coastal Decline Model in mind:

- Are Holocene sea level shifts visible in the archaeological shell midden record of the Mission Bay area?
- Are there signs of siltation in Mission Bay?
- Is there a change in the subsistence pattern found in the archaeological record?
- How does Mission Bay compare to other lagoons and bays?

SITES AROUND MISSION BAY

From the 1970s on, studies that were part of cultural resource management (monitoring, testing, and data recovery programs) have been performed in this area. Shellfish analysis sections of these reports differ in their length and thoroughness, and generally are descriptive and/or explore future research potential (for more elaborate analyses, see Heuett 1979; Smith and Pierson 1992; Winterrowd and Cardenas 1987). They usually follow prehistoric diet over time to detect trends in preference, and estimations of the number of species are made. This is done by speciating, weighing, and counting hinges of the shell. Further, they describe dominant shell species and their habitats, and their vertical distribution within units. In this way, results can be compared to other sites.

For this study, I mostly relied on existing studies and data from five sites: La Rinconada de Jamo (SDI-5017), SDI-46 in Ocean Beach, SDI-11,571 at Crown Point, and two sites in Rose Canyon (SDI-12,556 and SDI-12,557). Of these sites, La Rinconada de Jamo and SDI-46 are the most important for this study, since they have the largest shell samples.

Originally recorded by Malcolm Rogers in 1929, La Rinconada de Jamo has since been studied more intensively. The midden deposits are rich and varied, and the site is considered a seasonal or multiseasonal residential camp with a broad exploitation strategy from Early Archaic to Late Prehistoric times (Garcia-Herbst 2009). Testing and data recovery data from Heuett (1979), Winterrowd and Cardenas (1987), Bissell (1992), and Kyle et al. (1997), and preliminary data from excavations by Laguna Mountain Environmental in 2005 (Unit 15) have been used for this study.

Site SDI-46, a refuse heap at Ocean Beach, was tested in 1991-1992 by Brian F. Smith and Associates. Radiocarbon analysis was performed on shell from the lowest level and upper level of one unit (Unit 3) and produced dates of 3910 ±70 years B.P. and 3580 ±80 years B.P respectively (Smith and Pierson 1992:66). In 2011, this site was excavated by Laguna Mountain Environmental. At the time I analyzed the data for this study, no data from the latter excavation were available yet.

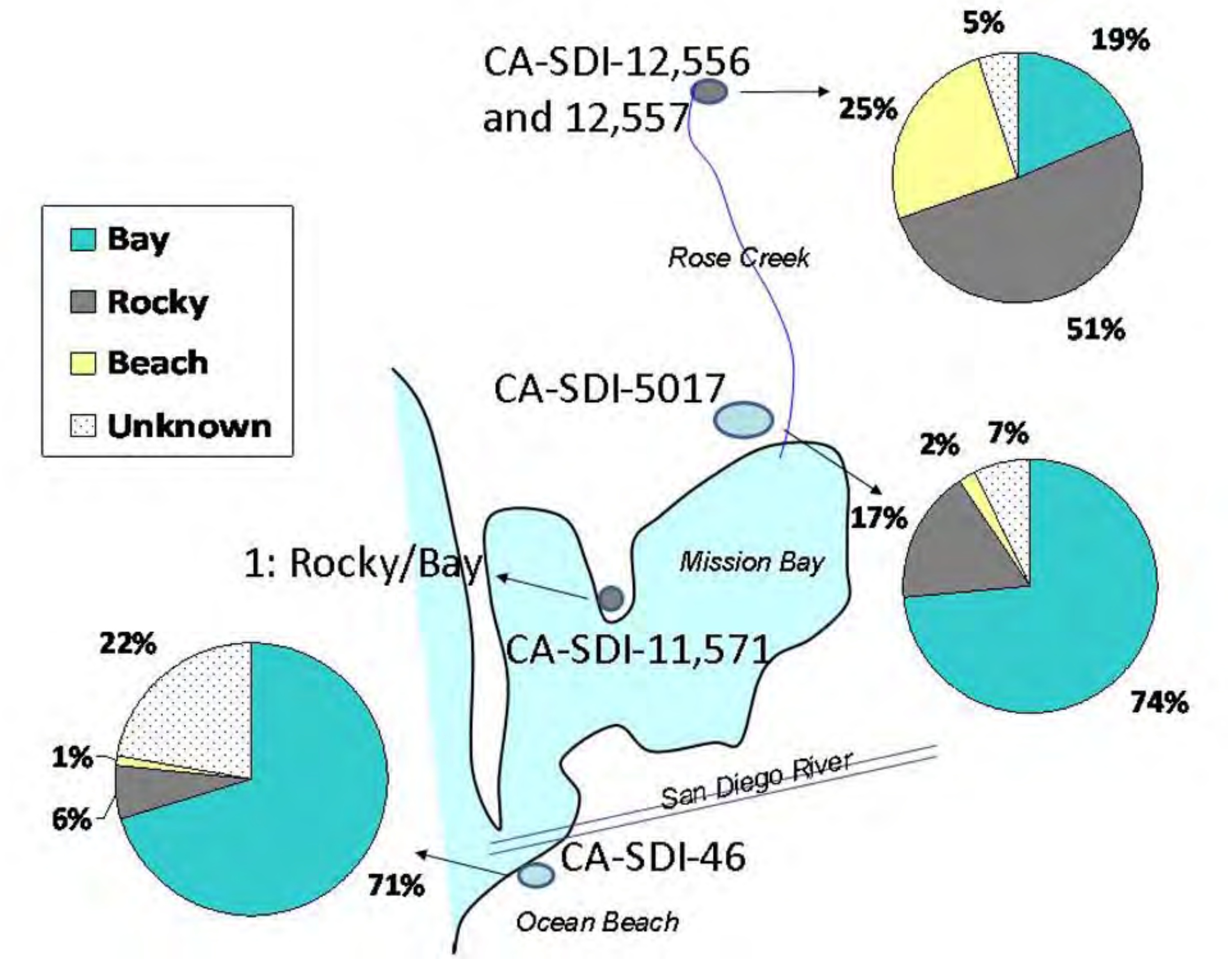

Figure 1. Distributions of shellfish categories found for each site around Mission Bay. The figure shows a map of Mission Bay area on which the four sites are indicated. For SDI-11,571 no percentages are available; however, the predominant categories are rocky shore and bay species.

Apart from these large sites, a smaller shell midden (intermittent camp site SDI-11,571) at Crown Point, originally recorded in the 1920s, was also included in this study. A little farther from Mission Bay in Rose Canyon, SDI-12,556 and SDI-12,557 were recorded and tested in 1991-1992 (Smith et al. 1992). The first one has been classified on the site record as a "dispersed artifact scatter with a possible midden deposit" and the second one as a "widely dispersed artifact scatter with a midden deposit." Since these last two sites are relatively close to each other (about 1.5 km apart) compared to their distance to Mission Bay (about 8-9 km), and the shell weights were quite low (56.8 g and 319.1 g), for the use of this study the data from these two sites have been merged.

In a first comparison of the shell of these sites, I looked at the general distribution of the different environments reflected by the shell (Figure 1). Most sites around Mission Bay show similar distributions, with bay species being the main source. The sites in Rose Canyon show a great difference from the other shell assemblages, with rocky-shore species representing about 50 percent and beach species about 25 percent. A possible explanation is that the inhabitants of these sites were more focused towards La Jolla (which is actually closer, as the crow flies) and did not follow the north-south drainage of Rose Creek. The Spindrift Site at La Jolla shows a significant use of rocky-shore species (Brodie 2009).

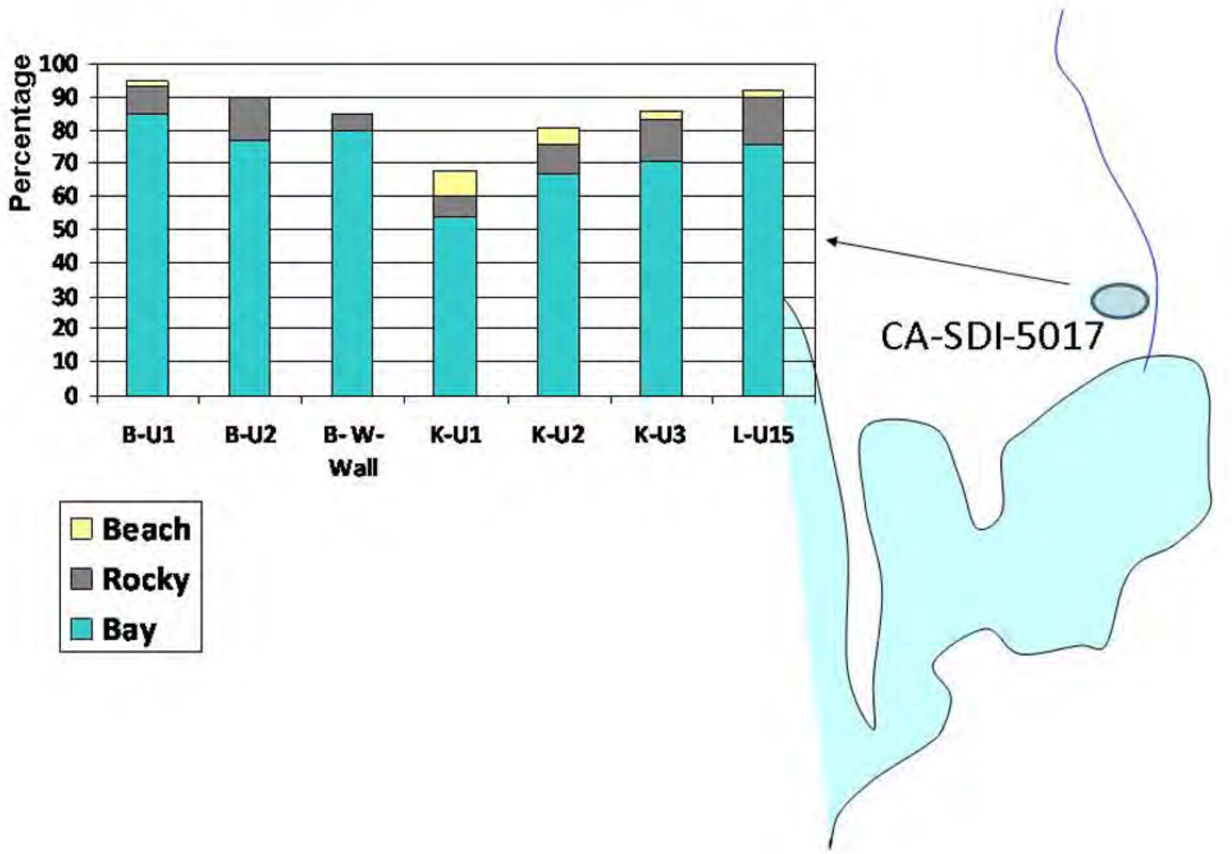

Figure 2. Intra-site variation of shellfish categories at La Rinconada de Jamo (SDI-5017). U1, 2 = Unit 1, 2; W-Wall = West Wall; B = data from Bissell (1992); K = data from Kyle et al. (1997); L = data from 2005 excavation by Laguna Mountain Environmental.

Although there also used to be a large mussel population on the rocks on the west side of Ocean Beach (Smith and Pierson 1992:61), SDI-46 is similar to La Rinconada de Jamo and shows mainly bay species in its shell midden.

ROCKY SHORE TO SANDY BEACH

When focusing on La Rinconada de Jamo, from which most data are available, some excavation units show a higher percentage of beach and/or rocky shore-species than others (Figure 2). Since there is not much material dated and numbers are small, it is not clear if this is an indication for spatial or temporal variation (or chance). Have different shellfish been processed in different locations within the site, or has there been a shift in usage over time?

The first question is hard to answer without any additional dated material, but the vertical stratigraphy of the units (assuming a fair level of vertical integrity) can give us a first insight into relative shifts over time. In Figure 3, the vertical distribution of the collected shell of each habitat is plotted in one graph. For each level, the percentage of the total weight of species collected belonging to a specific habitat is shown. In this way, the distributions of the collected shell from the habitats can directly be compared. Shifts of habitats are visible: in general, beach species come up later than bay species. The opposite holds for rocky shore species, although the pattern is less clear.

When compared to other bays and lagoons, the data from La Rinconada de Jamo site near Mission Bay are in line with conclusions at other bays and lagoons in the area: the population followed

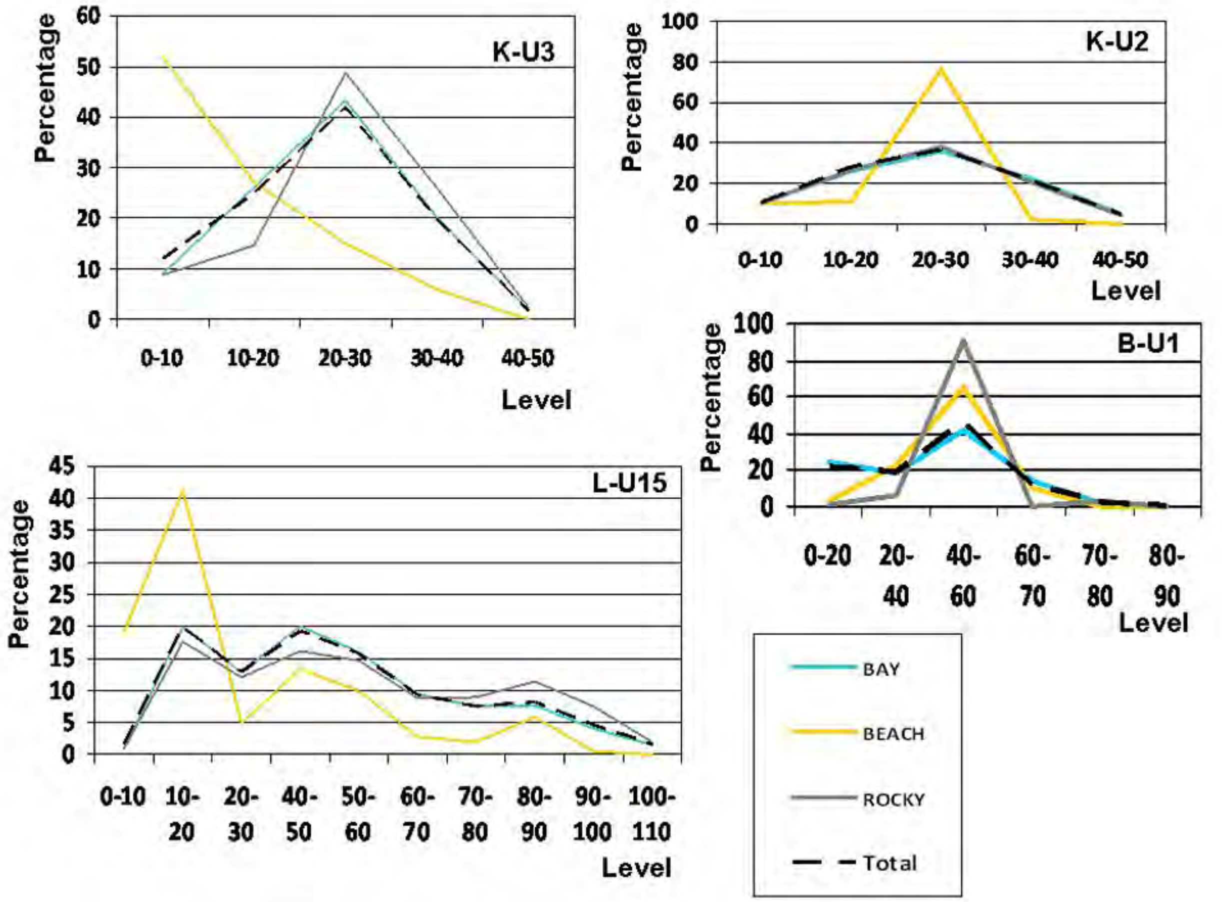

Figure 3. Vertical distribution of shellfish categories at La Rinconada de Jamo. The graphs show for each level the percentage of the total weight of each of the categories found. In Unit 3 (Kyle et al. 1997), 50 percent of the total weight of beach species has been found in the 0-10 cm level. For bay and rocky shore species, this is only 10 percent.

the environmental shift in their collection habits, although the pattern seems to be less strong than at other sites. At San Diego Bay, data show a shift from *Argopecten* dominance (a bay genus) to *Chione* and open-beach species (Pigniolo 2005); La Jolla Shores shows a horizontal stratigraphy with different dominant habitat types matching the timeline for rocky-shore, estuary, and sandy-beach environments (Brodie 2009); and the lagoons along the northern San Diego coast show a shift to the smaller and more labor-intensive *Donax*, found at sandy beaches (Byrd and Reddy 2002:57).

SILTATION?

Now that we have a broad view on the use of different habitats around Mission Bay, we can focus more on the individual genera. The main genus for the two major sites (La Rinconada de Jamo and SDI-46) is *Argopecten* with 32 and 30 percent, respectively. (Rose Canyon again shows a different pattern, with *Mytilus* as the main genus, followed by *Tivela*. Data from SDI-11,571 this time do not support the trends observed in the main two sites, with *Ostrea* and *Astraea* being mentioned as main species. However, data for this site are very limited.) The different units within La Rinconada de Jamo however show a diverse pattern, with only three units having *Argopecten* as their main genus and the other six having *Chione* (Figure 4).

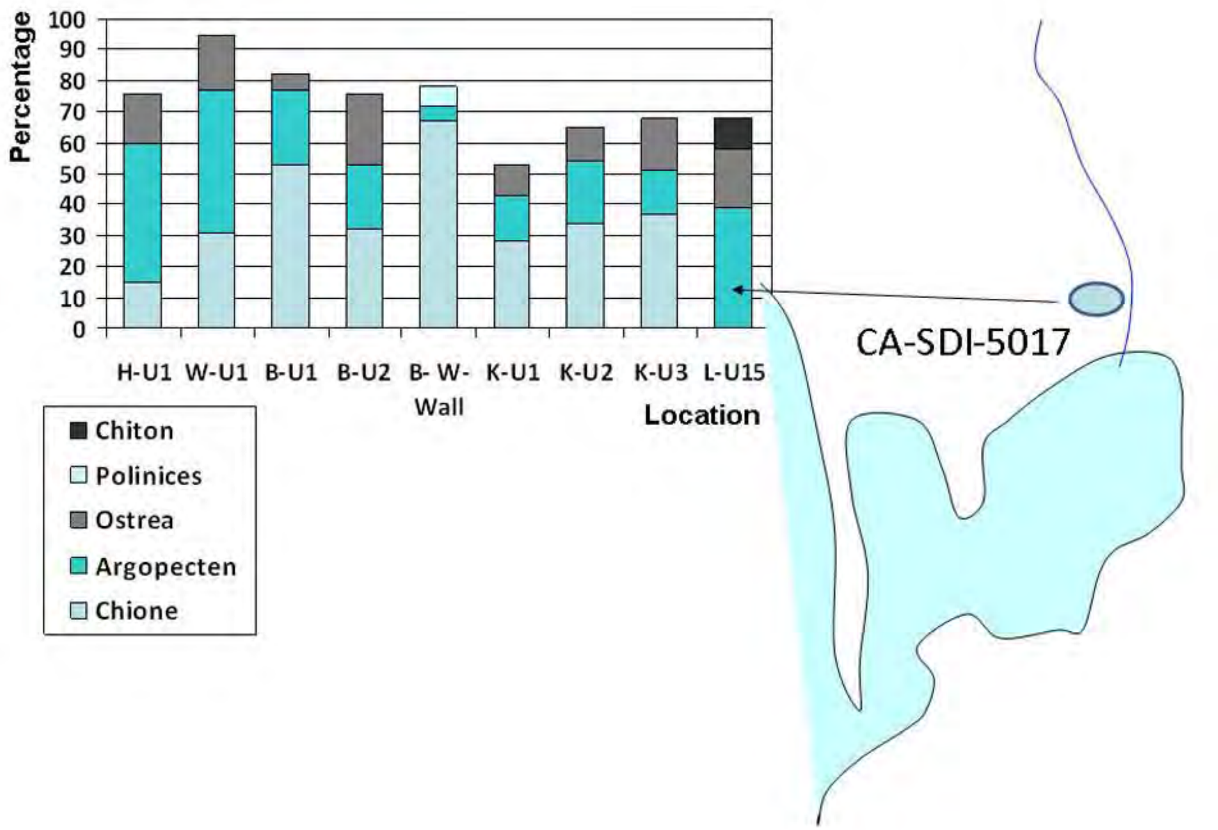

Figure 4. Intra-site variation for main shellfish species found at La Rinconada de Jamo. H = data from Heuett (1979); W = data from Winterrowd and Cardenas (1987); B = data from Bissell (1992); K = data from Kyle et al. (1997); L = data from 2005 excavation by Laguna Mountain Environmental.

Argopecten has a slightly different micro-habitat than *Chione* and is found in deeper water. At Batiquitos Lagoon, an increasing use of *Chione* instead of *Argopecten* has been linked to siltation of the lagoon, in line with the Coastal Decline Model (Gallegos 1987). In contrast, a strong decline in *Argopecten* in the San Diego Bay area most likely was not caused by siltation, since this bay is not thought to have ever been closed off from open waters. Here, overexploitation or extended periods of colder water are mentioned as possible causes (Pigniolo 2005). Timing in both bays is similar, though: at around 4000 B.P., there was almost no *Argopecten* to be found.

The Mission Bay data were expected to show similar shifts to San Diego Bay, but, remarkably, the pattern found strongly differs from the one at San Diego Bay. In Figure 5, the ratio between *Argopecten* and *Chione* for each level in six units is shown to see if there is a shift to shellfish collection from a muddier habitat. There is no clear pattern in the plot, but in any case it rather suggests a rising trend than a declining trend of *Argopecten*.

So the data from La Rinconada de Jamo do not support the possible explanations for the decline of *Argopecten* at San Diego Bay. James E. Hall in Heuett (1979) already noted a predominance of *Argopecten* at La Rinconada de Jamo in his study. Possible explanations he mentioned were the silting up of the areas and bays, *Argopecten* being simply more abundant, a "species preference," and better micro-environmental conditions for *Argopecten*. Combined with the results of San Diego Bay, I think a difference in micro-environmental conditions (and shifts) between these bays may be the most likely explanation. Also adding to this is that the pattern for SDI-46 seems to be a little different from the one at La Rinconada de Jamo. In two of the five units, *Chione* yields higher amounts than *Argopecten* in the

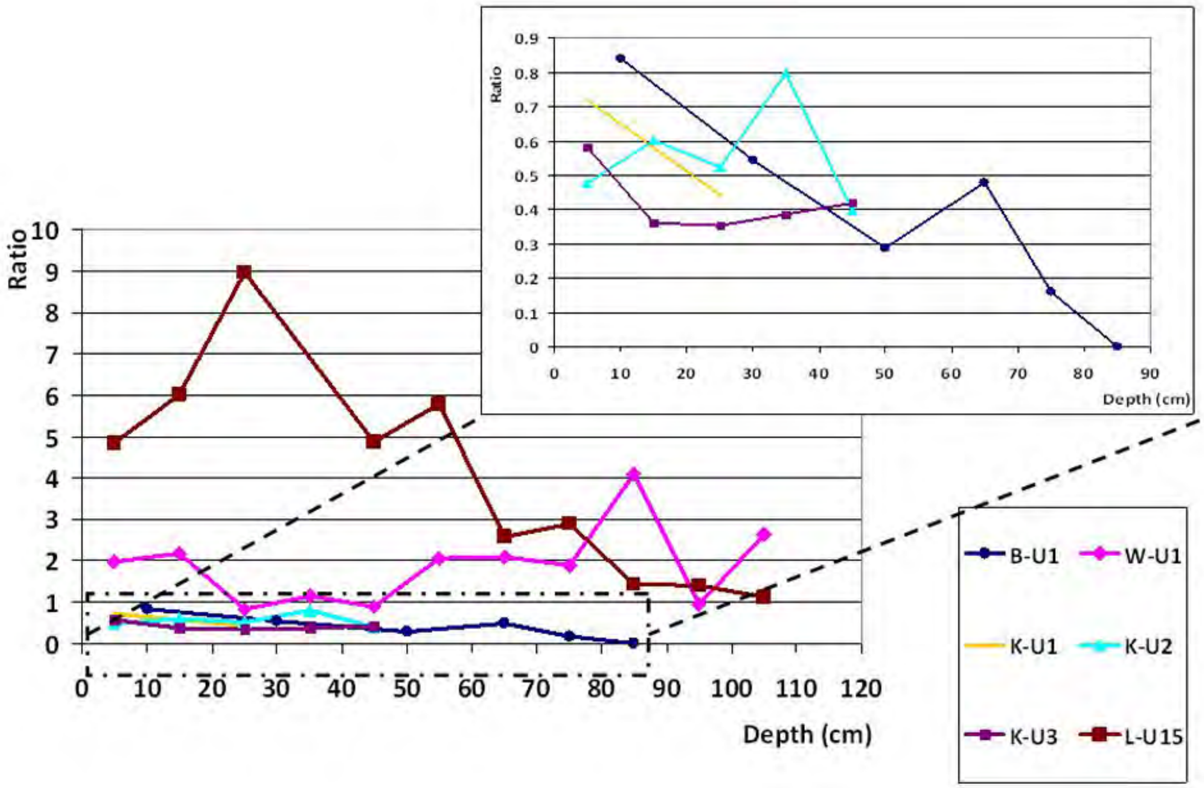

Figure 5. Argopecten/Chione *ratio at La Rinconada de Jamo. A ratio larger than 1 indicates that there is more* Argopecten *than* Chione*. Top right: a blowup of part of the figure.*

upper levels (Smith and Pierson 1992:62, Figure 13-16). This suggests variety in micro-environmental shifts within the Mission Bay area, too. More data are needed here to see if the difference between the units is significant, or if the differences are random.

NO SHIFT TOWARDS TERRESTRIAL RESOURCES

The reaction of the inhabitants to siltation of the lagoons is thought to have been a change in subsistence pattern and even moving away from the coast (Gallegos 1987; Warren 1964). Both San Diego Bay and sites on the northern San Diego coast show a change in main shell species collected, from bay species to open coast shellfish (Byrd and Reddy 2002; Pigniolo 2005). Migration from the coast did not occur at San Diego Bay, where the population trend seems to follow the general upward population trend (Pigniolo 2005), or the Spindrift Site, where preliminary data suggest continuous habitation (Brodie 2009).

Although there are no signs of siltation found in Mission Bay (as yet), the environment did change, and it could still have had an impact on the subsistence pattern. Therefore I determined the ratio of faunal bone to shell weight and looked at the vertical distribution pattern for both. The bone fraction is very small (0-3 percent), except for the sites at Rose Canyon. Although bone of course is much lighter than shell, shellfish collection was clearly an important means of subsistence for the people who lived on the bay.

For four units at La Rinconada de Jamo, relative vertical distribution patterns are shown in Figure 6. The graphs imply that the importance of shellfish collection reached its peak in the shallower levels,

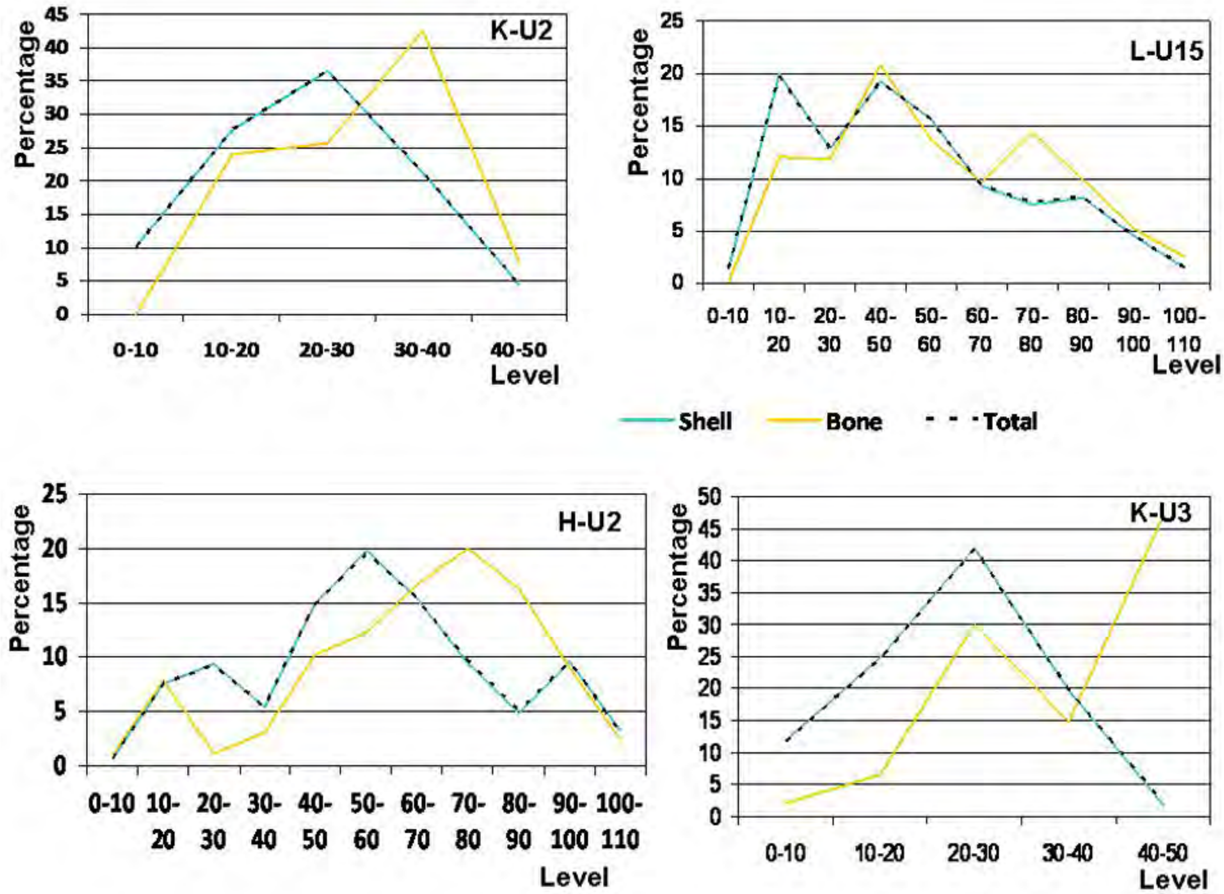

Figure 6. Vertical distribution of shell and faunal bone at La Rinconada de Jamo. The graphs show for each level the percentage of the total weight of shell and faunal bone found. H = data from Heuett (1979); K = data from Kyle et al. (1997); L = data from 2005 excavation by Laguna Mountain Environmental.

and thereby later in time than hunting. Frequencies are small however, especially for bone, so patterns should be approached with caution.

TO CONCLUDE…

Although a general pattern of an environmental transition from rocky shore to bay to beach environment (increasing beach species and declining rocky-shore species) is visible in shell middens around Mission Bay, this pattern does not seem to be very strong. Furthermore, as expected, Mission Bay is not following the Coastal Decline Model, since there are no signs of siltation based on the *Argopecten*/*Chione* ratio. The area interestingly in this sense also deviates from San Diego Bay, where a strong decline of *Argopecten* is apparent. Possible explanations given for this decline (colder currents) are not compatible with the data found around Mission Bay. Apparently, the environment here has always been good for *Argopecten*.

Besides a change in the focus of shell species collected, there are no signs of a shift in subsistence pattern towards more terrestrial sources. Data on changes in subsistence patterns are very limited, though, due to a very small fraction of faunal bone found at the sites.

This study represents a first impression based on relatively few data, so the conclusions should be viewed with caution. Rodent activity, inconsistency of data (unit/level size differences, incomplete determination of species), and small numbers (weight) will have had an influence on the outcomes. More consistent data and dating are needed, in combination with other paleo-environmental data. It would be interesting to focus more on individual species other than *Chione* and *Argopecten* and see if Mission Bay has been a relative stable environment compared to other bays and lagoons. Micro-environmental changes may have played a larger role in Mission Bay than macro-environmental change and may explain the differences between San Diego Bay and Mission Bay.

Recently, more data from SDI-5017 and new data from SDI-46, from the 2005 and 2011 excavations by Laguna Mountain Environmental, have become available. Hopefully, these can provide insight in the stability of the Mission Bay area as well and give more insight in the different habitats exploited around Mission Bay.

REFERENCES CITED

Bissell, Ronald M.

1992 *Cultural Resources Monitoring of the Mission Bay Sewage Interceptor System, Phase I Project, San Diego, San Diego County, California*. RMW Paleo Associates, Mission Viejo, California.

Brodie, Natalie J.

2009 Shells by the Shores: An Examination of Marine Invertebrates from the Spindrift Site in La Jolla, California. *Proceedings of the Society for California Archaeology* 22.

Byrd, Brian F., and Seetha N. Reddy

2002 Late Holocene Adaptations along the Northern San Diego Coast: New Perspectives on Old Paradigms. In *Catalysts to Complexity. Late Holocene Societies of the California Coast*, edited by Jon M. Erlandson and Terry L. Jones, pp. 41-62. Perspectives in California Archaeology Vol. 6. Cotsen Institute of Archaeology, University of California, Los Angeles.

Gallegos, Dennis

1987 A Review and Synthesis of Environmental and Cultural Material for the Batiquitos Lagoon Region. In *San Dieguito - La Jolla: Chronology and Controversy*, edited by Dennis Gallegos, pp. 23-34. San Diego County Archaeological Society Research Paper No. 1. San Diego.

Garcia-Herbst, Arleen

2009 Conservation of a Significant Prehistoric Archaeological Site in Urban San Diego. *Proceedings of the Society for California Archaeology* 22.

Heuett, Mary Lou

1979 *Preliminary Archaeological Investigations at the Village of* La Rinconada de Jamo *SDMM W-150*. Archaeological Consulting & Technology, San Diego.

Kyle, Carolyn E., Sinéad Ní Ghabhláin, and Dennis R. Gallegos

1997 *Group Job 518B, Data Recovery Report for a Portion of Prehistoric Site CA-SDI-5017, the Village of* La Rinconada de Jamo, *San Diego, California*. *Dep No. 95-0671*. Gallegos and Associates, Carlsbad, California.

Masters, Patricia M.

2006 Holocene Sand Beaches of Southern California: ENSO Forcing and Coastal Processes on Millennial Scales. *Palaeogeography, Palaeoclimatology*, *Palaeoecology* 232:73-95.

Pigniolo, Andrew R.

2005 Subsistence, Settlement, and Environmental Change at San Diego Bay. *Proceedings of the Society for California Archaeology* 18:255-259.

Smith, Brian F., Johnna Buysse, Larry J. Pierson, Stephen J. Burke, James R. Moriarty, and Frank Lorey
1992 *A Cultural Resources Study for the Rose Canyon Trunk Sewer Project, City of San Diego, San Diego, California, DEP #89-0876*. Brian F. Smith and Associates, San Diego.

Smith, Brian F., and Larry J. Pierson
1992 *Results of an Archaeological and Ocean Beach Gateway Project: An Archaeological and Historical Evaluation of a 2.08-Acre Development Project Conducted in Accordance with CEQA and the Guidelines of the City of San Diego, California, DEP #91-0504*. Brian F. Smith and Associates, San Diego.

Warren, Claude Nelson
1964 Culture Change and Continuity on the San Diego Coast. Unpublished Ph.D. dissertation, Department of Anthropology, University of California, Los Angeles.

Winterrowd, Cathy L., and D. Sean Cardenas
1987 *An Archaeological Indexing of a Portion of the Village of* La Rinconada de Jamo *SDI-5017 (SDM-W-150)*. RBR & Associates, San Diego.