# Changing coastlines and implications for understanding the archaeology of the San Quintín-El Rosario region, northern Baja California

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For the last 40 years, there has been an intense awareness that the archaeological record is sculpted by a variety of cultural and natural processes. We archaeologists may risk mistaking as evidence of prehistoric cultural behavior patterns that in fact result from noncultural processes. That is an obvious error.

I want to discuss three ways in which environmental changes and postdepositional processes have shaped the archaeological record of the San Quintín-El Rosario region (Figure 1). First, I will present evidence for the Middle Holocene creation of Bahía San Quintín and discuss how that made San Quintín Bay a less significant resource zone than similar habitats in the Californias. Second, I will summarize how coastal erosion has influenced the chronology of settlement from the San Quintí n-El Rosario region. Finally, I will present evidence from a stratigraphic profile showing how local changes in coastlines produced changes in molluscan assemblages even when the same subsistence strategy was employed.

**PASE research 1995-1999: background**

Beginning in 1992 with ethnohistoric investigation into indigenous demography during the Colonial period (Gasco 1996; Moore and Gasco 1993; Moore and Norton 1992), the "Proyecto Arqueológico San Quintín-El Rosario" (PASE) completed three seasons of archaeological survey in 1995, 1998, and 1999 (Figure 2). The survey covered a 10% sample of the 630 km$^2$ project based on a stratified random sample that selected 63 survey quadrants 250 m x 4 km (1 km$^2$). We recorded data on 275 sites within the sample survey and 15 additional sites (Moore 2000a, 2000b; Moore and Gasco 1997, 2001). Site density averages 4.37 sites per km$^2$, with individual quadrant densities ranging from 0 sites to 14 sites per km$^2$. Extrapolating from this sample, an estimated 1,780-4,060 sites are located in the entire project area.

Radiocarbon samples from 59 archaeological contexts indicate human occupation of the region from 7000 B.P. and continuing to the historic period. Settlement data and a variety of artifactual materials are interpreted as indicating a high degree of settlement mobility in which the Pacific coastal zone was only one region in a larger, transhumant settlement system that also encompassed interior and Gulf of California habitats.

This model interprets the archaeology of the San Quintín-El Rosario region as reflecting a "desert adaptation" to coastal resources in which desert collectors utilized the Pacific coastal zone as one element of an extensive and transhumant adaptation. This strategy differed from better-known coastal adaptations in southern Alta California (e.g., Arnold 1987, 1990, 1992a,


Figure 1. San Quintín-El Rosario project area.

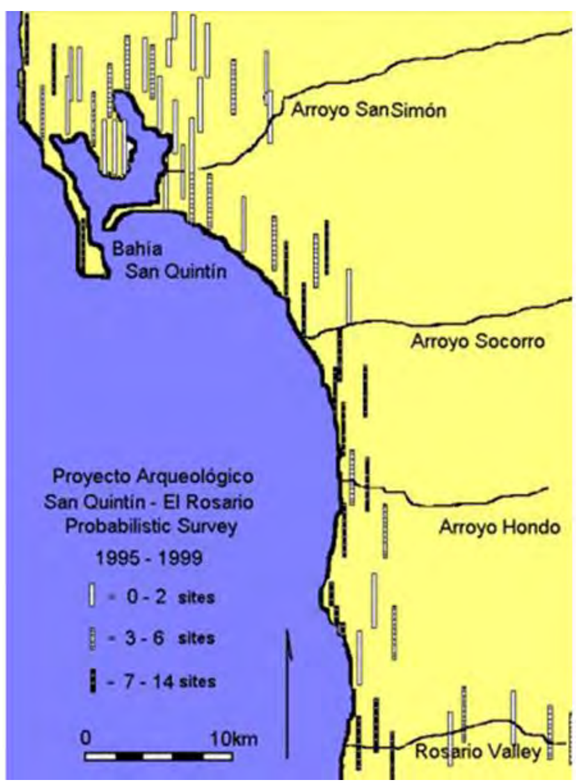


Figure 2. San Quintín-El Rosario probabilistic survey.

1992b, 1995; Christenson 1992; Colten 1989; Erlandson 1985, 1988, 1994, 1997; Erlandson and Colten 1991; Erlandson and Glassow 1997; Glassow 1980, 1996, 1997; Glassow and Wilcoxon 1988; Glassow et al. 1988; Jones 1991, 1992 1996; King 1971, 1990; Masters and Gallegos 1997; Raab 1992, 1997; Raab and Yatsko 1992). Unlike areas of southern Alta California where it is hypothesized that rich coastal habitats were the locations for the evolution of sedentism, high population densities, and other dimensions of "complexity," such developments did not occur in this portion of northern Baja California, posing important issues regarding intensive vs. extensive subsistence and settlement systems (Beaton 1991; Glassow 1997).

## Embayment adaptations: the middle Holocene reappearance of San Quintín Bay

A large archaeological literature from the Pacific coast and elsewhere points to the significance of estuaries and embayments for prehistoric hunters and gatherers. Estuaries and embayments support specific quiet-water resources, and because they are juxtaposed with other coastal habitats (e.g., open sandy beaches or rocky coasts), these habitats are often more diverse than more uniform stretches of coast. Along the length of southern California, embayments and estuaries were the locales for early and continuous prehistoric occupation. In Baja California, a similar point is made by Ritter et al. (1995:152):

> The littoral zone of Baja California has long been known for its marine richness and diversity, notwithstanding variability from west coast to east coast, and from beach to beach. Those often sheltered sections of coast, where a diversity of shore environments was close at hand, seem to have favored the most intense use, at least during mid- to later Holocene times.

Ritter et al. (1995:152) further note, "Estuaries, at the mouth of lagoons or arroyos, were especially favored by peoples of the past for intensive use, at least on a seasonal basis," stating this was specifically the case for Bahía de las Animas. I assume that similarly accurate statements could be made for the Ensenada de Todos Santos, based on the reported density of archaeological sites at La Bufadora (Michael Wilken, personal communication), and probably other areas like the estuary at La Misión and elsewhere.

But this was not true of the San Quintín-El Rosario region. At the northern end of the project area, San Quintín Bay is a large tidal embayment (Woodford 1928) The bay is the major feature of the San Quintín valley and provides habitat for various quiet-water shellfish species (e.g., *Chione* spp., *Saxidomus nuttalli*), fish species and migratory waterfowl (Figure 3). When we began fieldwork in 1995, I fully expected the bay to be a major focus of settlement and that estuarine resources would be well represented in the archaeological record.

But survey data showed the area adjacent to the bay to contain the lowest site densities within the project area, with 0-3 sites per $km^2$. Further, the molluscan assemblages indicate that quiet-water shellfish were rarely taken and were never more significant than open-coast species, whether *Mytilus californianus*, taken from rock coastlines, or *Tivela stultorum*, taken from sandy beaches (Table 1). The extreme rarity of estuarine species occurs even in sites immediately adjacent to Bahía San Quintín. The table shows qualitative data on the relative occurrence of different mollusks at all sites within 1 km of San Quintín Bay. I have excluded any site that was equally close to the bay and another coastal habitat. What these data show is that even when encampments were closer to San Quintín bay than to any other coastal habitat, quiet-water species were rarely exploited.

Figure 3. San Quintín Bay.

Table 1. Relative abundance of shellfish species at sites near (< 1 km) San Quintín Bay (A = abundant; C = common; R = rare).

| Site | *Tivela* | *Mytilus* | *Protothaca* | *Chione* | *Haliotis* | *Ostrea* | *Septifer* |
|---|---|---|---|---|---|---|---|
| PASE-11 | -- | C | -- | -- | -- | -- | -- |
| PASE-12 | A | -- | -- | -- | -- | -- | -- |
| PASE-13 | C | R | -- | -- | -- | -- | -- |
| PASE-14 | C | R | -- | -- | -- | R | -- |
| PASE-15 | A | R | -- | -- | -- | -- | -- |
| PASE-16 | A | R | -- | -- | -- | -- | -- |
| PASE-17 | A | R | -- | -- | -- | -- | -- |
| PASE-18 | A | -- | -- | R | -- | -- | -- |
| PASE-19 | A | R | -- | -- | -- | -- | -- |
| PASE-20 | A | R | -- | -- | -- | -- | -- |
| PASE-22 | A | -- | -- | -- | -- | -- | -- |
| PASE-23 | C | -- | -- | -- | -- | R | -- |
| PASE-24 | C | -- | -- | -- | -- | R | -- |
| PASE-100 | A | R | -- | -- | -- | -- | -- |
| PASE-119 | C | -- | -- | -- | -- | -- | -- |
| PASE-120 | C | -- | -- | -- | -- | R | -- |
| PASE-121 | C | -- | -- | -- | -- | -- | -- |
| PASE-187 | -- | R | -- | C | R | R | -- |
| PASE-188 | -- | -- | R | -- | R | C | -- |
| PASE-189 | -- | R | -- | -- | -- | A | -- |
| PASE-190 | -- | R | -- | -- | -- | A | -- |
| PASE-192 | -- | -- | -- | -- | -- | -- | -- |
| PASE-193 | A | R | -- | -- | -- | -- | -- |
| PASE-194 | C | C | -- | R | -- | -- | -- |
| PASE-205 | A | R | -- | -- | R | -- | -- |
| PASE-220 | A | R | -- | -- | R | -- | -- |
| PASE-221 | A | C | -- | -- | R | -- | -- |
| PASE-227 | C | A | R | -- | R | R | -- |

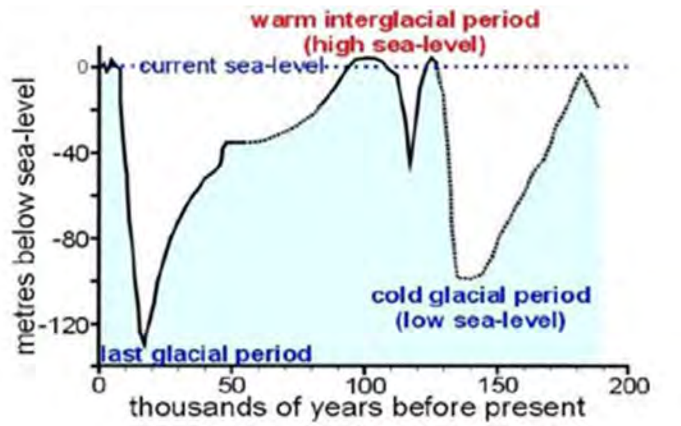


Figure 4. Pleistocene and Holocene fluctuations in sea level.

There are several factors that account for the relative insignificance of lagunal resources. The qualitative data based on surface evidence may underrepresent quiet-water species, and certainly controlled excavations would refine our rather crude results, but I doubt the fundamental picture would change dramatically. Other variables seem more relevant, and one factor is that San Quintín Bay probably did not exist until after ca. 4000-3000 B.P., when sea levels reached near-modern levels.

What follows is my amateurish attempt at the reconstruction of paleocoastlines. Reconstructing of coastal paleoenvironments is beyond my competency, but I want to suggest some of the potential impacts that Holocene changes in coastal topography may have had on the archaeology of the PASE project area.

It is well known that Pleistocene fluctuations in global sea level had left their signatures on coastal geomorphology (Figure 4). One of the major features of the San Quintín valley is the Santa Maria escarpment, a steep terrace rising to 100 m that defines the eastern limit of the San Quintín valley (Figure 5). In their early geological overview of the San Quintín region, Gorsline and Stewart (1962:290) observed that the Santa Maria escarpment was “an old sea-cliff cut at shoreline approximately 10 to 15 meters higher than present” which was associated with a Pleistocene high stand of ca. 130,000-120,000 B.P. In LANDSAT imagery, this topographic feature can be followed from at least Camalú south to El Consuelo, a distance of about 60 km (Figure 6).

Another major topographic feature are the San Quintín volcanic cones that form the protective barrier that creates the embayment. The San Quintín volcanic cones have “no apparent terraces of wave cut benches” (Gorsline and Stewart 1962:290), suggesting the volcanic cones formed after the Pleistocene high stand of ca. 130,000-120,000 B.P. (Moore 1999:24).

However, the volcanic cones existed and created a protective barrier by 38,000-40,000 B.P., based on three radiometric dates of a fossil deposit called “Bahía Antigua” (33,710 ±550, 38,910 ±1130, 40,260 ±810 RCYBP, adjusted for reservoir effect; Figure 7). The Bahía Antigua deposit probably corresponds to a mid-Wisconsin high stand (Inman 1983:8), but as sea levels dropped to their late Pleistocene low stand at ca. 18,000 B.P., San Quintín Bay would have drained.

San Quintín Bay is extremely shallow, with most of the bay less than 2 m in depth (Defense Mapping Agency 1988; Figure 8). The bay is shallow today because throughout the Late Holocene it infilled with sediments deposited by the outflows from Arroyo San Simón and other seasonal drainages; it is certainly shallower today than it was in the Middle Holocene. But

Figure 5. Santa María escarpment.

Figure 6. San Quintín-El Rosario region, showing Santa María escarpment.

Figure 7. Bahía Antigua fossil deposit.

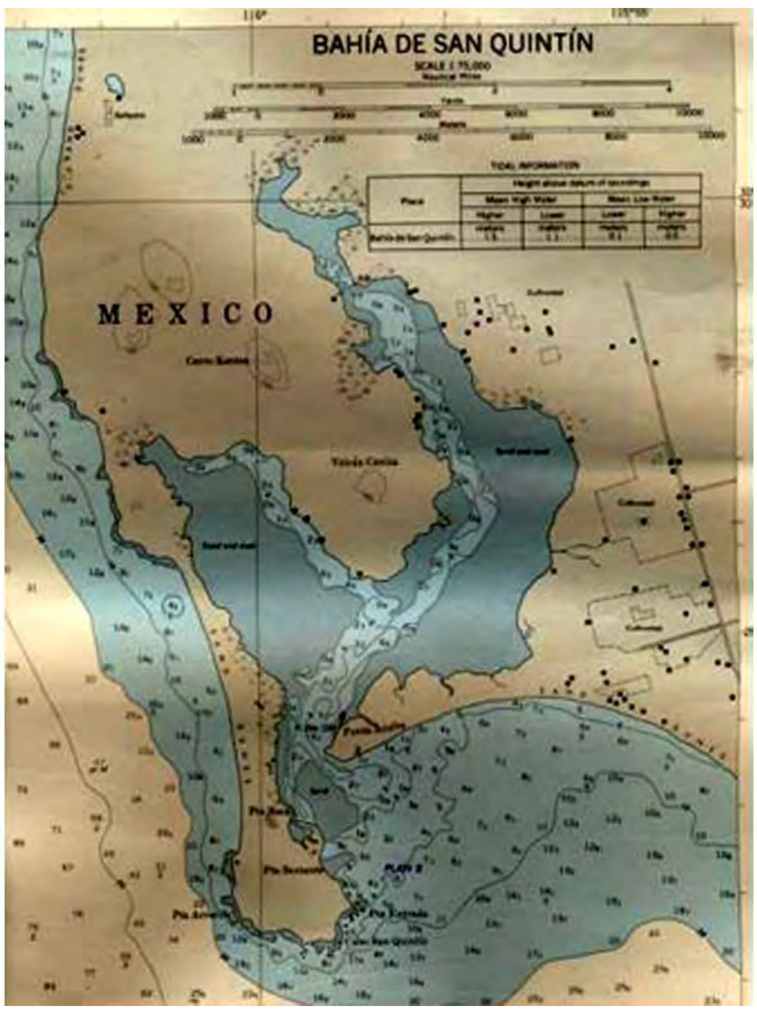


Figure 8. Bathymetric map of San Quintín Bay.

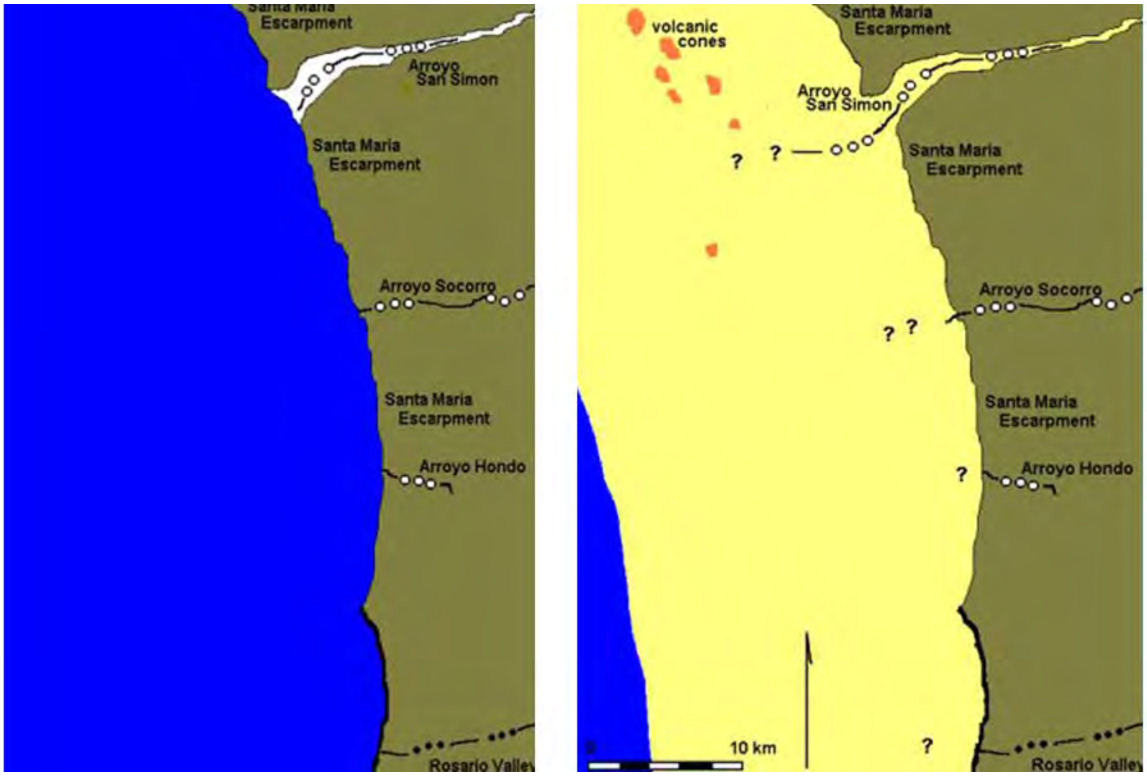


Figure 9. Reconstructed coastline: (left) 130,000-120,000 B.P.; (right) pre-40,000 B.P.

if we assume that Douglas Inman's reconstruction of sea levels for La Jolla are analogous to the San Quintín-El Rosario coast, the most recent iteration of San Quintín Bay probably did not form until the Middle Holocene, when sea levels rose to within 2-4 m of current levels at ca. 5000-3000 B.P. (Inman 1983:9). This may account, in part, for the absence of quiet-water species in early shell middens.

These data lead to the following tentative reconstructions of the region's coastline. At 130,000-120,000 B.P., a eustatic high stand cut the Santa Maria escarpment (Figure 9). At an unknown point after that date but before 40,000 B.P., sea levels dropped and the San Quintín volcanoes formed. By 40,000-35,000 B.P., another rise in sea level to within about 0.5 m of modern levels created the embayment we call "Bahía Antigua," but we do not know if the tombolo connecting Monte Mazo to the mainland was present at that time, nor is it certain how much of the coastline south of Arroyo San Simón was exposed (Figure 10). At 18,000 B.P., the well-documented glacial maximum lowered eustatic sea levels in excess of 100 m. Using the current 100-m depth contour as a guide, the San Quintín-El Rosario region would have been a broad plain, presumably with some freshwater streams from arroyos (although their courses are unknown) and the Bahía Antigua would have disappeared. With the decrease in glaciation and the rise in sea levels, San Quintín Bay would have gradually refilled, although it did not assume its modern form (Figure 11) until sometime after 5000-3000 B.P. When sea levels rose, the Monte Mazo tombolo began to form, creating the back eddy that scoured the coastline and redeposited sediments to form Punta Azufre. This last factor in turn influenced the presence of dated archaeological components in the San Quintín-El Rosario region.

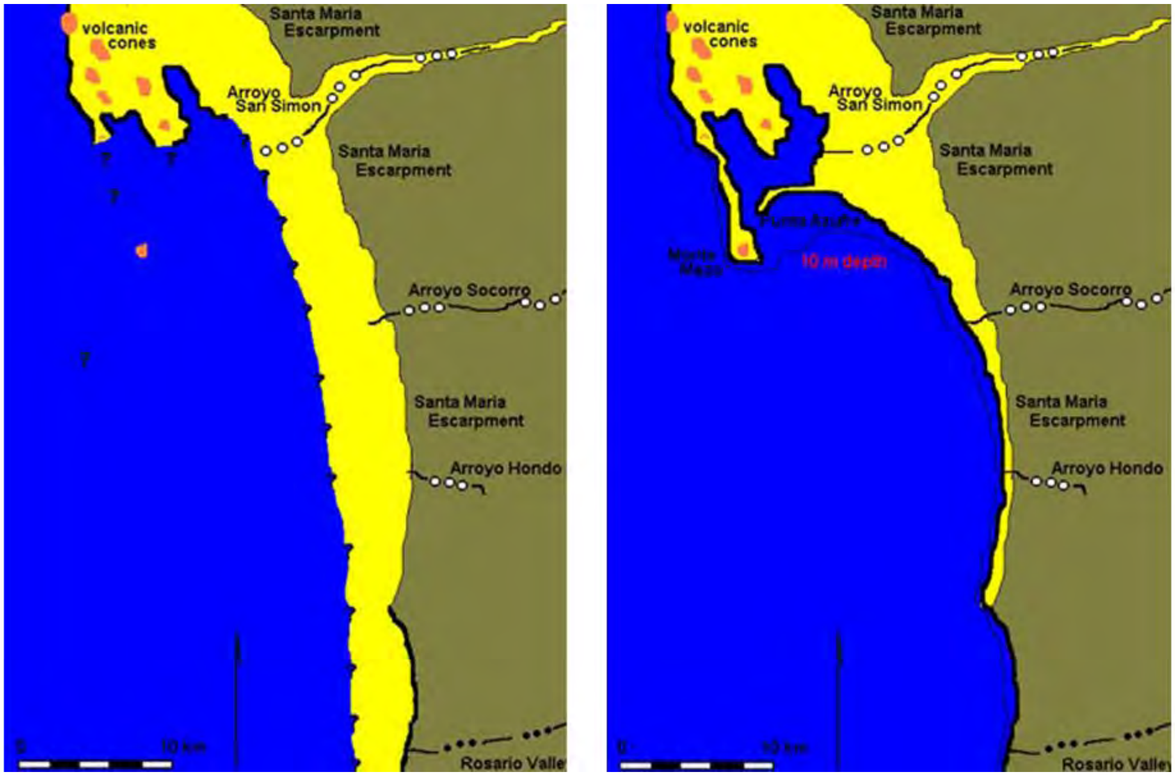


Figure 10. Reconstructed coastline: (left) 40,000-35,000 B.P.; (right) 18,000 B.P.


Figure 11. Modern coastline.

## Changing coastlines and absolute dating of human occupation

Based on 59 radiometric dates from archaeological contexts, human occupation of the PASE area began by at least 5300 B.C. and continued into the historic period. A possible gap in the dates at ca. 4200-3400 B.C. may reflect the consequences of the Altithermal, but is just as likely the product of chance radiocarbon sampling. Later droughts (Euler et al. 1979; Larson and Michaelsen 1990; Larson et al. 1989; Scuderi 1984) are not marked by gaps in the PASE radiocarbon record. For example, six radiocarbon dates fall within the A.D. 980-1250 period known as the Medieval Climatic Anomaly, which in southern Alta California was associated with drought, decreased terrestrial resource productivity, and high marine resource productivity (Jones et al 1999; Kennett and Kennett 2000; Raab and Larson 1997). In fact, it may be that coastal zones like the PASE project area were more desirable than interior zones during this period, given the availability of marine resources.

There is an apparent increase through time in the number of dated components, but I believe this reflects the dynamics of coastal erosion and our biased selection of radiometric samples from exposed sea cliff profiles, rather than an actual population increase or intensified occupation within the PASE project area. Because we did not conduct excavations yet wanted to maximize stratigraphic control for radiocarbon samples, we chose many of our samples from sites exposed in sea cliffs. Yet, most of the modern coastline consists of relatively late landforms, with the oldest landforms limited to wave-resistant basalts in the northern part of the project area.

With a single exception (i.e., PASE-13), the earliest dated components come from sites located on steep volcanic cliffs in the northern project area. Based on field inspections and geological maps of the project area (CETENAL Carta Geológica "Lazaro Cardenas" HIIB64), these basalt cliffs are the eastern remnant of a volcanic cone steeply cut by wave erosion. Four of the oldest dated deposits (PASE-87, -137, -184 and -185) are from virtually identical sites located on the steep volcanic cliffs northeast of San Quintín Bay (Table 2). The four sites have radiocarbon dates from the seventh millennium B.P. (e.g., PASE-137 Sample 1, 6900 ±100 RCYBP, 5490-5315 B.C.; PASE-87 at 7.6 m, 6000 ±100 RCYBP, 4555-4345 B.C.). Given the precarious locations of these earliest sites, I assume that human beings entered the region when the coast was further west, prior to 5500 B.C. Assuming a rough symmetry for the remnant volcanic cone, a pattern evident for the extant cones in the San Quintín group, the landform probably extended at least 500-1,000 m further west than at present. The sedimentary conglomerates south of San Quintín Bay have eroded more rapidly than the basalt cliffs located in the northern project area. The coast from San Quintín bay south to the Rosario valley is approximately 10-15 km farther east than the coastline immediately north of San Quintín Bay. The resistant rock of the San Quintín volcanic cones and Monte Mazo creates a local eddy that scours the coastline and redeposits sediments to create the vast dune fields of the Pabellón locale and the sand spit across San Quintín Bay that terminates at Punta Azufre. Table 2 presents available $^{14}$C dates from sea cliff profiles in the project area and shows the clear association between landform and antiquity. This has had a significant impact on the preservation of ancient landforms and archaeological sites, resulting in an underrepresentation of older sites except in rare sections of older coastline.

## Changing coastlines and archaeological assemblages

Just as these processes impacted the overall archaeological record, we can see their

Table 2. Dates of PASE sea cliff exposures, listed north to south.

| Context | Sample Number | Conventional radiocarbon age ($^{13}C$ corrected) | Calibrated one-sigma date range |
|---|---|---|---|
| *Sites north of remnant volcanic cone* | | | |
| PASE-217 | Beta-135803 | 990 ±60 | A.D.1475-1635 |
| PASE -219 | Beta-135804 | 580 ±50 | A.D. 1310-1365, 1380-1415 |
| PASE-219 | Beta-135805 | 760 ±60 | A.D. 1680-1885, 1945-1950 |
| PASE-219 | Beta-135806 | 910 ±60 | A.D. 1480-1715 |
| PASE-219 | Beta-135807 | 920 ±60 | A.D. 1525-1675 |
| PASE-219 | Beta-135808 | 920 ±60 | A.D. 1525-1675 |
| *Sites on remnant volcanic cone* | | | |
| PASE-137 | Beta-123966 | 7120 ±90 | 5490-5315 B.C. |
| PASE-185 | Beta-123971 | 6400 ±80 | 4765-4545 B.C. |
| PASE-185 | Beta-123972 | 6470 ±70 | 4825-4665 B.C. |
| PASE-184 | Beta-123962 | 6080 ±80 | 4400-4235 B.C. |
| PASE-87; 7.6 m | Beta-87480 | 6220 ±90 | 4555-4345 B.C. |
| PASE-87; 3.2 m | Beta-87479 | 2810 ±70 | 380-190 B.C. |
| PASE-87; 1.1 m | Beta-87478 | 2160 ±90 | A.D. 370-595 |
| *Site on Monte Mazo tombolo* | | | |
| PASE-6; Str. VII1 | Beta-87476 | 3280 ±70 | 975-800 B.C. |
| PASE-6; Str. II | Beta-87475 | 1760 ±70 | A.D. 780-970 |
| *Sites south of San Quintín Bay* | | | |
| PASE-4; terminal stratum | Beta-87485 | 4840 ±60 | 2915-2845 B.C. |
| PASE-5 | Beta-87473 | 730 ±50 | A.D. 1710-1950 |
| PASE-246 | Beta-135813 | 1180 ±60 | A.D. 1330-1445 |
| PASE-246 | Beta-135814 | 1290 ±60 | A.D. 1275-1385 |
| PASE-2 | Beta-87468 | 850 ±70 | A.D. 1635-1740 |
| PASE-2 | Beta-123974 | 190 ±50 | A.D. 1660-1690, 1735-1815 |

(Marine reservoir correction has reduced age by 220 years and added 10 years to standard deviation.)

consequences for specific archaeological sites. Again, we do not have excavated or quantified data, but the qualitative data from one site, PASE-87, are so clear that the basic shifts in assemblage are quite evident. This site consists of three superimposed sets of archaeological strata exposed in 1995 in an 18-m tall exposure. These three sets of strata exhibit dramatic shifts in molluscan assemblages. The uppermost Stratum A is located 1.2 m below the surface and is dominated by *Mytilus californianus* and *Septifer bifurcatus*, rocky shore species. Stratum A is dated to A.D. 370-595 (Beta-87478; 2160 ±90 B.P.). The middle Stratum B, 3.2 m below the surface, exhibits a mix of species, with rocky shore species like *Mytilus californianus* and *Haliotis cracherdoii*, sandy beach species like *Tivela stultorum*, and *Protothaca staminea* found in moderately shallow water at depths of 10-25 m (Morris 1966). Stratum B is dated to 380-190 B.C. (Beta-87479; 2810 ±70 B.P.). Stratum C is the deepest cultural level at 7.6 m below the current surface, and its molluscan assemblage is exclusively *Tivela stultorum*, many of them large clams 8-10 cm in width. Stratum C dates to 4555-4345 B.C. (Beta-87480; 6220 ±90 B.P.).

The data from PASE-87 point to several important issues. First, the changes in molluscan assemblages almost certainly reflect changing coastlines rather than shifts in procurement strategies or pressures towards intensification. Although digging for Pismo clams and collecting mussels from rocky shorelines require different collecting strategies, the data suggest they are roughly comparable in search times and returns (Erlandson 1988). For example, Alpin (1947)

Table 3. Nutritional value of selected shellfish (data in grams per 100 g portion of raw meat; from Erlandson 1988).

| | Protein | Fat | Kilocalories |
|---|---|---|---|
| *Mytilus* sp. | 14.4 | 2.2 | 95 |
| *Haliotis* sp. | 18.7 | 0.5 | 98 |
| *Ostrea lurida* | 9.6 | 2.5 | 82 |
| *Protothaca staminea* | 13.5 | 1.0 | 77 |
| *Saxidomus nutalli* | 13.0 | 1.2 | 79 |
| *Tivela stultorum* | 11.2 | 1.4 | 74 |

reported on the Pismo fishing industry at San Quintín bay in the 1940s and estimated that a professional clam digger during a low tide could obtain enough protein for 100-450 adults. Casual conversations with clam diggers today suggest that a man can collect around three dozen clams during a low tide, perhaps reflecting greater pressure on Pismo populations. Similarly, mussels are readily collected at low tides and often colonize rocks in dense clumps; for example, Wessen (cited in Erlandson 1988:106) estimated that mussel beds on the Olympic peninsula of coastal Washington State reached densities of 2,800 mussels per $m^2$. Finally, the nutritional properties of these different shellfish species are roughly the same, so it is not as though the shifts in molluscan assemblages reflect a shift to less optimal species (Table 3).

Instead, what appears to have been happening was the application of analogous subsistence strategies to a reconfigured coastline. Throughout the sequence at PASE-87, foragers were collecting readily available shellfish from the upper intertidal zones of open coastline. What changed was the coastline. At circa 6000 B.P., sea level was somewhat lower than currently and a sandy beach was present, and it is possible that one existed on the down shore side of a rocky jetty, the remnants of which form a reef due west of PASE-87. As sea level rose to modern levels, this rocky formation eroded until the current configuration of open rocky coastline was arrived at by 2000 B.P. While the archaeological record exhibits clear changes in molluscan assemblages, the overall subsistence strategy apparently did not change.

## Conclusion

The dynamics of coastal geomorphology have influenced the archaeological record of the San Quintín-El Rosario region. I have discussed three arenas in which patterns in the archaeological record reflect those dynamics. First, I argue that the relative insignificance of San Quintín Bay as a resource zone is in part due to its late formation at ca. 5000-3000 B.P. Second, I contend that the increase in radiocarbon-dated assemblages after A.D. 1000 reflects (a) our reasonable but biased collection of $^{14}C$ samples from sea cliff exposures and (b) the elimination of earlier landforms by coastal erosion, particularly in the region south of San Quintín Bay. Finally, I suggest that clear-cut shifts in molluscan assemblages at PASE-87 reflect changes in the local coastline and not in basic subsistence strategies.

Again, I am acutely aware of the limits of this study. There are additional variables -- tectonic uplift, sediment transport and beach formation, stream processes, or various other factors -- I have not discussed for lack of data and expertise. I feel as though I have outlined topics for a doctoral dissertation and two M.A. theses, and additional research is obviously required. But despite these inadequacies, I believe I have shown the importance of exploring the range of variables that create the archaeological record. When our archaeological data bases were limited, sporadic, and often nonsystematic (e.g., Rozaire 1964), these issues rarely were evident. But now, as we develop larger and comparable data sets from throughout the peninsula, such issues assume greater significance. As we attempt to understand different patterns from Isla Cedros (Des Lauriers 2005), Bahía de los Angeles and Bahía de las Animas (Ritter 2000), Isla Espiritu Santo, the Cape Region and the San Quintín-El Rosario region, we will need to discriminate between cultural behaviors and natural processes as we try to understand prehistoric human adaptations in the dynamic coastal environments of Baja California.

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