

BCS-1, A Las Palmas Mortuary Site in Baja California Sur: An Archaeo- skeletal Investigation

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Abstract

This paper describes the archaeological recovery and analysis of human skeletal remains salvaged from a Las Palmas Culture burial cave site (BCS-1) located in the Cape Region of Baja California Sur. Though undisturbed by human behavior, natural taphonomic processes, such as water erosion, have resulted in the disturbance of bones and cultural material, the exposure of which led to the site's discovery in 1996. As BCS-1 was located outside the licensing region of the Las Palmas Bioarchaeological Project (LPBP), only the exposed human and cultural remains were recovered and stored at the Museo de Antropología in La Paz, resulting in the identification of two incomplete male burials. BCS-1-#1 is a secondary (presumably bundle) red-ocher treated skeleton estimated to be 40 ± 5 years of age, based on multiple aging methods. Typical of Las Palmas remains is the hyperdolichocranic cranial shape, the partial ossification of pterygoalar ligaments and persisting infraorbital sutures. The skull has a healed fracture of the nasal bones from interpersonal violence which is common in Las Palmas Culture. The advanced dental attrition and antemortem trauma illustrate the highly sclerotic nature of the Las Palmas diet. BCS-1-#2 represents the unpainted remains of a young adult (30 ± 5 years). It was not possible to determine if the remains were primary or secondary. BCS-1 offers the possibility of examining the first undisturbed Las Palmas cave site since Massey's work in the late 1940s, adding appreciably to our understanding of mortuary customs and biology of these enigmatic peoples.

Introduction

This paper reports on investigations at BCS-1, a burial cave similar to several previously known

sites in the Cape Region of Baja California (Fig. 1). William C. Massey defined a burial pattern he termed "Las Palmas Culture" on the basis of his excavations of three undisturbed caves (Massey 1955, 1966). He distinguished between "primary" and "secondary" burials, both of which included individuals of either sex and of various ages. Primary burials consisted of the articulated bones of individuals, usually flexed but extended in one case, interred in bundles or on mats. They were provided with a variety of grave goods, such as marine shells, feathers, atlatls, and baskets. Primary bones were not reddened with ocher. Secondary burials consisted of disarticulated, sometimes ocher-reddened bones redeposited in the caves from unknown locations. They were sometimes bundled and some had grave goods. Unfortunately, the grave goods in the mortuary cave sites do not include diagnostic artifacts that might correlate them with artifacts from other types of sites, such as cave occupations and shell middens. Archaeological, chronological, and bioarchaeological aspects of Las Palmas Culture have been further investigated by later researchers (Adams 1998; Carmean and Molto 1991; Fujita 1995; Kowta 1968; Molto and Fujita 1995; Molto,

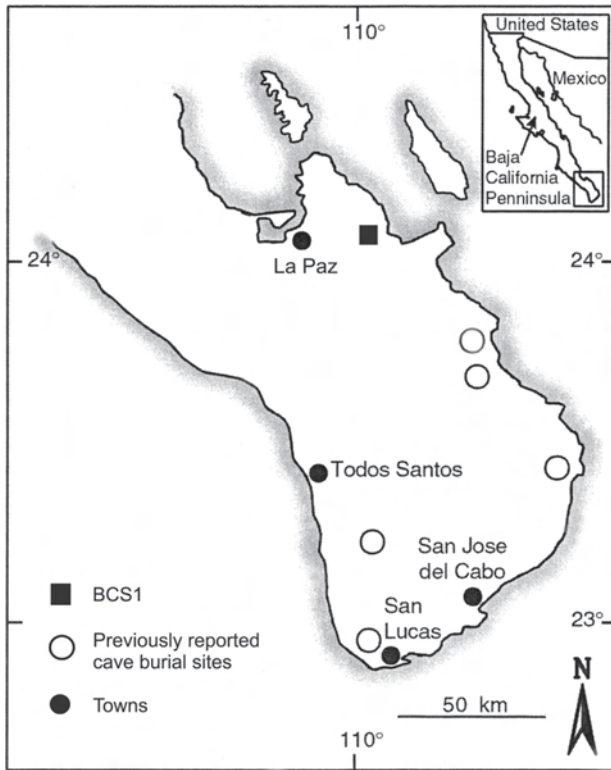


Fig. 1. Map showing burial cave site locations in the Cape Region of Baja California Sur.

Stewart, and Reimer 1997; Schober 1998; Schober, Molto, and Kennedy 1995; Stewart, Molto, and Reimer 1998; Touhy and Van Wormer 1995; Tyson 1977). Radiocarbon dates on the human bones are, in theory, difficult to interpret due to likely oceanic reservoir effects (Molto, Stewart, and Reimer 1997), but dates on associated terrestrial materials suggest a maximum 2-sigma calibrated time span from ca. AD 1300, or possibly as early as 1050, to ca. 1650, or possibly the late 1700s (Stewart, Molto, and Reimer 1998).

BCS-1 is located east of La Paz, approximately 5 kilometers west of the coast of the Gulf of California, or Sea of Cortez. The mouth of this "cave," is actually a cavity between the steep surface of a hillside and an immense cap of detached granitic rock. The interior is partially filled by boulder to sub-sand sized detritus consisting of *in situ* surface material, material weathered from the

caprock, and surface material transported into the cave via a small opening an estimated 20 m upslope to the south. The distribution of this detritus, along with breaks in slope, allows division of the interior into five areas, here designated Areas A - E (Fig. 2). Area A is a space relatively free of rubble along the northern margin of the cave, where a wide opening between the cap rock and the ground surface forms the mouth of the cave. Southwest of Area A is Area B, another relatively rubble free area with a small exterior opening upslope at its western end. The southern upslope limit of Area B is defined by a wall-like accumulation of rubble. Area C, upslope and south of Area A, is rockier but includes small, fairly clear spaces. The rubble "wall" behind Area B continues eastward to form the southern limit of Area C but is interrupted by a small interior opening into Area D, which is a long tunnel-like, rubble floored cavity terminating at the upslope opening referred to above. Only the extreme

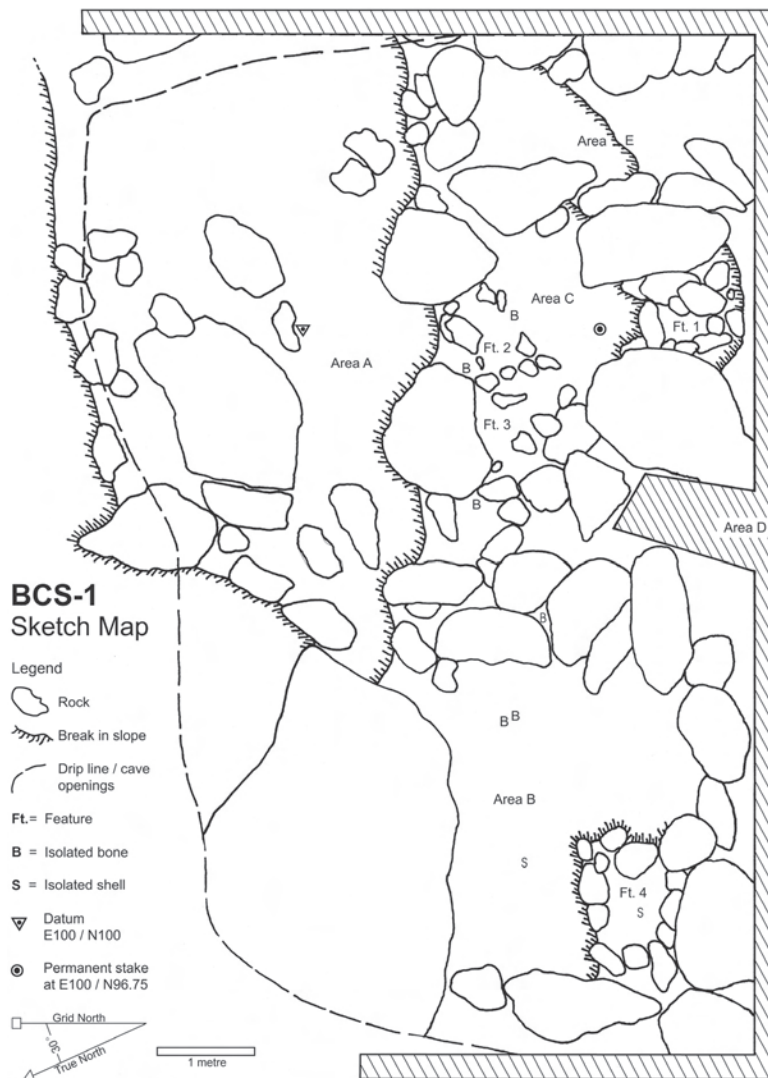


Fig. 2. Sketch map of BCS-1, showing Areas A-E and locations of exposed bones removed by INAH and LPBP personnel.

northern end of Area D is shown in Figure 2. Also only partially mapped is Area E, another relatively clear area extending upslope and southeastward from Areas A and C, again with a small exterior opening at the upper end. Although the mapped area of the cave has a considerable amount of surface space, rubble and the low ceiling over much of the area hamper movement. Three known concentrations of human bones, described in detail below, are designated Features 1-3, and Feature 4 is a small rock-surrounded area with a *Pinctada*

mazatlanica shell showing on the surface, which we suspect may be a burial location.

Initial Investigations

In late February, 1996, a resident of La Paz discovered BCS-1 and observed human bones on and protruding from the surface. He made two subsequent visits in about late February-early March with a brother and friends. On those occasions, the visitors gathered some bones from the area of Features 1 and 3, and piled them by

a cranium at Feature 2, and they photographed the bone pile. No items were removed from the site on any of these three occasions. On March 19, the discoverer led several representatives of the Instituto Nacional de Antropología e Historia, Baja California Sur (INAH, BCS) and the Instituto Sudcaliforniana de la Cultura (ISC) to the site, at which time INAH archaeologist, Harumi Fujita, made notes. One visitor crawled part way up the “tunnel” of Area D past Feature 1 to try to estimate its length. He reported finding some mother-of-pearl (*Pinctada mazatlanica*) shells in or around Feature 1, and another reported seeing three more in Area B. Some video footage was taken. Then, on March 25, Alfonso Rosales-López, Physical Anthropologist of the INAH and others returned to the site, removed the loose bones and shells, made some preliminary observations and took photographs.

It is not possible to completely reconstruct the proveniences of the initial surface collection of bones and *Pinctada mazatlanica* shells, although some approximate locations are indicated in Figure 2. Detailed morphological examination permits the assignment of some of the other bones to particular individuals and, by inference, to one or another of Features 1-3 that were defined in later fieldwork by the Las Palmas Bioarchaeology Project (LPBP). Also, memories of persons present on the early visits, suggest that the two innominate bones and sacrum of a complete pelvis and most of the other bones that were gathered up and piled near the cranium, as well as *Pinctada mazatlanica* shell pieces, probably came from the vicinity of the find spot later designated Feature 1. An exception is a complete, ocher-reddened left femur remembered to be from the vicinity Feature 3.

Fieldwork of the Las Palmas Bioarchaeology Project

On April 11, two of the authors (JEM and HF), with personnel from the INAH, visited the site for further observations. As the project’s license for excavation did not include the local area, it was decided that the LPBP would conduct fieldwork by authorization of Jorge L. Amao Manríquez, Director of the INAH, BCS. The terms of reference allowed for documentation of the site and collection of the cranium and any other exposed human remains and archaeological materials, but not for excavation.

The LPBP conducted fieldwork April 29-30, May 3, and May 6, 1996. The site datum, designated grid E100/N100 m, with an arbitrary elevation of 100 m, is an “X” chiseled into a small concavity in the underside of the cap rock near its outer edge. A steel reinforcing bar is embedded directly below the datum, and another is embedded at E100/N96.74 m. These permanent stakes mark the main N-S grid base line, oriented at a compass bearing of 30° East. A temporary E-W baseline was established along line N97.80 (a physically convenient position) by the Pythagorean method. Measurements were done by means of tape measures and line levels.

As mentioned above, three concentrations of exposed human bone and surrounding rocks were designated Features 1, 2, and 3. The features were mapped and the exposed bones collected. Bottom depths were taken at the middle of bones lying approximately horizontally and at both the upper and lower extents of inclined bones. Loose deposit from the surface of each feature was screened through 0.32 millimeter (1/8 inch) mesh. The skeletal elements recovered are listed with the burials below. As explained below another location was designated Feature 4, subsequent to the field operations.



Fig. 3. Photograph of Feature 1. The 10-centimeter scale points north.

Feature 1 was in the extreme northern end of Area D at the lower end of the long tunnel-like chamber (figures 2 and 3). There, rock rubble forms a break in slope, stepping up from the level of Area C. Feature 1 was situated on this step in loose sediment surrounded by rocks. When collected by the LPBP, the surface yielded a number of red-ocher stained infra-cranial bones, apparently representing part of a bundle burial. As mentioned above, a previous INAH party had removed several additional infra-cranial bones and *Pinctada mazatlanica* shells. It appeared that this burial had been disturbed and some materials displaced down slope (northward) from flowing water through the “tunnel.” This is consistent with the fact that the atlas recovered from Feature 1 fits the cranium from Feature 2, described below. There was no apparent evidence of any further skeletal material embedded in the surface at Feature 1. Screening of the loose surface debris from Feature 1 produced one quartz flake, a possible scraper. Whether this was a burial association is not determinable.

Feature 2, centered at E100.1/N98.1, was located near the northern edge of Area C in loose sediment

amidst a scatter of rocks (See sketch map and Fig. 4). An ocher-reddened cranium was the principal constituent of Feature 2. Oriented face up, it was mostly exposed but the posterior end was partially buried. Upon removal, matrix was found encrusted on the posterior surface, indicating the cranium had been in this location and position for some considerable time. However, other evidence indicates it originally belonged to Feature 1, directly upslope. In particular, as noted above, the atlas from Feature 1 fits the Feature 2 cranium. In addition, both the cranium and mandible show signs of weathering by water. A reddened phalange loose on the surface nearby was the only other bone we found in Feature 2. However, the discoverer recalls that the mandible which fits the cranium collected earlier by INAH was found near the cranium. In the lab, removal of the dirt fill from the interior of the cranium revealed several reddened hand and foot bones, a typical trait of Las Palmas Culture burials. Thus, it appears that the cranium and mandible were displaced some time ago, perhaps by flooding down the Area D “tunnel,” from their original location at Feature 1, and were redeposited in the location of Feature 2. The nearby phalange likely



Fig. 4. Photograph of Feature 2.

was originally contained within the cranium. There was no evidence of additional skeletal material embedded in the surface at Feature 2. Screening of surface debris produced one unidentified seed and a rodent maxilla (*Sciurius* spp.?), not considered to be associated with the human remains.

Feature 3, due west of Feature 2, was the most complex of the three features, containing bones of at least two individuals, one ocher-reddened and the other not reddened, within loose sediment amongst a scatter of rocks (Fig. 2 and Fig. 5). While brushing aside loose matrix during removal of the exposed bones, the presence of additional bones buried below was noted. Also, holes appeared, indicating hollow space below, suggestive of bundle burials. In keeping with the terms of our licensing agreement with the Mexican government, excavation was not done, and the buried bones were left in place. Hence, a full description and interpretation of Feature 3 is impossible, and important questions remain unanswered. Was Feature 3 complete when examined or had it been partially disturbed by flooding or other agencies? At least one of the bones, an unreddened left femur

shows signs of water damage on the proximal end. Are all the bones in Feature 3 in original context or have some been redeposited, for example, from Feature 1, above and to the south? These questions can be addressed to some degree on the basis of a detailed study of the skeletal elements (see below). Non-human materials collected from Feature 3 included two *Lepus* sp. bones, four unidentified seeds, unidentified organic (root?) material and two quartz flakes. None of this material is evidently associated with the human remains.

Feature 4 (Fig. 2). A small, slightly raised area of sediment surrounded by an arrangement of rocks, including a *Pinctada mazatlanica* shell fragment, was observed and mapped in the southwest corner of Area B. As the shell could not be demonstrated to be of cultural origin, and as no human bones were exposed, this was not designated as a formal “feature” at the time. However, subsequent discussions and examination of the map and field notes leads us to designate it as Feature 4 at this juncture. It is quite possibly a burial location, which has some bearing on the question of the number of burials in BCS-1, as discussed below.



Fig. 5. Photograph of Feature 3. The 10-centimeter scale points north.

Miscellaneous Surface Occurrences

Several items were exposed at the surface while mapping the site, including three human bones, one faunal bone and one *Pinctada mazatlanica* shell fragment. All were left in place and were lightly covered with dirt if exposed to easy view. The following three items were observed in Area C—an unreddened mandible partially exposed in the northeast corner of Feature 3, which may belong to one of the Feature 3 individuals; an unknown number of reddened ribs partially exposed just outside Feature 3 to the northwest; and one unreddened vertebra between some rocks. A small unidentified mammal's scapula on the surface in Area B is assumed to be a natural occurrence.

Discussion of Archaeological Context

Three factors confound the identification of the number of individuals represented by the human remains retrieved. These are the significant taphonomic disturbances within the cave, the displacement of some of the bones prior to the LPBP, and the incomplete recovery of the remains

at the site due to lack of permission to excavate. At the south and west ends of the cave there are two openings. During the rainy season, water streaming through these openings would cause significant disturbance to sediments, artifacts, and burial remains. Such a process is likely to have transported and exposed the human remains from their original context to the positions at which they were first reported.

The degree of disturbance of Feature 3 is problematic. The ochre-reddened bones likely were positioned originally at Feature 1 and moved by water, during the rainy seasons, to the lower level of features 2 and 3. However, very well preserved unreddened bones were found on top, amongst and underneath the reddened bones of Feature 3. The arrangement of the bones recovered from Feature 3 suggests a number of possibilities. One possibility is that only the reddened secondary burial bones were washed down from Feature 1 and became mixed with unreddened bones of a primary or secondary burial in Feature 3. However, this seems unlikely since the two large unreddened bones (i.e., the tibia and femur) were on top of a number of

well-preserved reddened ribs. Another possibility is that the unreddened bones represent an intrusive burial. This is also unlikely since the bones are all in very good condition and fairly evenly dispersed within Feature 3. It is possible that two secondary burials, one reddened and the other unreddened, were interred together, although this is improbable as only the reddened bones are widely dispersed. The most plausible explanation for the arrangement of the bones in Feature 3 is that both the reddened and unreddened bones originally might have been positioned further south in the cave, either at or beyond Feature 1. Then, during flooding, all the bones might have been transported into the lower area, finally anchoring against the large rock in Feature 3.

While several questions remain, some fairly confident observations are evident. Ocher-reddened bones were present in all three features, and most of the bones that were surface collected prior to formal retrieval were also reddened. In spite of the dispersed distribution of the reddened bones, they all are believed to be from the same individual, based on the following observations: (a) the cranium found in Feature 2 matches the atlas from Feature 1; (b) a surface collected right first cuneiform fits with the right navicular found within the cranium, and (c) the two reddened femora appear to be mates. These factors, as well as the color, intensity, and general thoroughness of the red ocher treatment, all support the conclusion that the reddened bones belong to one individual.

The unreddened bones seem to belong to the same individual. Both unreddened calcanei, both femora and the right tibia and femur are well matched, while the left fibula is proportionate to the right fibula. Color, robustness, density, and proportions of the unreddened bones all suggest that they represent a single individual. Without excavation,

it is impossible to determine whether additional ocher-reddened individuals were buried in the cave.

The Burials

As noted above, the postmortem disturbances displaced many bones, although at least two individuals are identified. The fact that there were red painted and unpainted bones facilitated the intra-individual assignment of the osseous components, as did the fact that bone articulations and size were consistent with two individuals.

Methods

Initially the bones were sorted by feature, cleaned, and then labeled with the site and sequence numbers. Generally the bones are in excellent condition and could be cleaned with water. During cleaning, care was exercised so as not to remove ocher or any biological evidence (for example, tartar/superficial periostitis). The endocranium of Individual 1 was packed with cave fill and extreme care was taken in its removal since part of the right base and vault had suffered water erosion. Too, as expected, there were many hand and foot bones housed in the skull which were useful in connecting the displaced elements such as the foot bones described above.

Standard aging and sexing criteria follow Ubelaker (1991), while estimates of age from the morphogenesis of symphysis pubis and sternal ribs respectively follow Katz and Suchey (1986) and Iscan, Loth, and Wright (1984). In addition, comparative Las Palmas data for dental attrition and pathology collected by the senior author during pilot research on the Las Palmas skeletal remains was used in the assessment of age, sex and body build. The analysis of dental pathology follows Patterson (1984), infracranial osteometrics and cranio-metrics follow Bass (1987) and Howells

(1973) respectively, while infracranial and cranial nonmetric analyses follow Saunders (1978), Ossenberg (1969), and Molto (1983) respectively. Stature estimates were based on the regression formulae for Mongoloids, following Totter (1970).

BCS-1-#1

This is the red ocher treated secondary burial of a robust adult male estimated to be 40 ± 5 years of age. It is the more complete of the two skeletons. The secondary nature of the remains suggests that it was a bundle burial, although no positioning of the bones was determined. Cut marks are absent on the bones present. Specific skeletal elements were obtained from each of the three site features. Assignment was based on ocher stain similarities and articulations (for example, the atlas found in Feature 1 articulates with the cranium that was displaced and located in Feature 2). The axial skeleton includes a skull with maxillary (all molars, premolars plus the left canine and lateral incisor) but no mandibular teeth, two cervical vertebrae (C1 and C6), five thoracic vertebrae (T1 and 4 other mid-thoracics), two lumbar vertebrae (1 and 3) and a sacrum. Appendicular elements include a fragmentary right scapula, three left ribs (#2 and two other true ribs), a fragmentary left clavicle, a left humerus, right ulna, both hips (the left is complete), both femora, both calcanei, the right talus, and numerous hand and foot bones (most of which were inside the skull). Placing tubular bones inside the skull has been reported before (Massey 1955; Molto and Fujita 1995), but the significance is unknown. It may have served a carrying function for bone transport from the original grave to the cave site. Bone condition is excellent, except for water erosion of the right cranial vault, right occiput, both mandibular condyles, and the neural arch of a thoracic vertebra. As noted, water disturbance is likely the major cause of the bone displacement.

Age

Age was assessed using symphysis pubis and rib morphogenesis, plus dental and skeletal pathology. The furrows of the left symphyseal face are clear, with greater expressiveness on the ventral than the dorsal surface. A definite ventral symphyseal rim is formed, while dorsal rim development is marginal (though part of the dorsal rim area is broken). The symphyseal score does not fit clearly into phases III/IV using the Suchey-Brooks symphysis pubis aging method. If a mean age of the two is taken then the symphysis value would indicate an individual 32 ± 8 years. An estimate of 38.8 ± 7 years was obtained from a left true rib. The heavy dental attrition of the maxillary teeth, plus antemortem tooth loss in the mandible when compared with other Las Palmas dentitions (for example, Piedra Gorda burial 7220) suggests an individual in the fourth decade of life. Although degenerative arthrosis changes are absent in all the synovial joints, there is considerable erosion of the surface and osteophytosis of S1. Such changes are only found in older Las Palmas male skeletons. Of note for skeletal aging is the fact that S1 and S2 have fully fused and that in the endocranium sutural synostosis is virtually complete for the three major sutures, though they are open in the ectocranium. Archnoid fovea are present in the endocranial surface of the left frontal bone and parietal. The latter occurs at the superior terminus of the middle meningeal vessels. Such fovea are generally found in older individuals (White and Folkens 1991), but aging standards have yet to be developed for age assessment. Collectively these data support an age range of 35 to 45 years.

Sex

Sex was assessed using cranial and infracranial criteria. In the hip bones there is no ventral arc or lateral recurve, the infra-symphyseal rim is thick,

the sciatic notch narrow, and the preauricular sulcus is very faintly developed. The sacrum shows extreme curvature with an S1 body that is more than half the sacral body width. These pelvic criteria are unequivocally male.

The skull (Fig. 6) is large (cranial module of 151.3) and shows a robust brow, large mastoids and well marked nuchal lines with a prominentinion. The malar and marginal tubercles and the supramastoid crest are moderately developed, while the zygomaxillary tubercles are very prominent.

A FORDISC analysis of the skull also supports the male assignment. The infracranial bones are generally thick and robust. In particular, the humeral attachment for the deltoideus (i.e., deltoid tuberosity) and right infraglenoid tubercle (for the triceps muscle) are extremely well developed, indicating powerful arm muscle development. There is virtually no skeletal dysplasia with regard to sexual dimorphism in this individual.

Table 1. Osteometrics (mm) BCS-1-#1 and BCS-1-#2; Right/Left for infracranial measurements.

Measurement or Index	Burial 1	Burial 2	Comment
Maximum cranial length	193	x	
Maximum cranial breadth	~132	x	estimate (right temporal squamous broken)
Basion-bregma height	129	x	basion partly broken but measurable
Basion-prosthion length	104	x	slight resorption at prosthion
Basion-nasion length	104	x	
Foramen magnum length	35	x	
Foramen magnum breadth	29	x	water erosion of right posterior area
Bi-formamen ovale breadth	44	x	
Bi-stylomastoid foramen breadth	70	x	
Biasterionic breadth	~104	x	estimate (water erosion of right asterion)
Maximum alveolar breadth	70	x	
Bi-zygomatic breadth	x	x	
Bifrontal chord	106	x	
Orbital breadth	45	x	
Orbital height	37	x	
Bi-ectochion breadth	x	x	
Nasion-prosthion height	80	x	
Maximum nasal-height	54	x	
Maximum nasal-breadth	26	x	
Simotic chord	9	x	
Minimum frontal breadth	97	x	
Nasion-bregma chord	115	x	
Basion-lambda chord	x	x	lambda not located
Lambda-opisthocranium chord	x	x	
Maximum mandibular breadth	x	x	



Fig. 6. Left lateral view of BCS-1-#1. Las Palmas crania are distinctive among Amerindians in their extreme longheadedness called hyperdolichocrany (Not visible in this position). Note the large brows, mastoids and inion, which indicate the male sex. Also note the auditory exostosis (arrow) of the tympanic plate. This trait may have a functional etiology caused by irritation of the auditory membranes from diving, which was a common subsistence related behavior among Las Palmas males.

Table 1. (cont.) Osteometrics (mm) BCS-1-#1 and BCS-1-#2; Right/Left for infracranial measurements.

Measurement or Index	Burial 1	Burial 2	Comment
Bicondylar breadth	x	x	
Cranial module	151.3	x	large
Cranial index	68.4	x	hyperdolichocephalic
Mean height-length index	79.4	x	low to medium
Nasal index	49.1	x	medium-middle of range
Orbital index	88.9	x	mesochochony-upper end of range
Sacrum - height	110	x	
Sacrum- breadth	68	x	
Maximum femoral length	444/448	448/454	
Maximum femoral head	46/46	46/46	
Bicondylar breadth	77/x	85/85	
Maximum tibia length	x/x	401/x	
Sagittal diaphysis (tibia)	x/x	37/x	
Transverse diaphysis (tibia)	x/x	24/x	
Cnemic index	x	64.9	
Maximum fibula length	x/x	x/393	
Calcaneus length	83/81	82/85	
Calcaneus breadth	x/51	50/51	
Talus length	58/x	x/x	
Talus breadth	44/x	x/x	
Maximum humeral length	x/330	x/330	
Maximum humeral head	x/48	x/47	
Maximum radius length	x/x	261/x	

Morphology

As noted, the skull (Fig. 6) with a cranial module of 151.4 is considered large. The cranial index of 68.3 identifies a hyperdolichocranic (extremely long headed) skull, which is a Las Palmas type feature. The skull vault is low in appearance (mean height index of 79.4), with medium values for both the nasal shape (nasal index of 49.1) and orbital shape (88.9). All these values are similar to those reported for other Las Palmas crania (Tyson 1977; Molto and Fujita 1995). A four disc analysis identified this skull as a male with 'Black' affiliation. The latter is a function of the hyperdolichocranic shape. The qualitative characteristics of the skull include a V-shaped brow, a bun shaped occiput with a prominent nuchal ridge, a bilateral chin form (weakly marked), and an H-shaped Pterion. As is typical of Amerindians the zygoma are deep and the zygomaxillary tubercles are prominent.

A number of key nonmetric traits occur with this burial. Most important is the bilateral presence of ossification into the pterygoalar ligament which has left spurs on each side (more expressed on the right), and the bilateral presence of the infraorbital (faintly expressed) suture, both traits which are extremely common in Las Palmas skeletons (Molto and Fujita 1995). The tympanic plate has bilateral presence of three traits; tympanic dehiscence (uniform on both sides), the marginal foramen which houses the auricular temporal nerve and auditory exostoses. The latter hyperostotic trait (Fig. 6) is also common in Las Palmas males and it may relate to diving activity. Dental nonmetrics are difficult to study because of the extreme attrition. The only traits analyzable are third molar agenesis and enamel extensions. The maxillary third molars have fully erupted and enamel extensions occur on both M2s and is absent on the remaining maxillary

molars. Infracranial nonmetrics include discrete anterior and middle facets on both calcanei.

Stature

Height estimates are calculated using formula based on the combined femoral maximum length of 44.6 centimeters: 2.15 (mean femur length) + 72.57 ± 3.80 (Trotter 1970). The estimated stature is 168.46 ± 3.80 (66.28 ± 1.5 inches). This represents his 'genetic' stature estimate. Because individuals lose stature starting in the third decade of life (>30 years) Trotter (1970) has proposed an amended estimate by subtracting 0.06 (age in years of the burial - 30). Using a mean age estimate of 40 years for this skeleton would result in a reduced stature of 0.6 centimeters or 0.24 inches. Thus this individual is approximately 5 feet 6 inches with a very robust build.

Pathology

The incomplete state of the skeleton limits our understanding of pathological processes that may have been present. This is further limited by the fact that only macroscopic analysis has been conducted at this time. A number of minor pathologies are present, which is the norm for an individual of his age in this population. These include degenerative joint disease (DJD), trauma, dental pathology and possibly infection.

DJD occurs on the superior body of S1 and is characterized by erosion of the cancellous bone over the entire centrum. There is concomitant osteopytotic lipping of the anterior rim which, though slight, is somewhat more pronounced on the left lateral margin. It is likely that the inferior body of the L5, had it been present, would also show similar osteoarthritic changes. The only

Table 2. Nonmetric morphology of BCS-1-#1 and BCS-1-# 2 (A=absent, P = present, T = partial expression, R/L, x = unanalyzable). Note: No odontometrics were recorded as the teeth were too worn and/or fractured to permit reliable measurements.

Trait	Burial 1	Burial 2	Comments
Metopic suture	A	x	
Os Japonicum	x/A	x	
Ovale-spinosum	A/A	x	
Open spinosum	A/A	x	
Infraorbital suture	P/A	x	
Tympanic dehiscence	P/P	x	both are tiny or puniform
Mendosal suture	A	x	
Staphne defect	A/A	x	
Marginal foramen	P/P	x	
Ptergyspinous ossification	A/A	x	
Pterygobasal ossification	T/T	x	larger expression on the right
Clino-clinoid ossification	A/A	x	
Carotico-clinoid ossification	A/A	x	
Squamoparietal synostosis	A/A	x	
Trochlear spur	A/A	x	
Divided hypoglossal canal	A/A	x	
Odonto-occipital facet	A	x	
Precondylar tubercle	A	x	
Ossified apical ligament	A	x	
Paracondylar process	x/A	x	
Divided jugular canal	A/A	x	
Palatine torus	A	x	
Mandibular torus	T/T	x	slight development, not true torus
Mylohyoid ossification	x/A	x	
Foramen of lateral pterygoid plate	A/A	x	
Supraorbital foramen	A/A	x	
Frontal grooves	A/A	x	
Parietal foramen	P/A	x	
Posterior condylar canal absent	A/A	x	
Anomalous temporal artery	x/A	x	
Zygomaticofacial foramen	P/P	x	two on the right, one on the left
Accessory optic canal	A/A	x	
Accessory mental foramen	A/A	x	
Transverse fissure of basi-occiput	A	x	
Fronto-temporal articulation	A/A	x	
Occipital suture	x/A	x	
Divided occipital condyle	A/A	x	
Intermediate condylar canal	A/A	x	
Pharyngeal fossa	A	x	

Table 2. (cont.) Nonmetric morphology of BCS-1-#1 and BCS-1-# 2 (A=absent, P = present, T = partial expression, R/L, x = unanalyzable). Note: No odontometrics were recorded as the teeth were too worn and/or fractured to permit reliable measurements.

Trait	Burial 1	Burial 2	Comments
Notochord remnant	A	x	
Coronal ossicle	A/A	x	
Bregmatic ossicle	A	x	
Sagittal ossicle	A	x	
Lambdic ossicle	x	x	
Lambdoidal ossicle	x/P	x	
Asterionic ossicle	A/A	x	
Occipito-mastoid ossicle	A/A	x	
Parietal notch ossicle	A/A	x	
Squamosal ossicle	x/A	x	
Pterionic ossicle	A/A	x	
Third molar agenesis - maxilla	A/A	x	
Third molar agenesis - mandible	A/A	x	
Spina bifida - atlas	A	x	
Spina bifida - S1	A	x	
Superior facet atlas bipartite	P/A	x	
Lateral bridge (atlas)	A/A	x	
Posterior bridge (atlas)	A/A	x	
Posterior arch foramen (atlas)	A/A	x	
Suprascapular variant	T/x	A/x	
Unfused acromial epiphysis	A/x	A/x	
Septal aperture	x/A	x/A	
Supratrochlear spur	x/A	x/A	
Separated anterior facet calcaneus	P/P	x	
Separated anterior facet talus	P/x	P/P	
Os trigonum	A/x	A/A	

other evidence of degenerative vertebral changes is some erosion of the superior centrum of C6 with concomitant 'slight' osteophytotic lipping. In the appendicular bones present the only evidence of degenerative change is a slight erosion of the superior lunate surface of the left acetabulum.

Trauma is represented by a long healed fracture of the inferior surface of the nasal bones. The fracture is curvilinear (arc-shaped) and is virtually symmetrical across the nasal suture (Fig. 7). Slight

smooth exostoses are present adjacent to the maxillo-nasal suture and on the inferior medial rim of the left orbit. These were likely concomitant with the same event that caused the nasal fracture. This trauma is classified as malintant. In Las Palmas Culture the prevalence of interpersonal violence was extreme as over 50% of males and 30% of females had evidence of cranial and/or facial fractures (Molto 1992).

Analysis of dental pathology was limited by the absence of mandibular teeth plus water erosion of the mandibular alveolus. At least five of the 16 mandibular teeth (R 2nd premolar, and 1st two molars on each side) were lost antemortem. In the maxilla (Fig. 8) antemortem tooth loss is absent (0/16), although four teeth were lost postmortem

(right canine, left and right I1s and the right I2). There are no periapical abscesses (0/16 maxilla, 0/11 mandible) or dental caries (0/12 maxilla). Dental attrition was extreme (complete dentin exposure of all occlusal surfaces) and antemortem dental fractures occur on 58% (7/12) of the teeth present (Fig. 9). Exposure of the pulp occurs

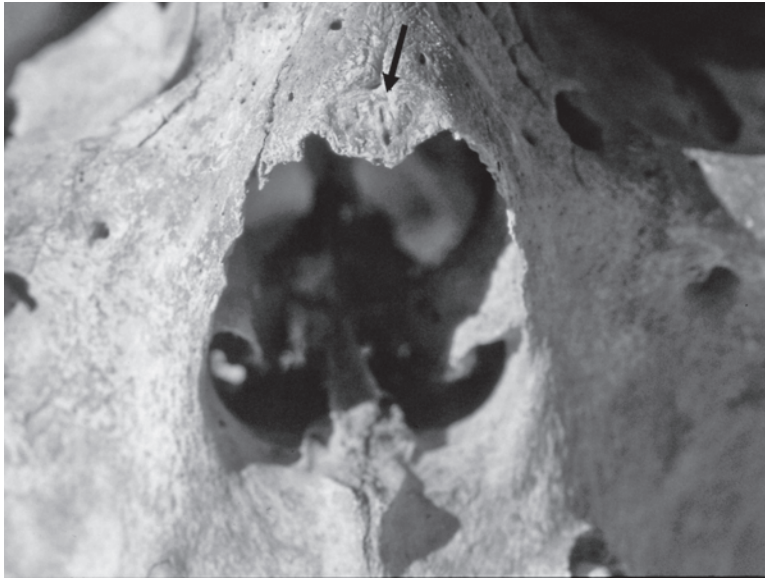


Fig. 7. Anterior view of nasal fracture of BCS-1-#1. Healed fracture (arrow) of the nasal bones likely in response to interpersonal aggression. Among Las Palmas skulls over 50% of males and over 30% of females have cranial and/or facial wounds from interpersonal violence.

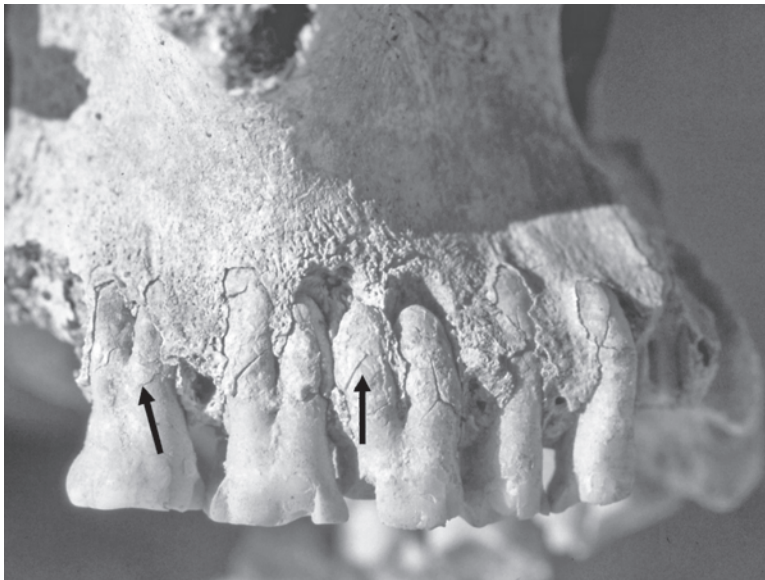


Fig. 8. Right lateral view of the maxillary dentition of BCS-1-#1. Note the alveolar fenestrations (exposures of roots) and resorption. Several of the teeth have secondary development (arrows) of the cementum which may be an adaptive response to extreme masticatory stress.

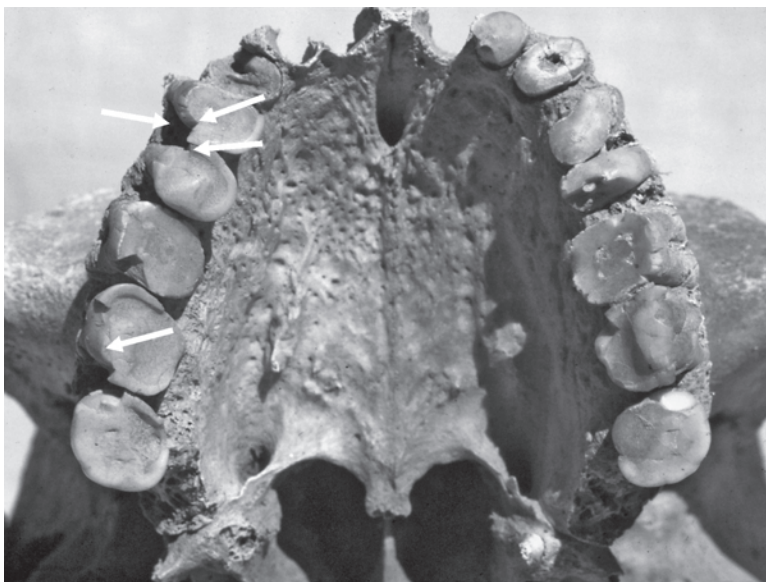


Fig. 9. Occlusal view of maxillary dentition of BCS-1-#1. Note the extreme attrition with dentin and/or pulp exposure and presence of antemortem fractures (arrows), both indicative of the abrasive quality of the Las Palmas diet, which consisted of both terrestrial and marine sources.

on left canine and left M1. As expected the third molars have the least wear. The pattern of attrition shows a lingual slope in the molars that has advanced to the CEJ. A buccal/labial shift occurs in the remaining teeth with labial/buccal attrition past the CEJ occurring on the left canine and premolars. This differential wear may be the result of earlier antemortem tooth loss on the right side of the mandible. The absence of mandibular teeth precludes an analysis of occlusion, but it seems likely the wear gradients noted would be the reverse of that seen on the maxillary teeth. Calculus is absent on all the tooth crowns and CEJ junctions. While it is possible that postmortem erosion removed some of the calculus, it appears more likely that the sclerotic non-pappy diet was not conducive to the development of dental plaque. The alveolus is difficult to analyze for periodontal resorption but it is clear that fenestration occurs on all tooth sites with concomitant exposure of the roots (Fig. 8); heavy wear has resulted in hypercementosis of the roots and subsequent resorption of the alveolar bone. Thus the periodontal resorption in this individual as with most older Las Palmas dentitions is likely of bio-

mechanical genesis. The pattern of dental pathology attests to the highly abrasive nature of the Las Palmas diet (Molto and Kennedy 1991).

The only possible evidence of infection is erosive lesions in the frontal fossae on both sides of the frontal crest. These bony changes are characterized by a resorption of the cortical bone with exposure of the diploe. They are unequivocally distinct in appearance from the archnoid fovea noted above. In the absence of vault and orbital lesions these changes are unlikely related to anemia, though normal aging cannot be excluded. Of interest is the absence of any 'treponemal lesions,' as a treponematosi, likely Bejel, was endemic to the Las Palmas population (Molto 1994).

BCS-1-#2

Feature 3 contained skeletal elements that were red-painted and unpainted. The former are unequivocally associated with BCS-1-#1 and are included in the description above. BCS-1-#2 is represented by the non-painted bones. Only the exposed skeletal elements of this individual were

recovered and consisted of seven ribs (five right and two left), five thoracic vertebrae, the fragmentary right scapula, a left humerus, both ulnae, a right radius, both femora, a right tibia, a left fibulae and both calcanei. As no skull, teeth or hips are present, the estimation of age and sex is provisional. The bones are in excellent shape. The nonmetric and osteometric data are presented in Table 1 and Table 2, respectively. In the bones present there is no evidence of cut marks. Whether this burial was a primary or secondary interment cannot be determined.

Age

All the long bone epiphyses are fused identifying an adult age status for this skeleton which is supported by a sternal rib age estimate of 28.2 ± 3 years. The healthy state of the synovial and vertebral joints also presumptively supports a 'young adult' age status. However, the previously studied Las Palmas skeletons do not generally show degenerative changes until late in the third decade of life. Without the dentition, hip bones and sacrum it is difficult to further delimit age. Overall, a provisional age range of 25 to 35 is suggested.

Sex

The long bones are moderately robust and their maximum lengths and the size of the articular surfaces are similar to the male data reported by Tyson (1977). In fact, the size of the femoral head and humeral heads are identical to BCS-1-#1. The tuberosities on this burial (for example, deltoid) are less well marked than on BCS-1-#1 suggesting that he was a less robust individual.

Stature

Using the following male Mongoloid regression formula for the maximum lengths of femur and

tibia, $1.22 (\text{femur} + \text{tibia}) + 70.37 \pm 3.24$, the estimated stature for BCS-1-#2 is 174.31 ± 3.24 centimeters (68.58 ± 1.03 inches). BCS-1-#2 is slightly taller than BCS-1-#1, which again supports the male estimate.

Pathology

The only evidence of osteopathology is a well healed fracture of a left true rib. Whether this fracture represents malintent or was accidental is indeterminate.

Summary Discussion

Although there is a limited amount of skeletal information available from burials BCS-1-#1 and BCS-1-#2, what is available supports previous research findings in terms of the Las Palmas diet (Molto and Kennedy 1991), morphological homogeneity and malintent trauma (Molto and Fujita 1995). The fact that BCS-1 is currently the only known Las Palmas site undisturbed by human intervention (apart from our salvage operation) is encouraging for future work at this site. Although BCS-1 is crowded with boulders, presumably limiting space for burials, other Las Palmas sites had numerous individuals packed into small spaces (Massey 1955, 1966; Molto and Fujita 1995). This, plus the presence of Feature 4, suggests the likelihood that BCS-1 contains more than two individuals, perhaps many more. If so, a great deal of additional information relevant to understanding Las Palmas burial ceremonialism, material culture, bioarchaeology, and chronology could emerge from scientific excavation of this cave. Moreover, excavation of this site would be juxtaposed against new hypotheses that have been emerging with the reanalysis of the Las Palmas material excavated by Massey (for example, Carmean and Molto 1991; Molto, Stewart, and Reimer 1997; Stewart, Molto, and Reimer 1998).

The integration of new data sources (for example, ancient DNA, stable isotopes, and AMS radiocarbon dating) and how they could expand our understanding of Las Palmas culture needs emphasis here. As with any archaeological quest, developing a chronology is crucial. At the time of Massey's work, radiocarbon dating was in its infancy, and no radiocarbon dating was done until Molto, Stewart, and Reimer (1997) published results on three human bone collagen samples from three Las Palmas caves in the Cape Region, two on the Gulf side and one on the Pacific side. That paper was experimental in that it simulated the expected impacts of marine reservoir effects on radiocarbon ages. It was already known that radiocarbon ages on shells of known historic age were skewed backward in time due to their incorporation of old carbon from the marine environment, and that this reservoir effect varied markedly between and within the Pacific and Gulf sides of the peninsula (Berger, Taylor, and Libby 1966). Further, it was virtually certain that the Las Palmas people consumed unknown but significant amounts of marine foods, and it was postulated that the marine reservoir effects would skew radiocarbon dates on human bone collagen in proportion to the marine component of the diet. Therefore, the simulation involved varying both the established reservoir effect values and the estimated percent of marine carbon in the diet when calibrating the radiocarbon ages, using the mixed atmospheric-marine calibration data set (Stuiver and Reimer 1993).

The results of the simulation showed that using human bone collagen to date the Las Palmas culture would be ill advised unless the problematic parameters could be better controlled. Accordingly, Molto, Stewart, and Reimer (1997) proposed obtaining comparative radiocarbon determinations on associated human bones and terrestrial materials, such as burial bundles or mats. Subsequently, when

this was done, the results for several paired samples differed markedly from expectations. In some cases, the radiocarbon ages of the terrestrial sample were actually greater than for the human bone. Therefore, in estimating the chronology of Las Palmas Culture, only dates on terrestrial samples were used (Stewart, Molto, and Reimer 1998). However, this leaves the question of reservoir effects on the bone dates in a puzzling state. A possible reason for the discrepancies might lie in the archaeological contexts. That is, the close positioning of the burial units within the caves raises the possibility of mixing of mat or bundle materials of one burial amongst the bones of a different burial. Although this seems unlikely to us, the issue cannot be resolved with certainty from existing information, so far as we know. However, BCS-1, if it does contain undisturbed burials, offers the possibility of careful excavation aimed at collecting samples of unequivocally associated bones and non-human organic items. Thus, BCS-1 has considerable potential for not only understanding Las Palmas Culture bioarchaeology but, also, for furthering the theoretical and empirical study of radiocarbon dating. Excavation is also needed from a resource management and preservation perspective, for natural processes will continue to disturb and degrade the site, and we fear it is only a matter of time until the site is discovered and vandalized.

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References Cited

- Adams, K. R.
1998 Role of Ethnobotany in Stable Isotope Studies of Human Skeletal Remains, Baja California, Sur. *Pacific Coast Archaeological Society Quarterly* 34(4):21-28.
- Bass, W.
1987 *Human Osteology: A Laboratory and Field Manual* (third Edition). Missouri Archaeological Society Special Publication 2. Columbia, Missouri.
- Berger, Rainer, R. E. Taylor, and W. F. Libby
1966 Radiocarbon Content of Marine Shells from the California and Mexican West Coast. *Science* 153:864-866.
- Carmean, K., and J. E. Molto
1991 The Las Palmas Burial Tradition of the Cape Region, Baja California, Sur. *Pacific Coast Archaeological Society Quarterly* 27(4):23-38.
- Fujita, Harumi
1995 Prehistoric Coastal Adaptations in the Cape Region, Baja California, Sur. *Pacific Coast Archaeological Society Quarterly* 31(1&2):4-19.
- Howells, W. W.
1973 Cranial Variation in Man. *Peabody Museum Papers* 67. Harvard University, Cambridge.
- Iscan, M.Y. S.R. Loth, and R. K. Wright
1984 Age Estimation from the Rib by Phase Analysis: White Males. *Journal of Forensic Sciences* 29:1094-1104.
- Katz, D., and Suchey J. M.
1986 Age Determination of the Male Os Pubis. *American Journal of Physical Anthropology* 69:427-435.
- Kowta, M.
1968 An Archaeological Survey in the Vicinity of La Paz Bay, Baja California, and Problems of Guaicurian Prehistory: A Preliminary Report to the National Science Foundation, Grant NO. GS-1565, Washington, DC.
- Massey, W.
1955 Culture History in the Cape Region of Baja California. Ph.D. dissertation, Department of Anthropology, University of California, Berkeley.
1966 Archaeology and Ethnohistory of Lower California. In, *Archaeological Frontiers and External Connections*, edited by G. F. Ekholm and G. R. Willey, pp. 38-58. Handbook of Middle American Indians, Vol. 4, edited by R. Wauchope. University of Texas Press, Austin.
- Molto, J. E.
1983 Biological Relationships of Southern Ontario Woodland Peoples: The Evidence of Discontinuous Cranial Morphology. Archaeological Survey of Canada, Paper

- No. 117 National Museum of Man, Mercury Series, Ottawa.
- 1992 Trauma in the Las Palmas Population of Baja California Sur. A Skeletal and Ethnohistoric Interpretation. Paper presented at the 19th Annual Meeting of the Paleopathology Association, Las Vegas, Nevada.
- 1994 Treponematosi "endemic" to the pre-contact cape region of Baja California Sur. In *L'origine de la Syphilis en Europe avant ou après 1493? The Origin of Syphilis in Europe Before or After 1493?* Edited by O. Dutour, G. Palfi, J. Berato, and J-P. Brun, pp., 176-184. Proceedings of the International Congress of Infectious Diseases held in Toulon, France, November 25-28, 1993. Toulon: Centre Archéologique du Var and Paris: Editions Errance.
- Molto, J. E., and H. Fujita
- 1995 La Matancita: A Las Palmas Mortuary Site from the West Cape Region of Baja California Sur, Mexico. *Pacific Coast Archaeological Society Quarterly* 31(1 & 2):20-55.
- Molto, J. E., and Brenda V. Kennedy
- 1991 Diet of the Las Palmas Culture of the Cape Region, Baja California Sur. *Pacific Coast Archaeological Society Quarterly* 27(4):47-59.
- Molto, J. E., J. D. Stewart, and P. J. Reimer
- 1997 Problems in Dating Human Remains from Arid Coastal Regions: An Examples from the Cape Region of Baja California. *American Antiquity* 62:489-507.
- Ossenberg, N. S.
- 1969 Discontinuous Morphological Variation in the Human Cranium. Ph.D. dissertation, Department of Anatomy, University of Toronto.
- Patterson, D. K.
- 1984 A Diachronic Study of Dental Paleopathology and Attritional Status of Prehistoric Ontario Pre-Iroquois and Iroquois Populations. Archaeological Survey of Canada, Paper No. 122, *National Museum of Man Mercury Series*, Ottawa.
- Saunders, S. R.
- 1978 The Development and Distribution of Discontinuous Morphological Variation of the Human Infracranial Skeleton. Archaeological Survey of Canada, Paper No. 81 *National Museum of Man, Mercury Series*, Ottawa.
- Schober, T. M.
- 1998 Reconstructing Las Palmas Diet: Stable Isotopes in an Arid Coastal Environment. Paper read at the 32nd Annual Meeting of the Society for California Archaeology, San Diego, April 8-11, 1998.
- Schober, T. M., J. E. Molto, and B. Kennedy
- 1995 Aboriginal Diets of the Baja Peninsula: An Isotopic Evaluation. Manuscript on file, Department of Anthropology, Lakehead University, Thunder Bay, Ontario.
- Stewart, J. D., J. E. Molto, and P. J. Reimer
- 1998 The Chronology of Las Palmas Culture: New Radiocarbon Dates on Non-human Terrestrial Materials from William Massey's Cave Burial Sites. *Pacific Coast Archaeological Society Quarterly* 34(4):1-19.

- Stuiver, M., and P. J. Reimer
1993 Extended 14C Data Base and Revised CALIB 3.0 14C age Calibration Program. *Radiocarbon* 35:215-230.
- Trotter, M.
1970 Estimation of Stature from Intact Long Bones. In, *Personal Identification in Mass Disasters: Report of a seminar, held in Washington, D.C. 9-11 December, 1968*, by arrangement between the Support Services of the Department of the Army and the Smithsonian Institution, edited by T. Dale Stewart, pp. 71-83. Washington, D.C.: National Museum of Natural History, Smithsonian Institution.
- Touhy, D. R., and S. Van Wormer
1995 An Unusual Burial Type from the Cape Region of Baja California. *Pacific Coast Archaeological Society Quarterly* 31(1&2):79-102.
- Tyson, R.
1977 Human Skeletal Material from the Cape Region of Baja California, Mexico. The American Collections. *Journal de la Société des Americanistes* 64:167-174.
- Ubelaker, D.
1991 *Human Skeletal Remains: Excavation, Analysis, Interpretation*. Aldine, Chicago.
- White, T. and Folkens P.A
1991 *Human Osteology*. Academic Press, New York.

