# Prehistoric Significance of Non-ornamental Modified Shell Implements from Baja California, Mexico

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**Abstract**

Archaeological expeditions to Bahía de los Angeles in Baja California, Mexico, recovered a collection of shellfish remains (*Dosinia ponderosa* - “almeja blanca”) which have been purposely flaked. A series of percussion blows to the exterior margin produced a sharp, serrated edge with conchoidal fractures as well as pieces suitable for use as small tools. Apparently ignored as viable artifacts in Baja California until recently, a sparse amount of literature is available with regard to shellfish implements, reduction techniques on bivalves, and/or modified shell utilization. This paper identifies specific reduction strategies on these shell specimens, notes the absence of stone tools in association with this modified shell, and suggests *Dosinia* is limited in its viability as a seasonal indicator. *Dosinia*’s prehistoric importance and efficiency ranking as a resource may need to be revised, however, owing to its combined nutritional value, and its use as a modified implement.

**Abstracto**

Sigue habiendo las expediciones arqueológicas a Bahía de Los Ángeles en Baja California, Méjico, recuperado una colección de los crustáceos (*ponderosa de Dosinia* – “almeja blanca”) que se han desconchado adrede. Una serie de soplos de la percusión al margen exterior produjo un sostenido, borde serrado con fracturas conchoidal así como los pedazos convenientes para el uso como herramientas pequeñas. No hecho caso al parecer como artefactos viables en Baja California hasta hace poco tiempo, una cantidad escasa de literatura está disponible con respecto a los instrumentos de los crustáceos, a las técnicas de la reducción en bivalvos, y/o a la utilización modificada de la concha. Este papel identifica estrategias específicas de la reducción en estos especímenes de las conchas, observa la ausencia de las herramientas de piedra en la asociación con esta concha modificada, y la sugiere que *Dosinia* está limitado en su viabilidad como indicador estacional. La importancia de *Dosinia* y la graduación prehistóricas de la eficacia como recurso pueden necesitar ser revisado, sin embargo, debido a su valor alimenticio combinado, y a su uso como un instrumento modificado.

The 1995 University of California, Berkeley, expedition to Bahía de los Angeles recovered a systematic collection of surface and subsurface shellfish remains from various sites (Fig.1, cf. Ritter 1997). The majority of these remains was extracted from two 1 by 1 meter units excavated within the shellfish midden apron of the rockshelter, Cuevas Abraham (UC-BC-13), approximately one kilometer from the shoreline and just south of the pueblo of Bahía de los Angeles. After screening through 1/4-inch mesh, all shellfish fragments recovered were bagged and recorded. Additionally, one-half buckets from each level were sorted through 1/8th-inch mesh for evidence of any smaller shellfish fragments.

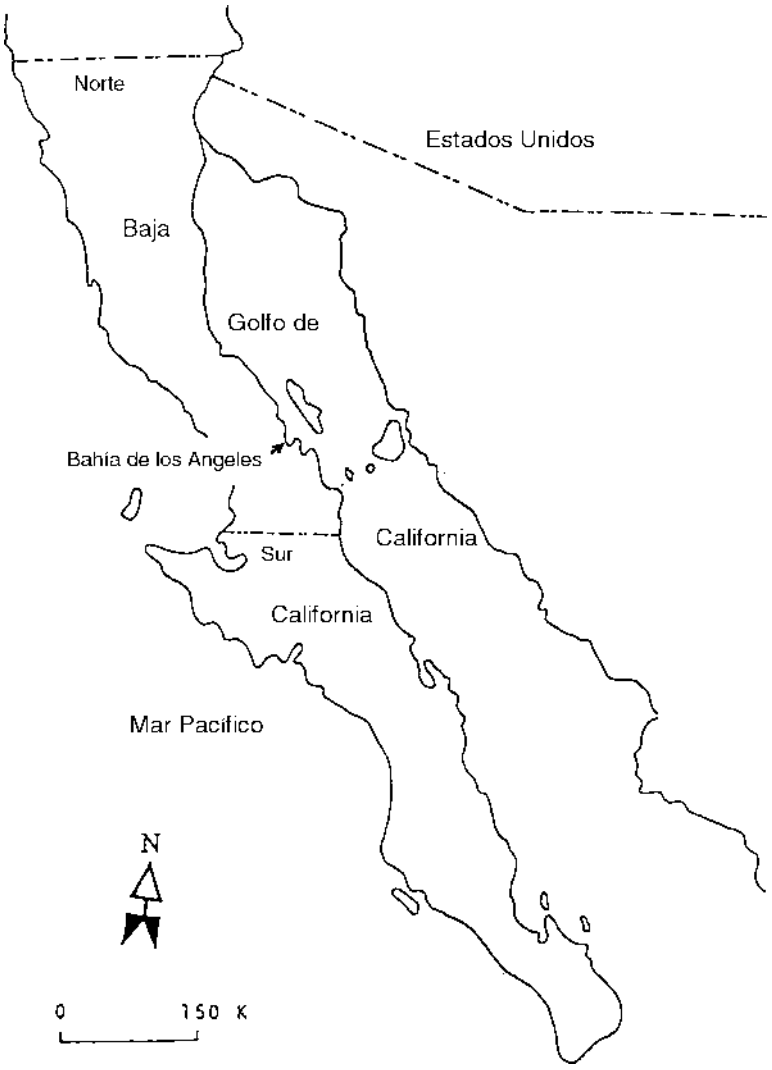


Fig. 1. General location of shellfish collection.

Another sample was recovered from a 1 by 1 meter unit at El Metate (UC-BC-30). Though this site is on the same bay as Cuevas Abraham, it is very near the shore in a dune area. At El Metate the collection of shellfish remains was less systematic. Archaeological technicians were requested to collect all hinges, gastropods, burnt shell, chiton plates, and any *Dosinia ponderosa* remains. Finally, a small sampling from several other sites is noted, including remains from a shellmound in nearby Bahía de las Ánimas which has been reported in an earlier report (Ritter et al. 1994).

Apparently ignored as viable artifacts in Baja California until recently, a sparse amount of literature is available with regard to shellfish implements, reduction techniques on bivalves,

and/or modified shell utilization. Previously, others have reported prehistoric utilitarian sea shell use such as chipped shell scrapers or spoons (Massey 1955), cutting or scraping tools (Williams 1975), and shell fishhook manufacture (Strudwick 1985) in Baja California and Southern California. Replicative experiments attempting to model the modification on shell artifacts (*Dosinia* sp.) recovered from Sonora, Mexico were performed by Rosenthal (1977). She suggests the presence of a tradition of the percussion-flaking of *Dosinia* bivalves. Specimens from the sites include scrapers, serrates, and gouges. More recently, at Bahía de las Ánimas, Ritter et al. (1994:14) have determined that

> Many of the *Dosinia* shells noted at the large middens appear to have been purposely flaked. A series of percussion blows to the exterior margin produces a sharp, serrated edge with conchoidal fractures.

Ritter et al. (1994:14) also suggest that modified shells from six other sites along Bahía de los Angeles

> have been struck at the ventral margin producing sharp, often serrated edges useful for various scraping and cutting activities on even durable items.

Noting the previous authors' attentions to *Dosinia* remains in particular, it was considered important by Ritter (1997) and Tyree (1997) that all of the *Dosinia* remains recovered from the 1995 expedition to Bahía de los Angeles be examined for:

> 1) the possibility that percussive flaking and/or further modification produced a useable tool,
> 2) modified shell morphology and identification of specific reduction strategies on these specimens,
> 3) the relationship between the presence of stone tools and the presence of modified shell, and
> 4) seasonality in combination with the possible aboriginal gathering/harvesting techniques employed.

*Dosinia* remains are relatively rare in these deposits and often constitute less than 1 per cent of the total shellfish remains (other specimens include *Glycemeris* sp. and *Trachycardium* sp.). Macroscopic use of a 10-power hand lens determined that a total of sixty-three shellfish remains was purposefully flaked (Fig. 2). In addition, ten per cent of these specimens were examined under a 200-power microscope to ascertain any evidence of damage from utilization.

Building on the basic typology previously established by Ritter (1995), these modified shell pieces have been morphologically separated into two main categories. Category 1 (Table 1) includes those valves, most often the larger segments, that retain their umbo region with the ventral margin flaked. Ritter's typology suggests that his Category 1 artifacts are "unifacially flaked" (1995:128), but an artist's rendition of a *Dosinia* artifact from El Basurero Diaz/ UC-BC-29 (1995:131) suggests that Category 1 artifacts may be bifacially flaked as well. There-

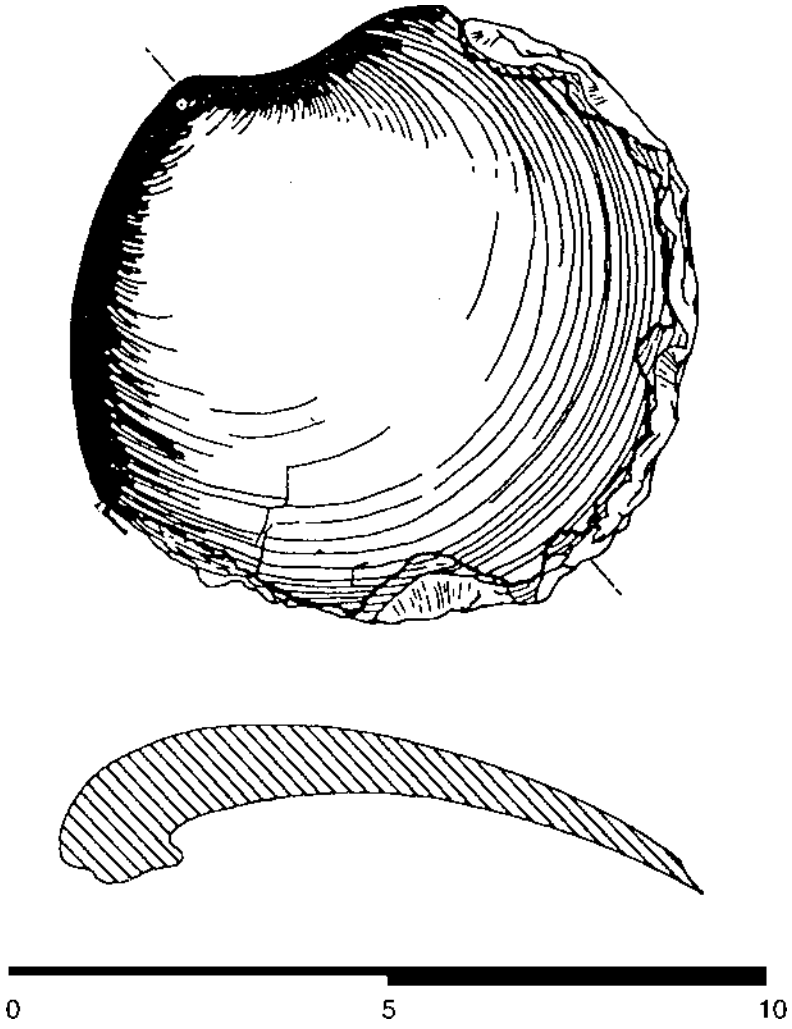


Fig. 2. Edge-flaked *Dosinia ponderosa* shell tool (centimeter scale).

fore, for the purposes of this report, both unifacial and bifacially flaked implements have been included in Category 1. Category 2 (Table 2) artifacts represent those shell fragments that lack the umbo. As a group they tend to be smaller in overall dimension but, most often, exhibit a higher proportion of edge modification than Category 1 artifacts. The two morphologies are presented in detail below.

Table 1. *Dosinia ponderosa* Category 1.

| Site | Length (mm) | Width (mm) | Thickness (mm) | Edge angle (degrees) | Amount of shell removed (per cent) | Amount of edge modification (per cent) | Unifacial or bifacial | Valve half right or left |
|---|---|---|---|---|---|---|---|---|
| UC-BC-13- | | | | | | | | |
| 11 | 86.6 | 62.3 | 23.3 | 90 | 40 | 65 | Uni | Rt |
| 15 | 68.2 | 54.6 | 22.6 | 35-70 | 50 | 70 | Bif | Rt |
| 16 | 73.3 | 71.8 | 19.2 | 60-72 | 20 | 75 | Bif | Rt |
| 20 | 54.2 | 25.4 | 7.0 | 40 | ? | 50 | Bif | Lft frag? |
| 22 | 55.5 | 47.4 | 12.5 | 42-59 | 60 | 70 | Uni | Lft |
| 37 | 50.8 | 35.8 | 15.2 | 62-80 | 50 | 60 | Bif | Lft |
| 38 | 47.6 | 44.1 | 14.9 | 48-75 | 60 | 70 | Bif | Rt |
| 44 | 69.8 | 46.0 | 16.7 | 45 | 20 | 45 | Bif | Lft |
| 45 | 81.8 | 58.0 | 24.8 | 38-50 | 30 | 60 | Uni | Rt |
| 46 | 77.8 | 77.0 | 24.1 | 72 | 45 | 85 | Bif | Rt |
| 47* | 34.0 | 33.5 | 5.0 | 68 | 50 | 60 | Uni | Rt |
| UC-BC-30- | | | | | | | | |
| 1 | 67.7 | 53.3 | 21.7 | 62 | 45 | 70 | Bif | Lft |
| 2 | 75.2 | 66.1 | 21.6 | 53 | 30 | 65 | Bif | Lft |
| 3 | 48.9 | 44.5 | 15.6 | 56-80 | 55 | 80 | Uni | Rt |
| 5 | 42.8 | 28.5 | 12.2 | 55-78 | 60 | 55 | Uni | Lft |
| UC-BC-46- | | | | | | | | |
| 1 | 71.0 | 58.5 | 13.8 | 42-54 | 20 | 75 | Uni | Rt |
| | | | | | | | | |
| Mean/Ratio | 62.8 | 50.4 | 16.9 | 60 | 42 | 61 | 7:9 | 9:7 |

**Megapitera* sp.

## Category 1

A total of sixteen Category 1 specimens were recovered from three localities, though the majority (n = 11) were recovered through excavation (refer to Table 1, Figs. 3a and 3b) at Cuevas Abraham/UC-BC-13. The *Dosinia* valves with their umbo region intact vary in size and the Cuevas Abraham sample tends to be generally smaller than Category 1 valves recorded at other sites (see Ritter 1994 and 1995). Primary and occasionally secondary stage reduction strategies on the margins of these valves removed anywhere from 20 to 60 per cent (average 42 per cent) of the initial dimensions of the valve. Invasive margin reduction often includes removal of most of the pallial sinus and occasionally the pallial line itself (Fig. 4) (See description by Keen 1971: 178, 186).

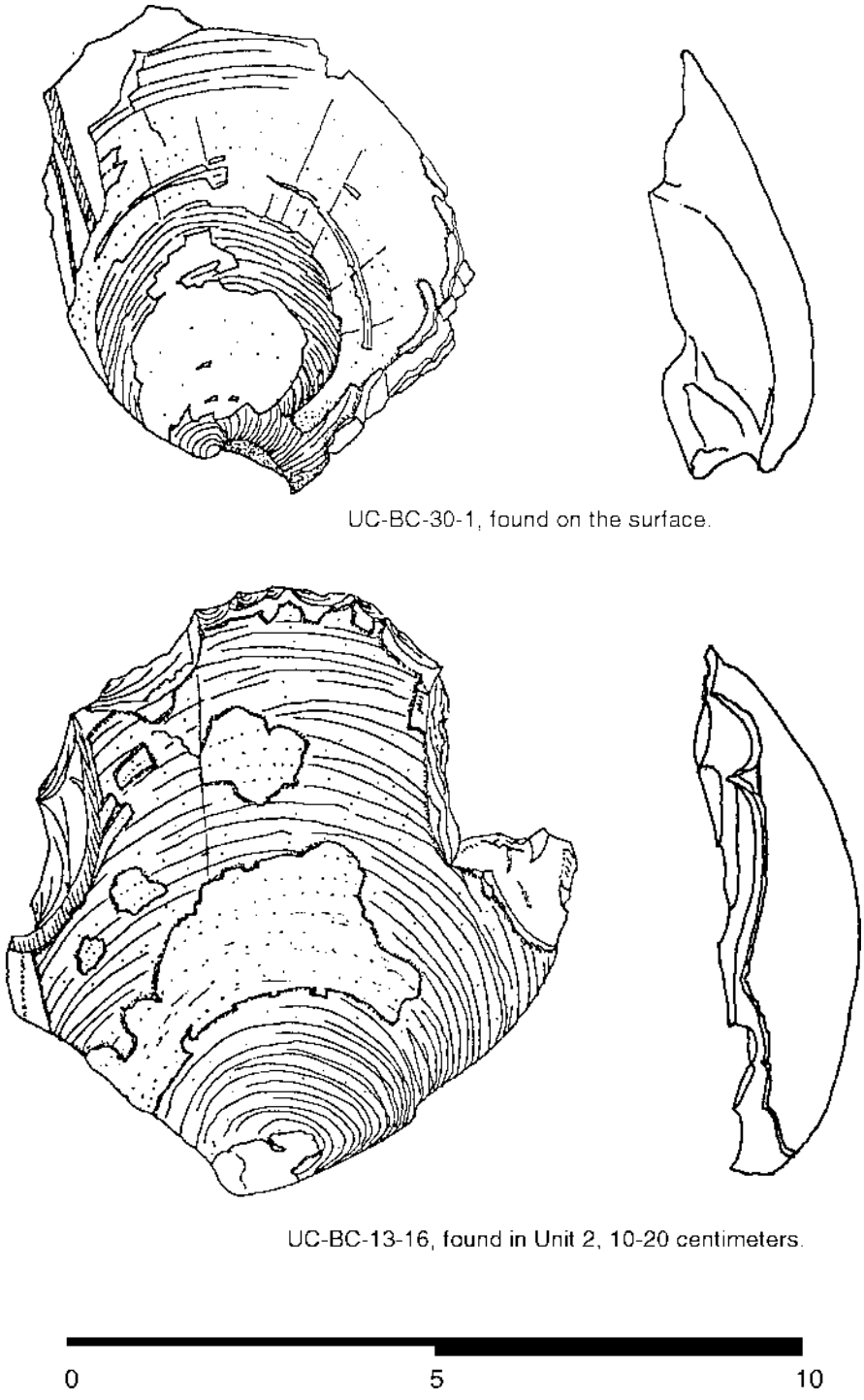


Fig. 3a. Modified shell implements, *Dosinia* sp., Category 1, (centimeter scale) Cuevas Abraham and El Metate, after Ritter 1995.

The remaining remnants have been modified anywhere from 45-85 per cent (average = 61 per cent) along their residual margins. The umbo, more specifically, the beak (Fig. 5), and ligament sections remain intact and apparently served as a “backing” while in use. Thus, the thickness of this umbo region appears to absolve it from further reduction. Valves display both concave and straight areas of modification. Measured edge angles range from 40 to 80 degrees (average = 60 degrees) with a variety of angles sometimes occurring on the same tool. These margins frequently display sinuous ridges which tend to follow the conchoidal direction of the valve. Thus, the tool shape is most often ovoid to elliptical in final form.

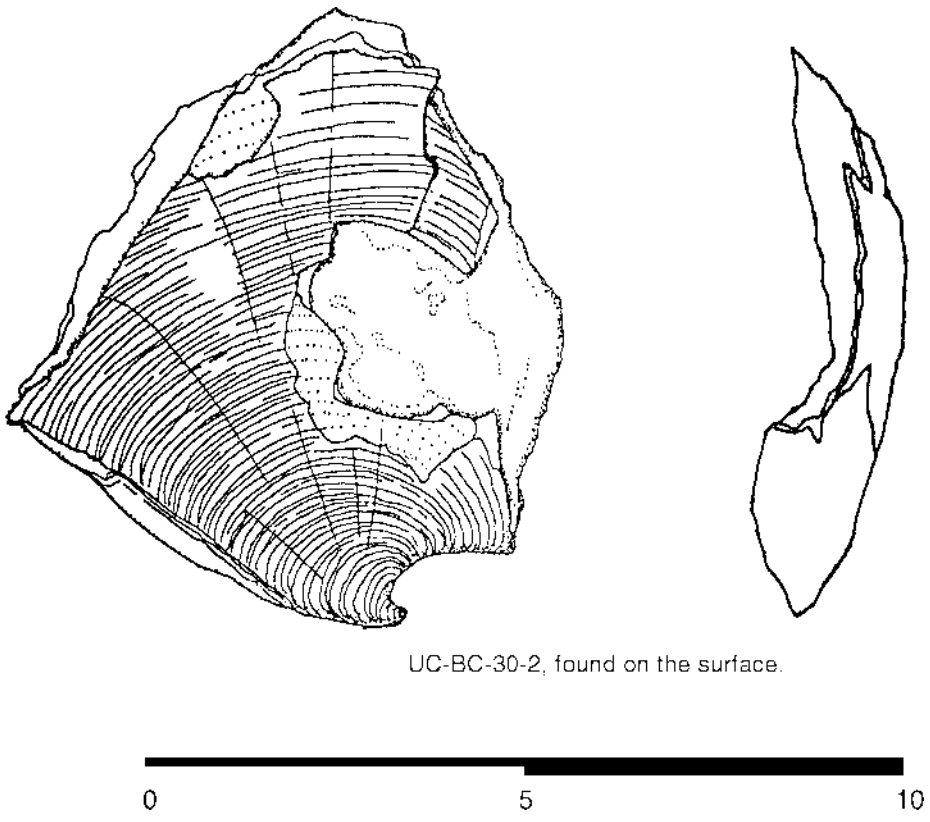


Fig. 3b. Modified shell implements, *Dosinia* sp., Category 1, (centimeter scale) Cuevas Abraham and El Metate, after Ritter 1995.

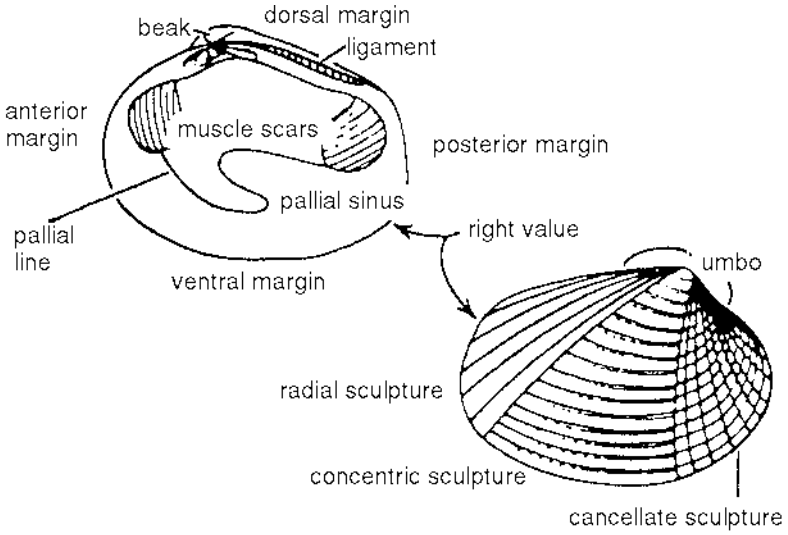


Fig. 4. Dorsal/ventral surfaces of shellfish.

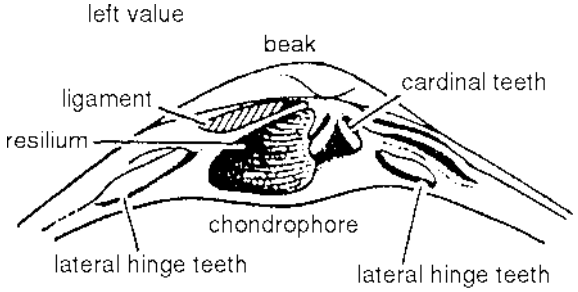


Fig. 5. Beak “umbo” region of shellfish.

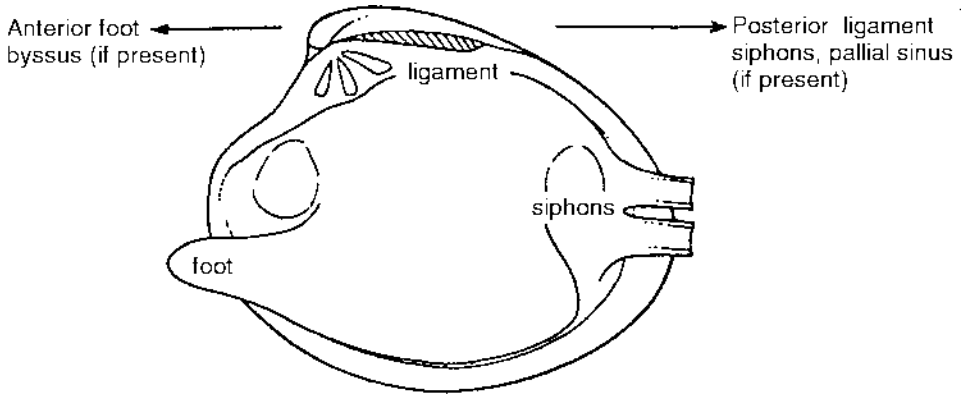


Fig. 6. Anterior/posterior regions of valve.

## Discussion

Both Rosenthal (1977:374) and Ritter (1995:130) suggest that these modified implements of shell might have been utilized as cutters or scraper-like tools. Additionally, given the durability of the material, tools with "triangular protrusions" (Ritter 1995:130) are said to have served possibly as cutters or piercers (gravers). Artifacts in this Category 1 collection more than likely can be said to satisfy similar functions though evidence of edgewear (i.e. striations or abrasions) was not encountered even under close scrutiny (200 power magnification).

Attempts to decipher preferences for, or a relationship between, bifacial versus unifacial reduction techniques (on either ventral or dorsal surfaces) does not appear justified at this time owing to the small sample size (n = 16) of Category 1 samples. Logistically, however, subtle differences in reduction strategies of *Dosinia* valves may be inferred with specific regard to the elongated thicker ligament region that extends toward the posterior of the valve, and is presumably much more difficult to reduce (Fig. 6). In this sample, the anterior ventral margins are the more heavily reduced, as opposed to posterior ventral margin, on both right and left valves. Since the right and left valve halves are mirror-images of each other, the toolmaker would find it necessary to direct and re-direct subsequent blows to the respective shell in a distinct manner depending on whether it was the right or left valve. Though, in any case, still "using the finger to dampen the blows" (Rosenthal 1977:374), the valve would, of necessity, be rotated (or flipped) and approached from either the dorsal or ventral side. Notably, this collection of Category 1 artifacts implies the toolmakers attempted to fully utilize *Dosinia* irrespective of right or left valve. Additionally, reductive strategies do not appear to be restricted to a prescribed or defined dorsal/ventral surface orientation.

Future samples could demonstrate the preference for right valve halves with respect to the ease in which the toolmakers were able to readily reduce the anterior ventral margin and still maintain an adequate grasp on the parent piece for further reduction. The latter presumes that the makers are predominantly right-handed individuals that hold the shell to be reduced in their left-hand and wield the hammerstone or billet in their right-hand.

## Category 2

Three-fourths of the *Dosinia* tool collection from the 1995 expedition are edge-modified valve pieces lacking their umbo region and therefore have been morphologically classified as Category 2 specimens (refer to Table 2, Fig. 7). These forty-six *Dosinia* segments (one from site UC-BC-13 is *Chione* sp.) range from 24.7 to 69.3 mm in length (mean= 39.5 mm). Edge angles range from 23 degrees to 90 degrees with an average edge angle of 52 degrees, slightly less than that of Category 1 specimens. The edges of these artifacts were modified from over half (55 per cent) to their entirety (i.e. 100 per cent of their margins or edges).

Table 2. *Dosinia ponderosa* Category 2.

| Site | Length (mm) | Width (mm) | Thickness (mm) | Edge angle (degrees) | Amount of shell removed (per cent) | Amount of edge modification (per cent) | Unifacial or bifacial |
|---|---|---|---|---|---|---|---|
| UC-BC-13- | | | | | | | |
| 1 | 48.0 | 34.8 | 7.5 | 44 | ? | 100 | Uni |
| 2 | 24.7 | 21.8 | 3.7 | 31 | ? | 55 | Uni |
| 3 | 48.5 | 41.2 | 8.7 | 40-55 | ? | 100 | Bif |
| 4 | 30.7 | 30.7 | 5.7 | 62 | ? | 100 | Bif |
| 5 | 40.4 | 26.9 | 10.3 | 72 | ? | 100 | Uni |
| 6 | 69.3 | 43.0 | 3.0 | 42 | ? | 45 | Uni |
| 7 | 56.5 | 43.0 | 9.5 | 56-66 | ? | 90 | Bif |
| 8 | 31.6 | 29.0 | 5.2 | 45 | ? | 75 | Bif |
| 9 | 49.2 | 35.8 | 4.2 | 48-62 | ? | 100 | Bif |
| 10 | 55.5 | 32.0 | 5.4 | 54 | ? | 95 | Bif |
| 12 | 38.2 | 27.5 | 5.0 | 45-68 | ? | 100 | Bif |
| 13 | 49.3 | 35.2 | 5.3 | 38 | ? | 95 | Bif |
| 14 | 25.3 | 25.0 | 3.3 | 48 | ? | 80 | Bif |
| 17 | 42.3 | 24.3 | 5.5 | 65-75 | ? | 100 | Bif |
| 18 | 27.2 | 20.9 | 4.9 | 38-90 | ? | 90 | Uni |
| 19 | 27.0 | 18.3 | 3.8 | 58 | ? | 100 | Bif |
| 21 | 28.0 | 23.2 | 8.0 | 65 | ? | 100 | Bif |
| 51 | 24.8 | 19.2 | 4.3 | 68 | ? | 100 | Bif |
| 23 | 42.3 | 34.8 | 4.3 | 64 | ? | 65 | Bif |
| 24 | 60.0 | 23.2 | 3.4 | 58 | ? | 55 | Uni |
| 25 | 40.6 | 39.7 | 5.5 | 30 | ? | 90 | Uni |
| 26 | 42.1 | 33.7 | 6.2 | 55 | ? | 60 | Uni |
| 27 | 40.8 | 28.9 | 4.6 | 48-65 | ? | 100 | Bif |
| 28 | 34.8 | 23.2 | 3.7 | 41-59 | ? | 100 | Bif |
| 29 | 36.2 | 24.8 | 6.1 | 28-55 | ? | 100 | Bif |
| 30 | 29.6 | 27.0 | 6.8 | 56 | ? | 100 | Bif |
| 31 | 43.5 | 28.4 | 5.5 | 24-59 | ? | 80 | Bif |
| 32 | 33.7 | 29.5 | 6.7 | 55 | ? | 100 | Bif |
| 33 | 38.3 | 23.5 | 5.5 | 60 | ? | 85 | Bif |
| 34 | 52.6 | 23.5 | 6.7 | 42-90 | ? | 100 | Bif |
| 35 | 40.3 | 35.7 | 4.4 | 35 | ? | 75 | Uni |
| 36 | 44.3 | 35.5 | 5.5 | 25-90 | ? | 75 | Uni |
| 39 | 26.2 | 22.2 | 5.7 | 55 | ? | 70 | Bif |
| 40 | 36.3 | 21.7 | 3.6 | 43 | ? | 100 | Bif |
| 41 | 40.8 | 39.5 | 3.1 | 50 | ? | 70 | Bif |
| 42 | 43.1 | 29.4 | 5.5 | 45 | ? | 65 | Uni |

Table 2. *Dosinia ponderosa* Category 2, continued.

| Site | Length (mm) | Width (mm) | Thickness (mm) | Edge angle (degrees) | Amount of shell removed (per cent) | Amount of edge modification (per cent) | Unifacial or bifacial |
|---|---|---|---|---|---|---|---|
| 43 | 50.8 | 31.5 | 7.5 | 60-90 | ? | 100 | Bif |
| 52 | 30.2 | 27.1 | 5.2 | 38 | ? | 85 | Uni |
| 48* | 29.5 | 26.6 | 7.7 | 57 | ? | 65 | Bif |
| 49 | 28.6 | 19.8 | 4.4 | 40-52 | ? | 85 | Bif |
| 50 | 38.2 | 21.5 | 3.8 | 23-35 | ? | 95 | Bif |
| Mean/Ratio | 39.5 | 29.4 | 5.5 | 52 | ? | 86 | 12:29 |
| UC-BC-30- | | | | | | | |
| 4 | 40.5 | 40.0 | 4.0 | 59 | ? | 85 | Bif |
| 6 | 51.8 | 0 10.6 | 42-90 | | ? | 100 | Uni |
| 7 | 32.2 | 20.0 | 7.3 | 44-61 | ? | 100 | Uni |
| 8 | 20.9 | 42.3 | 6.8 | 66 | ? | 100 | Bif |
| Mean/Ratio | 36.4 | 33.8 | 7.1 | 61 | ? | 96 | 2:2 |
| UC-BC-29- | | | | | | | |
| 1 | 63.2 | 42.5 | 6.0 | 38-49 | ? | 95 | Bif |
| de San Juan | 46.2 | 34.4 | 7.7 | 56 | ? | 100 | Bif |

* *Chione* sp.

Ritter (1995:130) maintains these tools are “knife-like” and “scraper-like”, albeit more fragile, implements than the larger Category 1 specimens. Indeed, most of the valve fragments in this collection retain a small portion of ventral margin with often two, sometimes parallel, heavily-flaked margins (Fig. 7, Category 2: UC-BC-13-39, Unit 2, 30-40cm) which may have served as fine cutting edges. In addition, bifacial reduction of these margins exceeds unifacial reduction by approximately a 2.5:1 ratio (71 per cent bifacial to 29 per cent unifacial).

## Discussion

These generally smaller shell implements appear fractured and fragmented. They also have no recognizable consistency or uniformity with regard to specific shape. Cutting edges, though most often straight, can be convex or concave on many of the artifacts. Apparently, the tool-makers considered these shell fragments of a fortuitous nature and were able to more heartily refine them. What is uncertain is the degree to which these were intentionally flaked and modified versus modification via utilization. The high percentage of bifacial reduction over unifacial reduction suggests “knife-wear” but, as of yet, this can not be justified microscopically.

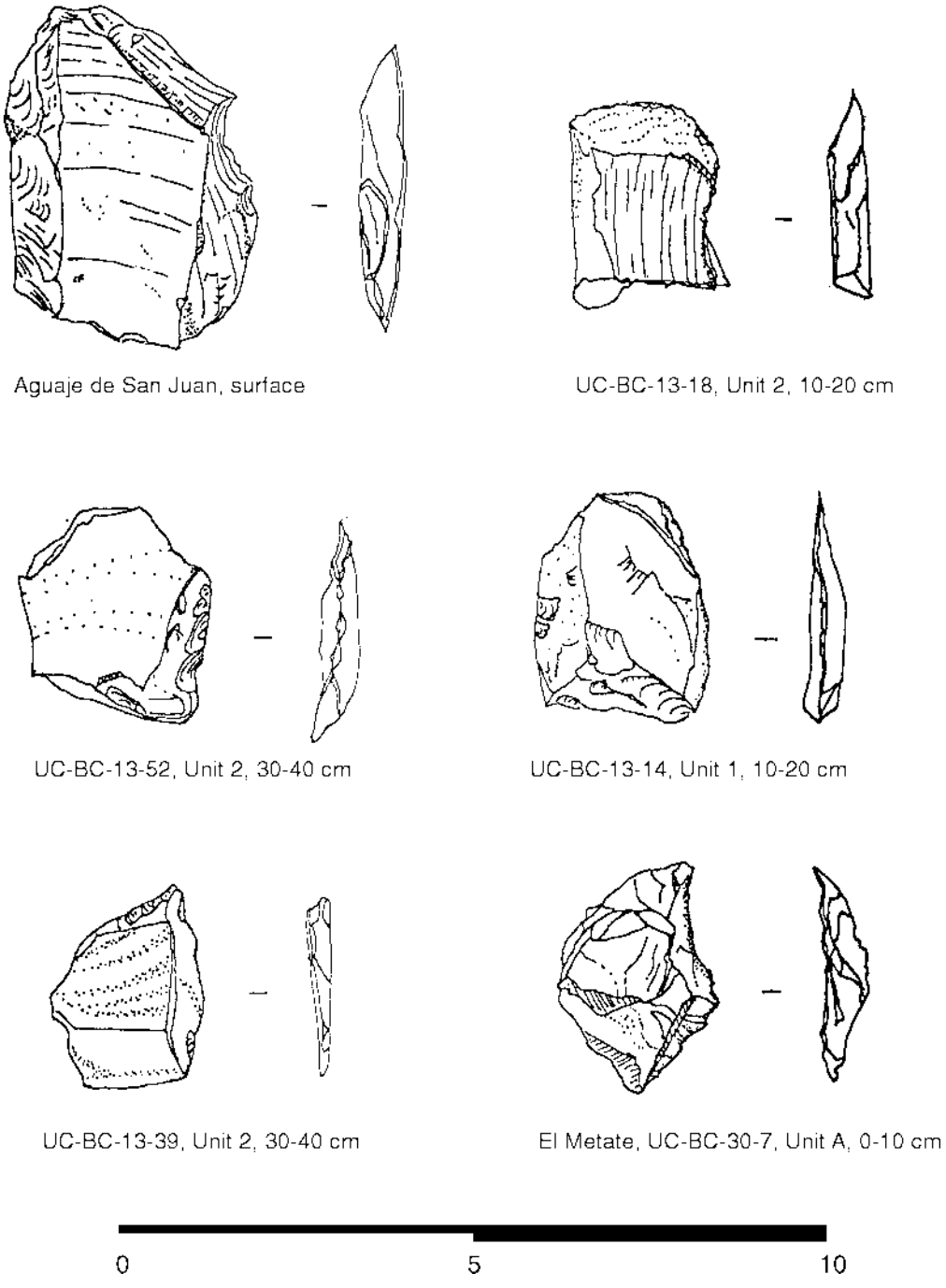


Fig. 7. Modified shell implements—*Dosinia* sp., Category 2, (centimeter scale) Bahía de los Angeles, after Ritter 1995.

Strikingly, and attesting to their usage as cutting implements, most of these specimens retain at least a small portion of their ventral edge (as mentioned above). It is assumed that, just as the umbo region provides for a "backed" area in Category 1 artifacts, this "remnant" ventral margin also allows the user a safe place with which to hold the implement (i.e. the "knife-handle").

## Cores and Debitage

A thorough examination of the debitage (*Dosinia* shell fragments which were not placed in either Category 1 or 2), reveals reduction techniques which indicate that *Dosinia* was reduced both in bivalve and valve forms. Much of the debitage appears to be the result of the fragmentation initially accomplished by prying the clam open. Abbott notes that "both valves, still attached, are quite often washed ashore" (1986:236). These resultant valve "pieces" or sections often retain a portion of the ventral margin along one edge.

If, however, the *Dosinia* collected was already in "valve" form (i.e. just the right or left half), the entire ventral margin of the valve could be beveled to establish a striking platform for further reduction. The resulting removal of the valve's periostracum (thin exterior layer) produces a flimsy shatter more than likely unusable for further tool use.

Previous researchers (Rosenthal 1977; Ritter 1995) have indicated that what are here noted as Category 1 valves may have also served as "cores" (or the parent piece) which, when reduced, produced smaller flake tools. In replicative experiments, Rosenthal notes that two types of flakes occur when valve reduction is attempted: 1) shatter, and 2) large flakes. These large flakes from the Sierra Pinacate region enter the tool-kit in the form of laterally retouched, notched and denticulated unifaces. Fragments of valves that were inadvertently broken during manufacture also may have been subsequently reduced (Rosenthal 1977:374).

Notably, given the morphological characteristics of this collection, some researchers might consider that all of the Category 2 valve fragments are basically synonymous with Rosenthal's "large flakes." Though the latter may be essentially true, the total shell collection from the 1995 expedition also includes some "large flakes," probably more appropriately termed "large fragments," that do not appear to be modified.

Just as flintknappers utilize cores and produce debitage as a resultant by-product as they fashion their tools, so too, the *Dosinia* toolmakers. There appears, however, to be a fundamental difference between the two reduction strategies, that of stone versus shell. Primary or initial reduction on stone most often produces useable flakes (in addition to the debitage), whereas primary reduction on shell most often produces shatter (debitage). "Larger fragments" (Rosenthal's "flakes") of shell tend to occur when a "core" (valve) essentially breaks apart.

## *Dosinia ponderosa* as a Seasonal Indicator?

Chatters (1987) developed a specialized technique for determining age and season of death for freshwater shellfish—particularly members of the genus *Margaritifera*. This technique has demonstrated great potential for establishing seasonality at sites at which the shellfish still retain enough of their resilial tuberosity (a portion of the umbo/ligament region). Chatters' technique involves counting annual growth rings to assess age, and then measuring the final growth increment in comparison to previous years to determine season of death. With Category 1 *Dosinia* valves (those that still retain their umbo region), techniques such as Chatters' may not necessarily be applicable for at least two reasons:

1) *Dosinia* is available year-round, and
2) saltwater valves are representative of a much broader ecosystem.

Due to its abundance in some regions of Baja California (further discussion later in this report), the regularity with which *Dosinia* is available may skew seasonal data. In fact, Abbott reports that *Dosinia* is "frequently washed ashore after storms" (1986:236). Archaeological shell implements rendered courtesy of the Baja California "storm season," roughly November through March in Baja California, or "hurricane season" July through October in Baja California Sur (Metcalf 1996), may be too broad-based to serve as appropriate seasonality markers.

An alternative approach has been developed in some contexts, like Franchti Cave, Greece, where the determination of seasonality on shellfish has been possible by utilizing oxygen isotope ratios (160 to 180 in carbonates) (cf. Deith in Bailey and Parkington 1988). The two factors affecting the isotope ratios in shells are temperature and salinity. Seasonality estimates for Franchti Cave are based on the comparison of isotope profiles of modern shells, archaeological specimens, and modern sea-temperature graphs. The isotope results from Greece suggest that collection occurred year-round, with a bias towards the summer months. Future isotope studies on the archaeological artifacts of *Dosinia* from Baja California may demonstrate their year-round availability.

A broader ecosystem also affects seasonal availability. Both Keen (1971) and Sergio Hernandez Vazquez (The Center for Biological Research, La Paz, Baja California Sur, Mexico, CIBNOR, personal communication 1996) relate that *Dosinia* can be found just offshore, often in mud flats, to a depth of about 60 meters. Questions arise, then, concerning the actual "gathering" efforts (whether for eating, tool manufacture, or both) of prehistoric peoples versus fortuitous collection of *Dosinia* washed up by the tide. As previously indicated, in comparison to other shellfish present at these sites, *Dosinia* represents often less than one per cent of the total archaeological shellfish specimens.

Collection of *Dosinia*, then, is probably not seasonal but is predicated on other environmental, cultural, or utilitarian factors. Both Rosenthal (1977:372-375) and later Ritter et al. (1994:14) speculate that "shell apparently was selected for tool manufacture, perhaps in response to the

absence of fine cryptocrystalline rock in this basaltic environment." The latter, given the present data for this region, appears to be the most plausible at this time. However, coupled with the above information, this author additionally speculates that: a) unlike the modern environment today, prehistorically *Dosinia* was a potentially scarce commodity, and b) both marine and terrestrial animals were not emphasized (for whatever reason) as the resource of "choice" at these sites. Thus, scraping or cutting implements were not considered a necessity.

## "Fresh" *Dosinia* is best!

Rosenthal's replicative experimentation graphically alerts us to the fact that *Dosinia ponderosa* may have been expeditiously, expediently, and immediately reduced upon collection. She notes:

> Fresh valves are preferable to long-exposed beach shell when percussion work is being contemplated. The latter shatters when struck, so serial removal of flakes can not be accomplished. There is thus a strong likelihood that a chipped shell tool was manufactured on a fresh valve (1977:374).

Future archaeological excavation in this region may produce larger data sets which, courtesy of the "fresh is best" theory, may shed more light on seasonality and gathering issues. For instance, matched right and left valve halves from similar levels could be suggestive of whole clam gathering (for potentially eating as well as toolmaking)— whereas, single, unmatched valves could infer collection of shell from the beach after storm periods, etc. Even this collection from Bahía de los Angeles, though admittedly small, elicits a modified matched valve set at UC-BC-13 at level 30-40cm.

## *Dosinia ponderosa*: Past, Present and Future

Hernandez relates that the locals of Baja California refer to *Dosinia ponderosa* as *Almeja blanca* ("white clam," personal communication1996). The commercial importance of this clam further south, in Baja California Sur, is attested to by the establishment of two prime catch locations: Bahía Concepción and Bahía de La Paz (both on the Gulf side of the peninsula). Dr. Hernandez notes that *Almeja blanca* can today be caught year-round yet, in more volume at Bahía Concepción. The spawning cycle of *Dosinia ponderosa* is being studied not only at Bahía Concepción, but also at Zihuatanejo, Mexico, across the Gulf, for the purpose of further future commercial procurement.

*Dosinia ponderosa* has been a viable faunal resource in the entire Baja California region for quite some time. Dr. Hernandez again relates that fossils collected at Santa Rosalía in Baja California Sur are dated to the Miocene epoch reflecting their long-term adaptation to Baja California's waters. An assessment of various environmental records, in combination with the archaeological record, has been shown to be a potentially dynamic factor (cf. Glassow et al. in

Bailey and Parkington 1988). It can be speculated that there is an apparent year-to-year abundance of *Dosinia ponderosa* during any given period. However,

> recent decades have brought a series of dynamic changes in the global climate which have had a notable impact on Northwest Mexico… Annual meteorological data of this arid region has been analyzed and correlated to marine resource harvests, and in turn, to global changes such as "El Nino." Lesser known events have also had an effect on the fishing resources of Northwest Mexico. These also merit in-depth study, and the need for a climatic and oceanic early monitoring system for Northwest Mexico has become urgent (Hernandez personal communication 1996).

While obviously these studies are geared towards the edibility and nutritional importance of *Dosinia ponderosa* (among other marine life), one may eventually come to more fully appreciate not only *Dosinia*'s food value for prehistoric peoples as well as its other use—as a modified shell implement. Though some authors suggest that shellfish (particularly smaller, freshwater specimens) are a high-cost procurement food resource with fairly low nutritional returns (Parmelee and Klippel 1974; also see Bayham 1979 and 1982 for ranked resource/optimal diet models), others still question the validity that shellfish may have been utilized as butchering implements at a kill site even with potentially overwhelming data (Chatters et al. 1995). Chatters et al. relate:

> Mussel shells and hinge fragments were closely associated spatially with the north FCR (fire-cracked rock) cluster, demonstrating an association with some aspect of the kill and butchering activities at the site (1995:759)…
> the group of mussel shells so tightly associated with the north FCR cluster is oddly out of place in a kill and butchering site…Perhaps it is the prehistoric equivalent of a sack lunch, brought along by a member of the hunting party in case the hunt failed or was prolonged…(1995:761).

Future researchers may need to revise their efficiency ranking of shellfish with specific regard toward the larger taxa such as *Dosinia ponderosa* as more than a "sack lunch" because of *Dosinia*'s additional use as an effective and efficient tool. Often the term "efficiency" is used to refer to the energetic relationship between the value of a particular resource and the costs associated with its collection and processing (Jochim 1981:65). Indeed, some authors recognize that discounting shellfish from an efficiency index of local resources altogether may influence and/or skew our understanding of long-term subsistence patterns (Broughton and Bayham in Bayham and Johnson 1990:150-154) in any given locality. Thus, *Dosinia ponderosa* the *Almeja blanca* still has much to tell us of the prehistoric peoples of Baja California.

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