

CLUES TO BAJA CALIFORNIA'S PREHISTORY FROM MARINE SHELL

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The marine invertebrate remains in innumerable shell middens along the coasts of the Baja California peninsula are one of the most conspicuous elements of the region's archaeological record. This overview, originally part of a symposium on "Balances y Perspectivas from the Baja California Peninsula: Where We've Been, Where We're Going," takes a look at the current status of studies of these remains and the ways those studies are contributing to the rediscovery of the peninsula's prehistory. Actual and potential contributions are seen in elucidating such topics as chronology, technology, natural and human-induced environmental change, settlement and mobility systems, exchange, and perhaps ethnic identities and shifts.

Baja California's extensive shell middens rank together with the peninsula's spectacular rock art as one of the foremost aspects of its archaeological record (Figure 1). In recent years, with the reporting of more extensive and intensive investigations throughout the region, marine invertebrate remains have become an increasingly important means of reconstructing many aspects of Baja California's prehistory.

MARINE SHELL AND RADIOCARBON CHRONOLOGY

The peninsula's prehistoric chronology has been based, to a considerable extent, upon radiocarbon dates taken from samples of marine shell. About 44 percent of the reported radiocarbon dates have been based on samples of shell, including 61 percent of the dates that are calibrated to earlier than B.C./A.D. 1 (Figure 2). However, the relative use of shell samples has declined slightly, with the increasing availability of AMS dating, through which smaller carbon samples from other sources have become datable. Ongoing problems with the use of shell for radiocarbon dating concern the need to verify that shell samples represent human harvesting rather than natural animal deaths (e.g., Fujita 2010a; Gusick and Davis 2010) and continuing uncertainty about the marine reservoir correction values appropriate for use in various parts of the region (e.g., Stewart et al. 2012; Stuiver et al. 2012).

VARIED PREHISTORIC USES OF MARINE SHELLFISH

The quantities of marine shell found at Baja California's archaeological sites range from minor to immense. At least 140 genera of marine invertebrates have been reported as being represented (Table 1). These genera include 64 gastropods, 59 bivalves, six chitons, one scaphopod, five echinoderms, three crustaceans, and two corals. (The scientific names accepted in the Integrated Taxonomic Information System and/or the World Register of Marine Species are used in this paper.) Most of the remains have been interpreted as being refuse from the extraction, processing, and consumption of meat for food. However, some of the archaeological shell may represent materials that were merely accidentally acquired, particularly in the case of very small gastropod shells. Preliminary attempts have been made to assess quantitatively the nutritional values that are represented by particular shell deposits (e.g., Sánchez García and Rosales-López 2008). Such analyses will need to be refined in methodology and more extensively applied if they are going to create a persuasive picture of the role played by shellfish in prehistoric diets.



Figure 1. Map of Baja California, showing areas discussed in the text.

The use of shellfish was not limited to subsistence. Shell beads and ornaments are the most familiar of the non-food uses, and such artifacts derived from at least six genera (*Chione*, *Codakia*, *Haliotis*, *Olivella*, *Ostrea*, and *Pinctada*) are attested archaeologically and ethnographically. Among these, *Pinctada* (pearl oysters) and *Olivella* (small olives) are the genera most abundantly represented for ornamental uses at southern Baja California sites and *Olivella* at northern sites (cf. Fujita 2008b).

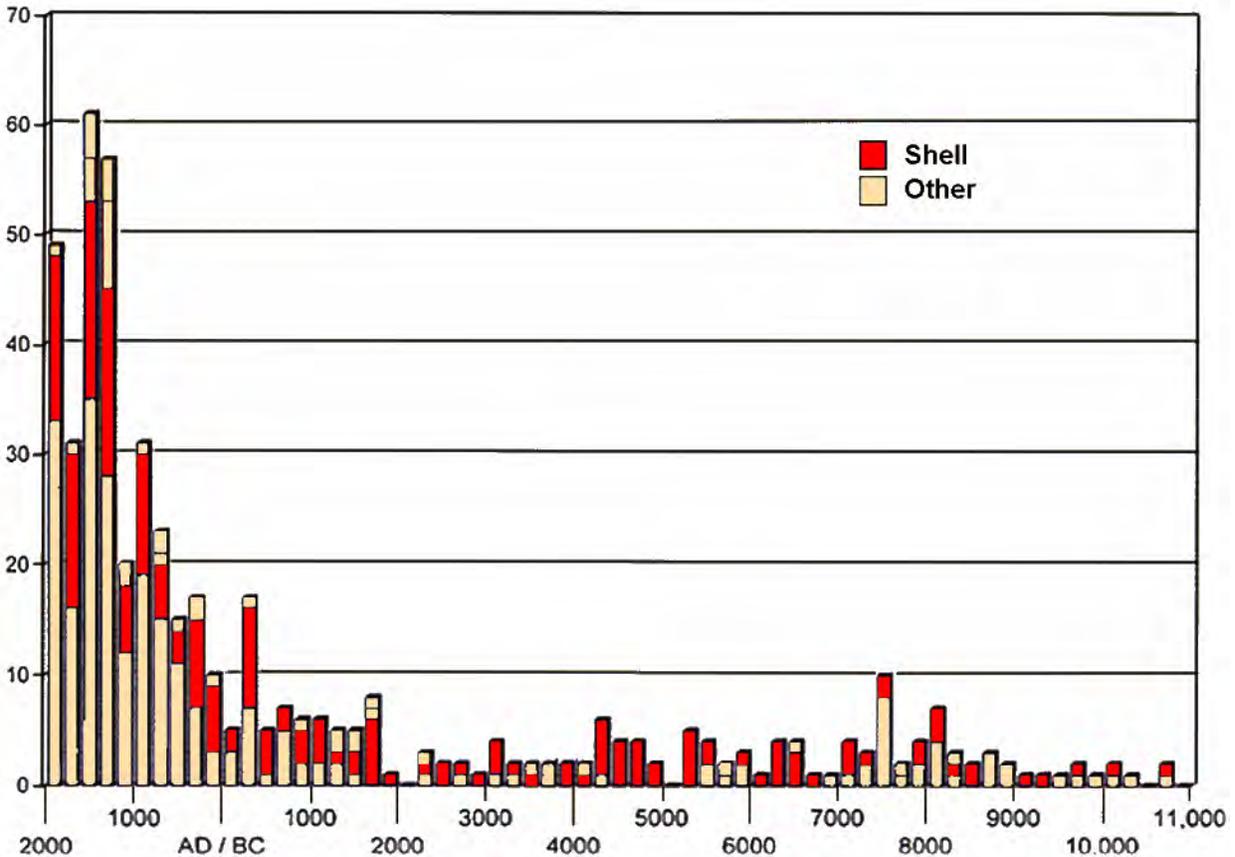


Figure 2. Radiocarbon dates from prehistoric Baja California sites. (Data from Laylander 2012a.)

Marine shell was also used in utilitarian technology, as tools and containers (e.g., Fujita 2006a; Ritter et al. 1994; Tyree 1998). Evidence of modification in manufacturing or use is increasingly being recognized in archaeological assemblages. Tools and containers made from at least 20 genera (*Callista*, *Chione*, *Codakia*, *Dosinia*, *Euvola*, *Fusinus*, *Glycymeris*, *Haliotis*, *Hexaplex*, *Hytotissa*, *Laevicardium*, *Lobatus*, *Lyropecten*, *Ostrea*, *Persististrombus*, *Pinctada*, *Spondylus*, *Strombus*, and *Triplofusus*, as well as coral) have been reported. Artifact types that have been recognized include drills, awls, hammers, scrapers, digging tools, polishers, plates, ladles, fishhooks, and possibly fish spear points, as well as whistles. *Dosinia*, a large Gulf of California venus clam, is the most extensively documented shell used for utilitarian, non-food purposes.

Little evidence has been reported so far concerning the workshops or manufacturing areas where shell ornaments and tools were produced on the peninsula. However, shell cores and debitage from *Dosinia* tool manufacturing were observed at Bahía de los Ángeles and San Felipe sites (Tyree 1998:57). Shell preforms and debitage, as well as diverse stone, shell, and coral instruments to manufacture pearl oyster shell fishhooks were recovered from Covacha Babisuri rock shelter on Isla Espíritu Santo (Fujita 2010b). Many more such locations are likely to exist, and in the future such remains will perhaps be more commonly distinguished from food-processing refuse.

GEOGRAPHICAL PATTERNING

The most revealing studies of archaeological shell on the peninsula are likely to be based upon the recognition and interpretation of patterning in the distribution of shell across space and through time.

Table 1. Genera of marine invertebrates reported in Baja California archaeological deposits (with identified species in parentheses).

<i>Acanthina</i> (<i>lugubris</i>)	<i>Fissurella</i> (<i>volcano</i>)	<i>Periglypta</i> (<i>multicostata</i>)
<i>Acanthochitona</i> (<i>arragonites</i> , <i>avicula</i>)	<i>Fusinus</i> (<i>dupetiithouarsii</i>)	<i>Persististrombus</i> (<i>granulatus</i>)
<i>Anadara</i> (<i>cepoides</i> , <i>concinna</i> , <i>formosa</i> , <i>grandis</i> , <i>multicostata</i> , <i>tuberculosa</i>)	<i>Glossaulax</i> (<i>reclusiana</i>)	<i>Pinctada</i> (<i>mazatlanica</i>)
<i>Anachis</i>	<i>Glycymeris</i> (<i>gigantea</i> , <i>maculata</i> , <i>mazatlanica</i> , <i>multicostata</i> , <i>undatella</i>)	<i>Pinna</i> (<i>rugosa</i>)
<i>Anomia</i> (<i>peruviana</i>)	<i>Haliotis</i> (<i>corrugata</i> , <i>cracherodii</i> , <i>fulgens</i> , <i>rufescens</i>)	<i>Pitar</i> (<i>alternatus</i> , <i>vulneratus</i>)
<i>Arca</i> (<i>mutabilis</i> , <i>pacifica</i>)	<i>Heterodonax</i> (<i>pacificus</i>)	<i>Plicopurpura</i> (<i>pansa</i>)
<i>Argopecten</i> (<i>ventricosus</i>)	<i>Hexaplex</i> (<i>erythrostomus</i> , <i>nigritus</i> , <i>princeps</i>)	<i>Pocillopora</i>
<i>Astraea</i> (<i>olivaceae</i>)	<i>Hinnites</i> (<i>multirugosus</i>)	<i>Pododesmus</i> (<i>macroscismus</i>)
<i>Atrina</i> (<i>maura</i> , <i>tuberculosa</i>)	<i>Hyotissa</i> (<i>hyotis</i>)	<i>Polinices</i> (<i>bifasciatus</i>)
<i>Balanus</i>	<i>Isogomon</i> (<i>janus</i>)	<i>Pollicipes</i> (<i>polymerus</i>)
<i>Barbatia</i> (<i>lurida</i> , <i>reeveana</i>)	<i>Laevicardium</i> (<i>elatum</i> , <i>substriatum</i>)	<i>Pomaulax</i> (<i>gibberosus</i>)
<i>Brachidontes</i>	<i>Leopecten</i> (<i>stillmani</i>)	<i>Psammotreta</i> (<i>viridotrincta</i>)
<i>Bulla</i> (<i>gouldiana</i>)	<i>Lepidozona</i>	<i>Pseudochama</i> (<i>enermis</i> , <i>exogyra</i> , <i>saavedrai</i>)
<i>Callista</i> (<i>aurantiaca</i> , <i>squalida</i>)	<i>Leptopecten</i> (<i>latiauratus</i>)	<i>Pseudozonaria</i> (<i>annettae</i>)
<i>Callistochiton</i> (<i>infortunatus</i>)	<i>Leukoma</i> (<i>grata</i> , <i>metodon</i> , <i>staminea</i>)	<i>Pteria</i> (<i>sterna</i>)
<i>Cancellaria</i>	<i>Lima</i> (<i>tetrica</i>)	<i>Puncturella</i> (<i>punctocostata</i>)
<i>Cantharus</i>	<i>Lobatus</i> (<i>galeatus</i> , <i>gigas</i>)	<i>Purpura</i> (<i>patula</i>)
<i>Cardita</i> (<i>megastropha</i>)	<i>Lottia</i> (<i>atrata</i> , <i>dalliana</i> , <i>gigantea</i> , <i>stanfordiana</i>)	<i>Saccostrea</i> (<i>palmula</i>)
<i>Carditamera</i> (<i>affinis</i>)	<i>Luria</i> (<i>isabellamexicana</i>)	<i>Scutellastra</i> (<i>mexicana</i>)
<i>Cerithidea</i> (<i>albonodosa</i> , <i>montagnei</i>)	<i>Lyropecten</i> (<i>subnodosus</i>)	<i>Semele</i> (<i>flavescens</i>)
<i>Cerithium</i> (<i>maculosum</i> , <i>stercumuscarum</i>)	<i>Macron</i> (<i>aethiops</i>)	<i>Semicassis</i> (<i>centiquadrata</i>)
<i>Chama</i> (<i>buddiana</i> , <i>echinata</i> , <i>frondosa</i> , <i>mexicana</i>)	<i>Mactromeris</i> (<i>hemphillii</i>)	<i>Septifer</i> (<i>bifurcatus</i>)
<i>Chione</i> (<i>californiensis</i> , <i>cortezi</i> , <i>fluctifraga</i> , <i>gnidia</i> , <i>tumens</i> , <i>undatella</i>)	<i>Malea</i> (<i>ringens</i>)	<i>Serpulorbis</i> (<i>margaritaceus</i>)
<i>Chionopsis</i> (<i>lilacina</i>)	<i>Megastraea</i> (<i>undosa</i>)	<i>Solen</i> (<i>rostriformis</i>)
<i>Chiton</i> (<i>virgulatus</i>)	<i>Megathura</i> (<i>crenulata</i>)	<i>Spondylus</i> (<i>crassisquama</i> , <i>leucacanthus</i> , <i>limbatus</i>)
<i>Chlorostoma</i> (<i>funerbralis</i>)	<i>Mercenaria</i>	<i>Stenoplax</i> (<i>conspicua</i>)
<i>Clypeaster</i> (<i>europacificus</i>)	<i>Mexacanthina</i> (<i>angelica</i>)	<i>Strigilla</i>
<i>Codakia</i> (<i>distinguenda</i>)	<i>Modiolus</i> (<i>americanus</i> , <i>capax</i>)	<i>Striostrea</i> (<i>prismatica</i>)
<i>Columbella</i> (<i>fuscata</i> , <i>strombiformis</i>)	<i>Mulinia</i> (<i>coloradoensis</i>)	<i>Strombus</i> (<i>gracilior</i>)
<i>Conus</i> (<i>brunneus</i> , <i>californicus</i> , <i>diadema</i> , <i>princeps</i> , <i>purpurascens</i> , <i>regularis</i> , <i>tiaratus</i> , <i>ximenes</i>)	<i>Murex</i>	<i>Tagelus</i> (<i>californianus</i> , <i>violascens</i>)
<i>Crassostrea</i> (<i>columbiensis</i> , <i>corteziensis</i>)	<i>Murexiella</i> (<i>lappa</i>)	<i>Tegula</i> (<i>eiseni</i> , <i>gallina</i> , <i>rugosa</i>)
<i>Crepidula</i> (<i>onyx</i> , <i>striolata</i>)	<i>Muricella</i>	<i>Tellina</i> (<i>coani</i>)
<i>Crucibulum</i> (<i>personatum</i> , <i>scutellatum</i> , <i>spinosum</i> , <i>umbrella</i>)	<i>Myrakeena</i> (<i>angelica</i>)	<i>Terebra</i> (<i>allyni</i>)
<i>Cryptochiton</i> (<i>stelleri</i>)	<i>Mytilus</i> (<i>californianus</i>)	<i>Thais</i> (<i>biserialis</i> , <i>emarginata</i> , <i>kiosquiformis</i> , <i>planospira</i> , <i>speciosa</i>)
<i>Cymatium</i>	<i>Nassarius</i>	<i>Theodoxus</i> (<i>luteofasciatus</i>)
<i>Cypraecassis</i> (<i>coarctata</i> , <i>tenuis</i>)	<i>Natica</i> (<i>chemnitzii</i>)	<i>Tivela</i> (<i>byronensis</i> , <i>delesserti</i> , <i>stultorum</i>)
<i>Dendraster</i>	<i>Neorapana</i> (<i>tuberculata</i>)	<i>Trachycardium</i> (<i>consors</i> , <i>procerum</i>)
<i>Dentalium</i>	<i>Nerita</i> (<i>funiculata</i> , <i>scabricosta</i> , <i>scabricostata</i>)	<i>Trigoniocardia</i> (<i>biangulata</i>)
<i>Diplodonta</i> (<i>inezensis</i>)	<i>Nucella</i> (<i>emarginata</i>)	<i>Triplofusus</i> (<i>princeps</i>)
<i>Donax</i> (<i>gouldii</i>)	<i>Oliva</i> (<i>incrassata</i> , <i>polpasta</i> , <i>porphyria</i> , <i>spicata</i> , <i>undatella</i>)	<i>Tripsycha</i> (<i>tulipa</i>)
<i>Dosinia</i> (<i>dunkeri</i> , <i>ponderosa</i>)	<i>Olivella</i> (<i>alba</i> , <i>biplicata</i> , <i>dama</i> , <i>tergina</i> , <i>zonalis</i>)	<i>Trivia</i>
<i>Echinometra</i> (<i>vanbrunti</i>)	<i>Ostrea</i> (<i>conchaphila</i> , <i>megadon</i> , <i>palmula</i>)	<i>Turbo</i> (<i>fluctuosus</i>)
<i>Encope</i> (<i>grandis</i> , <i>micropora</i>)	<i>Panulirus</i>	<i>Turritella</i> (<i>anactor</i> , <i>gonostoma</i> , <i>lentiginosa</i> , <i>leucostoma</i> , <i>nodulosa</i>)
<i>Episcynia</i> (<i>medialis</i>)	<i>Parviturbo</i>	<i>Uvanilla</i> (<i>unguis</i>)
<i>Erosaria</i> (<i>albuginosa</i>)	<i>Patella</i>	<i>Vasum</i> (<i>caestus</i>)
<i>Eucidaris</i> (<i>thouarsii</i>)	<i>Patelloida</i> (<i>semirubida</i>)	<i>Vermetus</i> (<i>contortus</i>)
<i>Euvola</i> (<i>vogdesi</i>)		<i>Vokesimurex</i> (<i>recurvirostris</i>)

Data from Laylander 2012b. It is likely that some of the identifications made were incorrect. For a concordance of obsolete names used in the original sources, see Table 2.

Table 2. Corrected names for marine invertebrates reported in the Baja California archaeological literature but rated as "invalid" or "not accepted."

Original Name in Reports	Corrected Name	Original Name in Reports	Corrected Name
<i>Ancistromesus mexicanus</i>	<i>Scutellastra mexicana</i>	<i>Ostrea angelica</i>	<i>Myrakeena angelica</i>
<i>Argopecten circularis</i>	<i>A. ventricosus</i>	<i>Ostrea columbiensis</i>	<i>Crassostrea columbiensis</i>
<i>Astraea unguis</i>	<i>Uvanilla unguis</i>	<i>Ostrea corteziensis</i>	<i>Crassostrea corteziensis</i>
<i>Cardita affinis</i>	<i>Carditamera affinis</i>	<i>Ostrea fisheri</i>	<i>Hyotissa hyotis</i>
<i>Cassis centiquadrata</i>	<i>Semicassis centiquadrata</i>	<i>Ostrea iridescens</i>	<i>Striostrea prismatica</i>
<i>Cassis coarctata</i>	<i>Cypraecassis coarctata</i>	<i>Pecten vogdesi</i>	<i>Euvola vogdesi</i>
<i>Cassis tenuis</i>	<i>Cypraecassis tenuis</i>	<i>Polinices reclusianus</i>	<i>Glossaulax reclusiana</i>
<i>Chione purpurissata</i>	<i>Chionopsis lilacina</i>	<i>Purpura pansa</i>	<i>Plicopurpura pansa</i>
<i>Collisella</i> spp.	<i>Lottia</i> spp.	<i>Spondylus calcifer</i>	<i>S. limbatus</i>
<i>Cypraea albuginosa</i>	<i>Erosaria albuginosa</i>	<i>Spondylus princeps</i>	<i>S. crassisquama</i>
<i>Cypraea annettae</i>	<i>Pseudozonaria annettae</i>	<i>Spondylus ursipes</i>	<i>S. leucacanthus</i>
<i>Fasciolaria princeps</i>	<i>Triplofusus princeps</i>	<i>Strombus galeatus</i>	<i>Lobatus galeatus</i>
<i>Megapitaria</i> spp.	<i>Callista</i> spp.	<i>Strombus granulatus</i>	<i>Persististrombus granulatus</i>
<i>Murex recurvirostris</i>	<i>Vokesimurex recurvirostris</i>	<i>Trachycardium panamense</i>	<i>T. procerum</i>
<i>Muricanthus</i> spp.	<i>Hexaplex</i> spp.		

Sources: Integrated Taxonomic Information System (2012); World Register of Marine Species (2012).

However, rich as these patterns may be, it will be no simple task to disentangle the various potential explanations to account for them.

Factors that may account for geographical variation in archaeological shell deposits include:

- large-scale environmental variability, notably in water temperature and its seasonal variation, and possibly in tidal range;
- more localized environmental variability; for instance, in the differences between rocky, sandy, and muddy substrates, between calm and turbulent waters, and between high and low salinity; and
- the contexts of sites within settlement systems, such as differences between sites situated on the coast and at inland locations, and differences between sites representing locations of extended settlement and sites used only for short-term processing or consumption.

Observed Patterns: Coasts/Interior

One of the dimensions of geographical variation in shellfish remains extends along east/west axes, between coastal and interior areas and between the two coasts. Some of the observed coast/interior contrasts are quantitative. Marine shell has commonly been reported at sites far within the interior of the peninsula, for instance in the Sierra Juárez, at Laguna Seca Chapala and Laguna La Guija, in the Sierra de San Francisco, and at Comondú. However, unsurprisingly, marine shell is much more abundant at coastal archaeological sites than at inland sites. This is largely explicable as a greater reliance on marine resources when they were more immediately at hand on the coast, but it probably also reflects a processing strategy. The degree of dietary reliance on shellfish at inland sites is likely to be underestimated archaeologically, because meat from shellfish may have been extracted and dried on the coast and then carried inland without the shell, and consequently would have left few archaeological traces.

Coastal/inland variation can be considered at several areas where substantial archaeological surveys have been reported. In the Cape Region, coastal settlements with substantial deposits of marine shell dominate the archaeological record. Five "major centers of socioeconomic and ideological importance" have been identified, all of them located in coastal settings: Isla Espíritu Santo, La Paz, Ensenada de los Muertos, Cabo Pulmo, and Cabo San Lucas (Fujita 2006b:88; Rosales-López and Sánchez García 2012). Archaeological sites recorded in the Cape interior include rock art sites and burial sites, but the sites seem to reflect a use of inland areas that was less intensive and perhaps only subsidiary.

An isotopic analysis of human burials from the inland site of La Matancita gave results that were compatible with a substantial reliance on marine resources (Molto and Fujita 1995).

Eric W. Ritter assessed coastal/inland differences at Bahía Concepción (Ritter 1979, 1985, 2001:60-61, 2006b:112-113) and Bahía de los Ángeles (Ritter 1998, 2001:61-63, 2006a:175-176). Based on the sharp drop-off in the frequency of shell observed at sites as one moved inland, as well as the presence of substantial settlements on the coast, Ritter concluded that the occupants of coastal and inland sites in these areas represented separate social groups, rather than the same groups moving seasonally between coastal and inland settlements.

A different pattern was found in the vicinity of the Sierra de San Francisco. Justin R. Hyland and María de la Luz Gutiérrez found relatively limited evidence of occupation along the Gulf coast adjacent to the sierra: "Shell remains were abundant along the coast but nowhere were accumulations significant enough to characterize the sites as shell middens. Sub-surface testing ... confirms that most shell appears to have occurred as a thin surface veneer at sites" (Hyland 1997:218-219; see also Gutiérrez and Hyland 2002:180). The investigators concluded that the Gulf coast occupations represented only short-term occupations, perhaps lasting for no more than a few days (Hyland 1997:240-241, 2006:130-131; Gutiérrez and Hyland 2002:184). In contrast to Ritter's findings at Bahía Concepción and Bahía de los Ángeles, Hyland and Gutiérrez found marine shells to be fairly common for over 30 km inland along the major drainages leading up from the Gulf into the sierra (Hyland 1997:242-243, 2006:130). The evidence seemed to suggest that Gulf coast shellfish were a substantially more important resource for the inhabitants of the sierra than Pacific coast shellfish (Hyland 1997:324). However, such a conclusion may be premature. The upland sites' greater distance from the Pacific coast may have meant that Pacific coast shellfish consumed by the mountain-based groups was more likely to have been either eaten on the coast or brought inland after the meat had been extracted from the shell.

On the coast to the west of the Sierra de San Francisco, around the Vizcaíno Desert lagoons, Ritter (2001:64-66, 2006c:148-149) found some more substantial shell deposits. However, as in the case of the Gulf coast sites east of the sierra, he interpreted the Vizcaíno lagoons sites as representing only intermittent exploitation by people who were based in the interior: "The archaeological evidence suggests we are dealing primarily with family and small multi-family groups clustered at inter-dune or coastal locations for short periods of time (days to weeks)" (Ritter 2001:66). The likely bases for these groups lay in the Sierra de San Francisco.

Farther to the north, the dry interior basins of Laguna Chapala and Laguna La Guija are located at approximately equal distances (40 km) from the Pacific and Gulf coasts. Ritter and his associates (1984:25) argued that the archaeological evidence "strongly suggests that [occupants of Laguna La Guija] came up from the Pacific coast rather than the Gulf." However, the testimony of shell remains is more ambiguous. Of nine shellfish taxa reported from sites in the Laguna Chapala/Laguna La Guija area, two are specific to the Pacific coast (*Haliotis* and *Mytilus californianus*) and one is specific to the Gulf coast (*Strombus*, possibly including *Lobatus* and/or *Persististrombus*), but the remaining six genera were available on both coasts (*Argopecten*, *Chione*, *Laevicardium*, *Olivella*, *Pecten*, and *Trachycardium*).

The northern portion of the Sierra Juárez lies about 80 km from the Pacific coast and about twice that far from the head of the Gulf of California. Nonetheless, the evidence from shellfish genera suggests that ties with the Gulf may have been as strong as or stronger than links extending to the west. Of 11 taxa reported at Sierra Juárez sites, four are specific to the Gulf (*Carditamera affinis*, *Glycymeris gigantea*, *Oliva incrassata*, and *Pitar*), one is specific to the Pacific site (*Haliotis*), five could come from either the Pacific or the Gulf coast (*Anadara*, *Chione*, *Oliva*, *Ostrea*, and *Turritella*), and one is undetermined (*Crassostrea*). One explanation of this apparent anomaly is that western-based occupants of the Sierra Juárez may have tended to consume or process shellfish at sites on the coast or in the intermediate valleys, whereas occupants coming from the east may have more frequently travelled rapidly and directly from Gulf coast procurement areas through the often-forbidding Colorado Desert to the sites in the sierra.

Table 3. Predominant shellfish genera in assemblages from sites around Bahía Concepción.

GENUS	SITE BS-D										
	9	15	50	55	67	68	139	140	150	155	160
	WEIGHT (G) OF IDENTIFIED SHELL SAMPLE FROM SITE										
	5198	1711	1335	1975	621	900	536	8674	17137	1404	824
<i>Anadara</i>			+				M		+		
<i>Arca</i>	+	M	+	+				M	+	+	+
<i>Argopecten</i>	M	+	+	M			M	+	+		+
<i>Callista</i>			M	M				+	+		
<i>Carditamera</i>			+	M				+	+		
<i>Chama</i>	M	M	+		M			M	M	M	+
<i>Chione</i>			M	+				M	M	M	+
<i>Glycymeris</i>			+	M		+	M		+	+	
<i>Hexaplex</i>	M		+					+	+	+	+
<i>Malea</i>					M						
<i>Neorapana</i>					M				+		
<i>Ostrea</i> *			M	+				+	M	+	+
<i>Pinctada</i>			+					+	+	M	+
<i>Spondylus</i>			+	+							M
<i>Turbo</i>	M	+	+	+	M	M		+	+		

Data from Ritter 1979.

M = major genus, defined as representing more than 10 percent by weight of identifiable specimens within a sample of more than 500 g of shell.

+

* Likely also includes some shell from other oyster genera; see Table 2.

East/west movement of shell is also attested by the occurrence at sites on one coast of shell from species that are found exclusively on the opposite coast. In one example, a shell specific to the Gulf, *Conus regularis*, has been found at a Pacific coast site north of Ensenada (Guía Ramírez and Oviedo García 2009:19; Porcayo Michelini 2010:10). In another, *Haliotis* shell from the Pacific coast has recently been found in the Sierra El Mayor, near the northern end of the Gulf.

Observed Patterns: Diversity along the Coasts

Along the peninsula's coasts, the prehistoric patterns of shellfish exploitation were far from uniform. Much of the variability is attributable to localized differences in the naturally available resources, but some of it may reflect cultural decisions. In several regions of Baja California, enough data have been presented on the distributions of shellfish genera and species at multiple archaeological sites to permit some assessment of patterns of variation. One case is presented by Ritter's (1979) data from the Bahía Concepción area. The distributions show considerable site-to-site variation in the predominant shellfish genera (Table 3). This variation does not seem to fit broad geographical patterns; instead, it evidently aligns with more localized environmental contexts of the sites.

The most abundant evidence available concerning the distributions of shellfish species comes from the Cape Region, and attempts have been made to discriminate subregional patterning within that region. Fermín Reygadas Dahl and Guillermo Velázquez Ramírez (2005) defined 14 zones encompassing the region's coastlines and reported the presence of shellfish species in archaeological middens within 10 of those zones. Altogether, the presence of 75 mollusk species was documented, and variations in their geographical distributions across the zones were recorded, but they were not discussed in detail or analyzed. Considered impressionistically, these presence/absence data do not suggest the existence of any

clear broad-scale patterning in the shellfish species exploited within the Cape Region, for instance along a north/south axis.

Also in the Cape Region, Fujita (2008a) distinguished four zones with differing patterns of shellfish species. In a zone that extended from Bahía de La Paz to Buena Vista and including Isla Espiritu Santo and Isla Cerralvo,

large bivalves such as pearl oyster [*Pinctada mazatlanica*], rock oyster [*Hyotissa hyotis*] and frondose jewel box (*Chama frondosa*), sometimes accompanied by giant eastern Pacific conch [*Lobatus galeatus*], predominate. In the sites near estuaries and protected bays, the frequency of California venus clams (*Chione californiensis* and *C. undatella*), bay scallop [*Argopecten ventricosus*], many ribbed ark (*Anadara multicostata* and *A. tuberculosa*), Mexican cockle [*Trachycardium procerum* and *T. consors*], and eastern Pacific fighting conch [*Strombus gracilior*] and granulated conch [*Persististrombus granulatus*] is very high. Mangrove oyster (*Ostrea palmula* and *O. conchaphila*) is abundant near mangroves in the sites in the protected bays. In some locations, Pacific turban (*Turbo fluctuosus*) and *Nerita scabricostata* snails are abundant [Fujita 2008a:15; parenthetical identifications are in the original, bracketed identifications are added].

A second zone extended from Buena Vista south to Punta Gorda. Within this zone, Fujita (1995:8) observed a north-to-south gradient, with bivalves being replaced in the middens by gastropods as the seas became more violent toward the south. Compared with the first zone, in this second zone,

rock oyster [*Striostrea prismatica*] appears in increments replacing [*Hyotissa hyotis*]. The other predominant species are speckled bittersweet clam (*Glycymeris maculata*) and the limpet [*Lottia discors*]. The pearl oyster and frondose jewel box are also present, however in smaller quantity. The Byron tivel (*Tivela byronensis*) is found in this area [Fujita 2008a:15].

The third zone ran along the south coast from Punta Gorda to Cabo San Lucas, where the exposed shores supported only short-term seasonal occupations, except for the site of El Médano at Cabo San Lucas (Fujita 1995:8). In this zone,

there are more gastropod remains than bivalve. The size of these gastropod species is medium or small and they are hard and resistant to this maritime condition. The predominant species in the archaeological sites are [*Lottia discors*], [*Astraea olivaceae*], [*Plicopurpura pansa*], *Thais planospira*, *Thais kiosquiformis*, *Thais speciosa*, [*Hexaplex nigritus*] and *Nerita scabricostata*. Bivalve most frequently found are [*Striostrea prismatica*] and *Chama mexicana*. It is worth mentioning that the high frequency of sea urchin and barnacle remains indicate that these were important food resources [Fujita 2008a:15-16].

The western coastline from Cabo San Lucas north to Todos Santos contained few shellfish remains. According to Fujita, the most common species was the gastropod *Thais biserialis*. The scarcity of remains seems to be attributable to the natural environment, characterized by high-energy waves impacting a straight, unprotected coastline which offered few resources, rather than to any prehistoric cultural decisions.

Characteristic shellfish have been noted in the middens of the peninsula's regions. In the vicinity of Bahía de los Ángeles, prominent genera include *Chione*, *Protothaca*, *Cardita/Carditamera*, *Lottia*, and *Callista*, as well as chiton (Bendímez et al. 1993; Ritter 1998; Ritter et al. 1994). At sites around San Felipe at the northern end of the Gulf, the bivalves *Glycymeris*, *Myrakeena*, and *Carditamera* are conspicuous (Porcayo Michelini 2010). In sites along the lagoons on the western edge of the Vizcaíno Desert, *Argopecten ventricosus* predominates, with smaller amounts of *Chione*, *Ostrea*, *Solen* or *Tagelus*, *Crepidula*, *Macron aethiops*, and *Crucibulum* (Ritter 2006:147). On Isla Cedros, *Mytilus* is the principal genus, along with significant amounts of *Tivela*, *Haliotis*, and *Stenoplax*. In northwestern Baja California, *Mytilus*, *Haliotis*, *Tegula*, and *Lottia* predominate (Guzmán-Muñoz 1997). Table 4 summarizes the

Table 4. Proportions of reported shellfish genera that were shared in archaeological middens among coastal Baja California regions.

REGION	NUMBER OF GENERA REPORTED	PERCENTAGE OF GENERA IN COMMON WITH							
		CAPE	BAHÍA CONCEPCIÓN	SIERRA DE SAN FRANCISCO	BAHÍA DE LOS ÁNGELES	SAN FELIPE	VIZCAÍNO LAGOONS	ISLA CEDROS	NORTHWEST COAST
Cape	81	--	58	40	53	23	12	11	11
Bahía Concepción	62	76	--	42	63	26	13	8	11
Sierra de San Francisco *	45	71	58	--	58	36	16	13	20
Bahía de los Ángeles	60	72	65	43	--	28	13	10	12
San Felipe	25	76	64	64	68	--	32	16	24
Vizcaíno Lagoons	12	83	67	58	67	67	--	25	25
Isla Cedros	22	41	23	27	27	18	14	--	55
Northwest Coast	23	39	30	39	30	26	14	52	--

* The reported data (Gutiérrez and Hyland 2002; Hyland 1997) were not separated for sites within the Sierra de San Francisco itself and sites located on the adjacent Gulf coast, but it seems likely that the data come primarily from coastal sites.

numbers of genera that have been reported at sites within eight coastal regions of Baja California and the frequency with which those genera were shared in common with other regions.

The available data do not permit statistically rigorous interregional comparisons. However, considered impressionistically, the variability between sites within the regions frequently seems to be greater than the variation between the different regions. Intraregional variation among sites is largely attributable to differences in the shellfish habitats in proximity to the sites and also, secondarily, to changes through time in exploitation strategies. The interregional differences that do exist may be largely attributable to interregional differences in marine habitats, notably in water temperature and wave action. However, in the future, more systematic reporting and rigorous analyses may be able to sort out meaningful cultural patterning as well.

CHRONOLOGICAL PATTERNING

Patterns of change in the exploitation of marine shellfish have been discerned primarily through radiocarbon dating of deposits and by stratigraphic excavations of middens. Potential explanations for variation through time in archaeological shell remains include:

- natural changes in the physical environment, such as the post-Pleistocene rise in sea level and in water temperature, as well as progressive patterns of coastal erosion and sedimentation;
- human-induced environmental changes, specifically the possibility of significant pressure on particular shellfish populations arising from intensive human predation; and
- cultural changes of various sorts, including ones related to changes in regional population density, seasonal scheduling, adaptive skills, and cultural preferences.

Carl L. Hubbs used the then-new radiocarbon method to date shell from Baja California middens (Hubbs and Bien 1967; Hubbs et al. 1960, 1962, 1965). He used the evidence to infer Holocene patterns of environmental change in ocean temperatures, rainfall, geomorphology, hydrology, and vegetation.

At archaeological sites around Bahía de San Quintín on the northwestern coast, Jerry D. Moore (2008:330) noted that the shell assemblages were dominated by open-coast species (*Mytilus californianus*

and *Tivela stultorum*) rather than bay/estuary species. He argued that this indicated that the bay may have

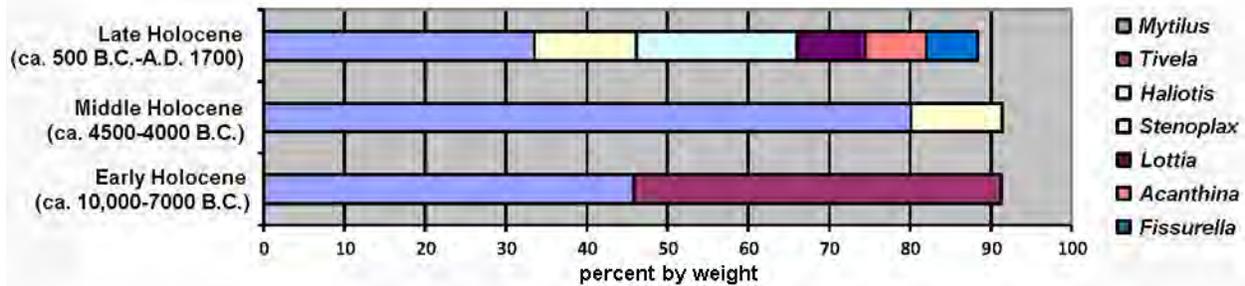


Figure 3. Proportions of major shellfish genera in sampled Isla Cedros deposits. (Data from Des Lauriers 2010. The late Holocene sample includes 21,957 g of shell from sites PAIC-7, PAIC-18, PAIC-32a, PAIC-36, and PAIC-45. The middle Holocene sample is 3,296 g from PAIC-32c. The early Holocene sample is 20,319 g from PAIC-44. Genera that represent more than 5 percent of the shell in each sample are shown.)

only come into existence during the late Holocene. Moore also noted stratigraphic changes in the predominant shellfish at site PASE-87, from the sandy-beach species *Tivela stultorum* to a mixture of sandy-beach species (*Tivela stultorum* and *Protothaca staminea*) and rocky-coast species (*Mytilus californianus* and *Haliotis cracherodii*), and then finally to a predominance of rocky-coast species (*Mytilus californianus* and *Septifer bifurcatus*).

On Isla Cedros, Matthew R. Des Lauriers reported shifts in shellfish genera in excavated samples from radiocarbon-dated sites (Figure 3). Within the early Holocene deposit, in addition to the open-coast species of Pismo clam (*Tivela stultorum*) and California mussel (*Mytilus californianus*), the upper portion of the deposit saw the appearance of bay species such as oyster (*Ostrea megadon*) (Des Lauriers 2010:72-74; cf. also 2006:163). This seems to have represented a change in the natural coastal environment rather than a shift in cultural choices. At the late Holocene sites, the added species likely reflect new cultural choices as well as environmental change. The issue of possible human impacts on Isla Cedros shellfish populations was also discussed. At PAIC-36, a late Holocene site, Matthew R. Des Lauriers (2010:139) observed:

The presence of low percentages of large and easily accessible species such as abalone (*Haliotis cracherodii*, *H. fulgens*) and mussel (*Mytilus californianus*) and high frequencies of small or high-labor-cost shellfish (e.g., *Stenoplax* chitons) raised the possibility of heavy pressure on, if not overexploitation of, the local shellfish population.

On the other hand, Sean Brown and Des Lauriers (2012) have argued that stability through time in the size of mussel valves in Isla Cedros archaeological middens may indicate a sustainable procurement strategy that avoided overexploitation and the "tragedy of the commons."

In the Cape Region, for areas on Isla Espíritu Santo and Bahía de La Paz, Fujita (2010a; cf. Fujita 2006b, 2008a; Fujita and Poyatos de Paz 1998) reported a shift in shellfish exploitation between an earlier period (ca. 9000 B.C.-B.C./A.D. 1) and a later period (ca. B.C./A.D. 1-1700). In the earlier period, the focus was on easily collected species living in estuaries, mangrove lagoons, and shallow, protected bays, including *Chione californiensis*, *C. undatella*, *Ostrea palmula*, *O. conchaphila*, *Strombus gracilior*, and *Persististrombus granulatus*, as well as chiton, crab, and sea urchin. In the later period, the focus was on large, thick-shelled species inhabiting the deep, rocky seabed, such as *Pinctada mazatlanica*, *Hyotissa hyotis*, and *Chama frondosa*. It is possible that the shift reflected intensification associated with a higher human population density or changes in resource availability, perhaps through human predation pressure on the more easily collected species (Fujita and Poyatos de Paz 1998:95). However, an alternative explanation would be that late prehistoric inhabitants of the region had developed a more sophisticated procurement strategy based on offshore diving that was more demanding but that may also have been

more productive than the earlier strategy. "It would appear that the ancient inhabitants chose to extract these molluscs after evaluating the balance between the energy used to collect the shells and the energy obtained by eating them" (Fujita 1995:6).

Around San Felipe, although the deposits were relatively recent, stratigraphic changes in species composition through time was also found. Three main species (*Carditamera affinis*, *Myrakeena angelica*, and *Glycymeris gigantea*) predominated, but less so in the lower levels than in higher ones. In the deepest level, *Myrakeena angelica*, associated with a rocky substrate, outnumbered *Glycymeris gigantea*, from a sandy environment. In the middle levels, *Glycymeris gigantea* predominated over *Myrakeena angelica* and *Carditamera affinis*, both associated with rocky environments. This situation reverted back again in the uppermost stratum (Guía Ramírez 2009).

INTERPRETIVE PROSPECTS

Archaeologically recovered data on marine shell have the potential to make substantial further contributions to Baja California prehistory in many respects. Among these, particular attention may be warranted for the delineation of changes in the natural marine and coastal environments, the reconstruction of prehistoric patterns in settlement and mobility, and the identification of ethnic signatures.

Environmental Changes

Studies of marine shell from datable archaeological contexts should be able to continue to elucidate prehistoric environmental change in several ways. Pleistocene-Holocene changes in seawater temperature may be reflected in the geographic distributions of species (perhaps only represented as minor or trace constituents in archaeological middens) near their northern or southern limits, as well as in temperature-sensitive isotopic ratios. The chronology of rising post-Pleistocene sea levels may be clarified by the distribution of submerged and subaerial shell middens, as in the preliminary observations of Amy E. Gusick and Loren G. Davis (2010) and Moore (2008). It may be possible to discern the evolution of coastal habitats as sea levels stabilized after the middle Holocene, for instance in the blocking of estuaries, the siltation of lagoons, and the development of sandy beaches, as these events were mirrored in the changing representation of habitat-specific shellfish in archaeological middens. On the northern Gulf coast, Miguel Téllez and his associates (2007) have detected the isotopic influence of water from the Colorado River on archaeological marine shell as far south as San Felipe, suggesting that dated shells may possibly be able to discriminate periods when the Colorado River was diverted to filling Lake Cahuilla rather than flowing through its delta into the Gulf.

The presence or absence of human-induced environmental change, primarily through predation pressure on shellfish populations, also merits further exploration. Was this factor responsible for the disappearance or decrease of some species in archaeological middens, or for decreases in mean shell size? Can the existence of cultural strategies to avert such effects and avoid "the tragedy of the commons" on Isla Cedros, as posited by Des Lauriers (2010), be confirmed, and can they be detected elsewhere in Baja California?

Settlement Systems

Shell analyses are well-suited to address issues concerning prehistoric systems of settlement, mobility, and exchange. Patterning in the movement of shell from coastal to inland sites has already been explored to some degree, as discussed by Ritter and by Hyland and Gutiérrez, but more rigorous quantitative analyses may be able to establish more generally for various regions and time periods whether coastal and inland settlements represented separate communities or only seasonal poses of single communities. Analyses of protein residues on tools and features at inland sites and human osteological isotopic analyses (Molto and Kennedy 1991; Schober and Molto 2011) may also be able to shed more light on this issue.

An archaeological assessment of seasonality was made by John S. Killingley (1981, 1982), using oxygen isotope analysis of shells from a site on Baja California's northwest coast. Another approach to the use of shell as a seasonality indicator has been to identify particular species that are likely to have been targeted in particular seasons, based on their habitats. Lawrence H. Feldman (1962) proposed that species such as *Pinctada mazatlanica*, *Hyotissa hyotis*, *Spondylus crassisquama*, and *Lyropecten subnodosus* would have been harvested in the summer, while *Ostrea palmula*, *Carditamera affinis*, *Arca pacifica*, *Modiolus capax*, *Strombus gracilior*, *Glossaulax reclusiana*, *Hexaplex erythrostomus*, and *Turbo fluctuosus* would have been harvested in the winter.

Long-distance exchange may also be addressable through locally exotic shell species. Although such movement of shell along the coasts seems unlikely to have served subsistence or technological needs, the movement of shell beads and ornaments is well worth further examination.

Ethnic Identities

Because the particular shellfish species that were harvested represented cultural choices, archaeological patterns in midden shell species may offer clues to the ethnic identities of the prehistoric people who procured the shells. The most likely evidence in shell middens for differences in ethnic identity may be in the sophistication that was involved in harvesting desirable species. Groups that were new to a region may at first have made procurement choices that did not represent the optimal strategies among the ones potentially available to them. Differences in shellfish choices might reflect contrasts between long-established and newly arrived groups, or between littoral-oriented and interior-oriented groups. Differences in the ratio of fish remains to shellfish remains in carefully excavated midden samples might reflect similar contrasts, with a focus on fish potentially representing a more productive but more demanding adaptation than the use of shellfish.

Prehistoric ethnic displacements have been hypothesized for several parts of Baja California, primarily on the basis of linguistic evidence, and those hypotheses may be testable using shellfish data. Hypothetically, in the southern portion of the peninsula, where localized environments afforded choices in shellfish exploitation strategies, late prehistoric shell middens that are characterized by shallow-water species may be indicative of Guaycura occupations, while deep-water species may mark the presence of the more maritime-oriented Pericú. This may shed light on the issue of whether or not the ethnohistoric distribution of language groups resulted from an early historic ethnic shift (Mathes 1975; cf. Laylander 1997; Massey 1949).

In central and northern Baja California, successive prehistoric waves of immigration by the Cochimí, Kiliwa, Core Yuman, and Paipai have been proposed, although long-term in situ emergence of these groups has also been suggested (see, for instance, Kirchhoff 1942; Laylander 1997, 2010; Massey 1966; Mixco 2006; Rogers 1945). Mauricio J. Mixco (2006) suggested that comparatively recent arrivals of Cochimí, Yuman, and Kiliwa speakers from a non-coastal homeland were indicated by a dearth of shared aquatic or marine vocabulary in the descendant languages. If this scenario is correct, and if the successive breakup of the proto-Yuman- Cochimí, proto-Yuman, and proto-Core Yuman linguistic communities occurred around 4,000-2,000 years ago, the arrival of newcomers might be detectable in the shell middens of northern and central Baja California. A very late arrival of Paipai speakers, less than 1,000 years ago, perhaps from western Arizona or the Lake Cahuilla basin, might also be detectable.

CONCLUSIONS

Taking stock (*balances*), considerable progress has been achieved in identifying the shellfish taxa represented in many of Baja California's archaeological middens, in documenting different uses to which the shell was put, and in suggesting some patterns of change in shellfish procurement between the terminal Pleistocene and the time of European contact. Looking forward (*perspectivas*), future studies can be expected to do much more to round out the peninsula-wide picture and to discover underlying causes for changes through time and differences in these patterns throughout varying landscapes.

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