

# Evaluating claims for early cultural occupation in the Laguna Seca Chapala basin, Baja California

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## **Abstract**

The Laguna Seca Chapala basin of Baja California has attracted the attention of archaeologists since the first half of the twentieth century, including Malcolm Rogers. Early work by researchers sought to address the relationship between prehistoric humans and paleoenvironmental conditions in the basin. An initial model advanced by Brigham Arnold argued for a long record of cultural occupation in the basin associated with a series of different pluvial lake environments. Of particular significance in this model was the assertion that the basin held a series of different periods of cultural occupation, signified by the presence of characteristic lithic tool assemblages. These three periods of cultural occupation are described in reference to their lithic technology and include the Elongate Biface Assemblage, the Scraper-Plane Assemblage, and the Flake-Core-Chopper Assemblage. Of these, the Elongate Biface Assemblage was argued to represent a pre-Clovis age occupation along the high stand of Pluvial Lake Chapala. Arnold's model became a key part of Malcolm Rogers's definition of a Southwestern aspect of the San Dieguito culture, which was extrapolated into much of the Baja California peninsula. Archaeological and geoarchaeological research conducted by the author between 1996 and 1999 sought to test Arnold's model by establishing chronometric age control for geomorphic units and key archaeological sites previously identified by Arnold. This research fails to support Arnold's cultural and geological chronology, finding that many of the landforms and cultural occupations do not date to the Pleistocene epoch. Indeed, several of Arnold's purported early sites have returned late Holocene-age radiocarbon dates and produced an artifact assemblage that is characteristic of the Comondú peoples (ethnographic Cochimí). Although some aspects of Arnold's model could not be evaluated with the information collected, the presence of large bifaces is not thought to represent an early artifact type associated with an ancient shoreline, but instead, represents a type of core technology that is time-transgressive and commonly found in proximity to outcrops of high-quality lithic tool stone.

## **Introduction**

While the prehistory of Baja California's Central Desert remains largely unknown, its potential for retaining early sites attracted many archaeologists throughout the twentieth century (Arnold 1957; Bryan and Gruhn 1999; Davis 1968; Rogers 1939, 1966; Massey 1947; Ritter 1976; Ritter et al. 1978, 1984). Despite the number of publications on Central Desert prehistory, many questions remain unanswered, particularly related to the timing and nature of prehistoric occupation in the region. To address these issues, and to look for evidence of early human

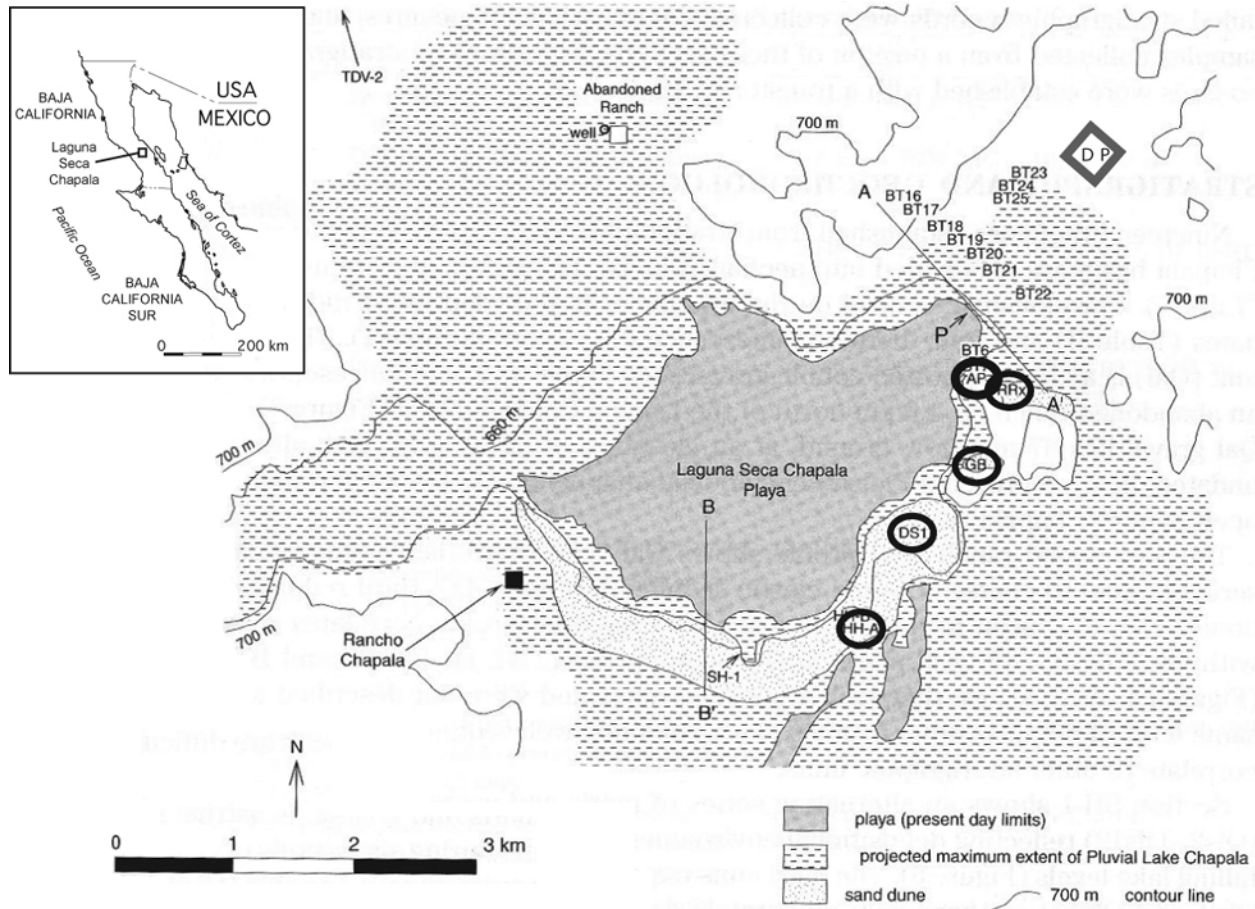


Figure 1. Location of the Laguna Chapala basin in Baja California and distribution of Laguna Seca Chapala sites mentioned in text (modified from Davis 2003). Excavated sites discussed in text are circled in bold lines and correspond to Haplopappus Hill (HH), Dune Site 1 (DS1), Cueva del Taller (CDT), Granite Bay (GB), Red Rocks (RRx), and Abrigo Paredón (AP). Backhoe trenches (e.g., BT23), stratigraphic transects (e.g., A-A'), and the Tinaja de Villegas geologic section (TDV-1) are discussed in detail by L. G. Davis (2003). Location of artifact-bearing desert pavement in the eastern embayment is shown as DP.

occupation of the New World, archaeological and geoarchaeological studies were conducted in the Laguna Seca Chapala basin of Baja California during field sessions in 1996, 1997 and 1999. This report summarizes some of the results of this research and provides discussion on the antiquity of human occupation in the Laguna Chapala basin.

## Study area

Laguna Seca Chapala is one of three dry lakes within a hydrologically closed basin of Mesozoic granitics and Plio-Pleistocene-age andesites and basalts (Morán-Zenteno 1994) located in Baja California's Central Desert (Figure 1), a subarea of the larger Sonoran Desert biome (Shreve 1942, 1951). Along with two other dry lakes to the south and west, Laguna Seca Chapala retains a history of pluvial conditions (Arnold 1957) during the late Pleistocene-early Holocene period (Davis 2003). Between 1953 and 1988, the Chapala weather station recorded an average of 12.7 cm of annual precipitation (National Climatic Data Center and Carbon Dioxide Information Analysis Center 2002), reflecting the region's high aridity. The study area

experiences marked seasonal differences in mean summer (ca. 23.8°C) to winter (ca. 10.8°C) temperatures (Turner and Brown 1994:Figure 110). Local vegetation is composed of tropical-subtropical desert species of the Vizcaíno biotic subdivision (Turner and Brown 1994:204-211) and includes such notable plants as agave, yucca, various cacti (e.g., *Opuntia* sp., *Mammillaria* sp., *Lophocereus schottii*), the boojum tree (*Fouquieria columnaris*), and the elephant tree (*Pachycormus discolor*). Other ethnographically important plants include cardón (*Pachycereus pringlei*), coyote gourd (*Cucurbita digitata*), creosote (*Larrea tridentata*), devil's claw (*Proboscidea parviflora*), hierba del pasmo (*Haplopappus berberidis*), jojoba (*Simmondsia chinensis*), mesquite (*Prosopis* sp.), and palo verde (*Cercidium peninsulare*, *C. praecox*) to name but a few (Nabhan 1993; Roberts 1989).

As a southern extension of the Sonoran Desert, many of its same animals were probably found in the Laguna Seca Chapala region during the past. In descending order of size, examples of Sonoran Desert mammals include desert mule deer (*Odocoileus hemionus crooki*), Sonoran pronghorn (*Antilocapra americana sonorensis*), coyote (*Canis latrans*), ring-tailed cat (*Bassariscus astutus*), desert cottontail (*Sylvilagus auduboni*), desert kangaroo rat (*Dipodomys deserti*), and the white-throated woodrat (*Neotoma albigula*). Some indigenous birds include mourning dove (*Zenaida macroura*), cactus wren (*Campylorhynchus brunneicapillus*), and black-throated sparrow (*Amphispiza bilineata*). A short list of notable Sonoran reptiles includes chuckwalla (*Sauromalus obesus*), desert iguana (*Dipsosaurus dorsalis*), and various rattlesnake (*Crotalus* sp.) subspecies.

Ethnographic peoples of the Central Desert were Yuman-speaking Cochimí (Massey 1949). Aschmann (1959) described the cultural ecology of the Cochimí in detail, emphasizing the quest for water and their generalized gathering-hunting-fishing lifeway (cf. Moriarty and Moriarty 1971). Relevant ethnographic lifeway aspects are summarized here to facilitate discussion in sections to follow. As can be expected, water was a limiting factor for Cochimí settlement patterns; however, the carrying capacity of the environment surrounding a water source ultimately appears to have controlled population densities and residence time. Settlements near marine ecosystems of the Pacific and Sea of Cortez could support higher populations due to the greater stability and productivity of their subsistence resources (Aschmann 1959:100-101). Movement throughout the Central Desert landscape apparently occurred in broad latitudinal transects as Cochimí groups moved from coastal to inland regions to exploit seasonal abundance of food and water. Aschmann (1959:Table 2) estimated that during most years, plant foods comprised the majority (ca. 57%) of the indigenous diet, while marine animals (ca. 25%) and land animals (ca. 18%) made up the balance. During times of resource stress, typically in the early spring, agave and marine animals probably dominated the diet, while roots and land animals were rare, and the *segunda cosecha* was practiced with certain seeds (cf. Aschmann 1966:63). In certain months, agave may have provided 75% of the diet. The Cochimí constructed basic shelters by digging shallow circular pits with semicircular windbreaks made of piled brush. These shelters protected a small fire hearth and several sleeping inhabitants.

The nuclear family formed the primary socioeconomic unit in the Central Desert, while several families (10-40) representing a larger population of perhaps 50-150 individuals comprised a band-level social organization that Spanish missionaries termed rancherías. Group size was fluid and responsive to environmental pressures on resource availability. Seasons of bounty were accompanied by large gatherings and celebrated with ceremonies. In times of extreme stress, rancherías would disperse across the landscape into family-level groups. Infanticide and monogamy were apparently practiced as practical means of maintaining group

survival, while exogamy probably existed as a means of strengthening support networks with other rancherías. Despite descriptions of quasi-clan affiliation and the presence of a ranchería headman, Cochimí society, by all other indications, was egalitarian. Individuals might hold certain positions of honor in times of conflict, or to serve in religious ceremonies. Massey (1966) defined Central Desert prehistoric components from the period between A.D. 1000 and Spanish contact as the Comondú culture. Diagnostic artifacts of this period include Comondú triangular and serrated projectile points and Guajademí split-stem projectile points. Other cultural materials include olivella shell beads, tubular stone pipes, metates, bone awls, and various cordage techniques (Ritter 1984:404).

### **Previous research in the Laguna Seca Chapala basin**

Rogers (1939) and Massey (1947) conducted the first formal investigations in the Laguna Seca Chapala basin through limited surveys of surficial sites. In his investigation of Laguna Seca Chapala geomorphology and archaeology, Arnold (1957) provided the first detailed descriptions of Pluvial Lake Chapala and its associated archaeological record. From a study of undated stratigraphic sections, geomorphic features, and archaeological materials found in both surficial and buried contexts, Arnold argued that Pleistocene-age sites existed along the shores of a large “pre-late Wisconsinan” Pluvial Lake Chapala. Ritter (1976) conducted surficial surveys of Laguna Seca Chapala basin archaeological sites, and dated calcium carbonate samples from suspected lacustrine sediments. Arnold (1957) identified four earlier stands of Pluvial Lake Chapala at 12-15 m (40-50 ft.), 6-7.6 m (20-25 ft.), 3-4.5 m (10-15 ft.), and 1.8-2.4 m (6-8 ft.) above the present playa surface. Arnold correlated the growth of Pluvial Lake Chapala with late Pleistocene climatic conditions, suggesting a pluvial origin for its lacustrine deposits. On this basis, he correlated the timing of the different lake stands “with stadials and interstadials of Wisconsin glaciation” (Arnold 1957:269), which literally correspond with marine oxygen isotope stages 4-2 (75,000-13,000 B.P.; Shackleton and Opdyke 1973).

Arnold (1957) defined three technological traditions from local archaeological sites, represented by the oldest Elongate Biface Assemblage (EBA), the Scraper-Plane Assemblage (SPA), and the youngest Flake-Core-Chopper Assemblage (FCCA). A relative cultural chronology was constructed based on the degree of weathering and patination on artifacts and their association with projected stands of Pluvial Lake Chapala. The namesake of the elongate biface assemblage is “made by removal of large thick flakes from either side of a core.... Supplementary flaking of edges is minor, and physical evidence of use is not clearly established” (Arnold 1957:250). According to Arnold, the EBA is found on the flanks of the basin, to the northeast and southeast of the Laguna Seca Chapala playa (Arnold 1957:Map 6); and is associated with the first rise of Pluvial Lake Chapala at 12-15 m. Scraper planes associated with the SPA are “roughly hemispherical, thick tabular, or somewhat elongate forms ... with a flattish base, generally [created by removal of] a single flake” opposite to “a high back which is wholly or mostly a network of flake scars” with a working edge created by “striking off flakes steeply from the margin of the base toward the back” (Arnold 1957:253-254). The SPA is found entirely around the southern edge of the Laguna Seca Chapala playa (Arnold 1957:Map 6). According to Arnold (1957:261), the SPA occupations immediately preceded a rise in lake levels to 6-7.5 m (20-25 ft.), which buried them by sands either deposited or reworked by lake currents. Soon after this rise, Pluvial Lake Chapala receded to an elevation 3-4.5 m (10-15 ft.) above the modern playa, eroding older deposits and exposing SPA artifacts. Flake-Core-Chopper Assemblages are

found as surficial scatters along the southwestern edge of the Laguna Seca Chapala sub-basin, and along the western and southwestern edge of the western playa (Arnold 1957:Map 6). Because the FCCA is largely found in the western playa sub-basin, near the hypothesized position of the final bodies of lake water, and includes small serrated projectile points and marine shells, Arnold interpreted it as being most recent and likely late Holocene in age.

Arnold's association of Laguna Seca Chapala archaeological occupations with late Pleistocene lake levels (Arnold 1957, 1978, 1984) attracted the interest of other archaeologists seeking evidence of early human occupation in the New World (Davis 1968; Ritter 1976; Ritter et al. 1978, 1984; Rogers 1966; cf. Willey's map in Joukowsky 1980:Figure 4-5). Rogers (1966) projected a southwestern aspect of the San Dieguito cultural complex on the basis of Arnold's (1957) description of EBA artifacts in apparent association with Pleistocene-age landform features. During two trips in the winters of 1971-1972, Ritter (n.d.) conducted surficial collection and analysis of artifacts at several sites in the eastern portion of the Laguna Seca Chapala basin. Bryan and Gruhn (1999) and Gruhn and Bryan (2001) reported on excavations conducted at the Abrigo Paredón site, located in the eastern embayment of the Laguna Seca Chapala sub-basin. At Abrigo Paredón, two early Holocene radiocarbon dates of 8650 ±60 B.P. (Beta-115421) and 9070 ±60 B.P. (Beta-115420) were returned on charcoal associated with a lithic production station complete with numerous foliate lanceolate bifaces.

## **Methods**

In order to evaluate Arnold's claims for early cultural occupation in the Laguna Seca Chapala basin, we conducted archaeological excavations at four sites during 1997. These sites were named Dune Site 1 (DS-1), Cueva del Taller (CDT), Granite Bay (GB), and Red Rocks (RRx) (Figures 1 and 2). With the exception of CDT, test excavations were placed in areas previously discussed by Arnold (1957:Map 6) as corresponding to his SPA sites, with the intention of evaluating the timing and nature of these prehistoric occupations. Excavations followed standard professional procedures and included the following methods. Elevations of excavation levels and finds were measured with reference to a string and line level tied to datum pins positioned at the highest corner of each excavation unit. Excavators carefully excavated each site using sharpened square-nose shovels and/or trowels and dustpans. Excavated sediments from each level were passed through wire mesh screen cloth with 1/8-in. aperture dimension. Artifacts and faunal materials were either bagged individually (with their associated provenience information) as they were encountered or were placed in a level bag without precise three-point provenience. In either case, all materials recovered from any given level or feature were ultimately placed in a corresponding level or feature bag. Standardized forms were filled out at the completion of each level or feature, and site and unit supervisors maintained notes. Photographs and sketches were made of level floors following completion of each level. All artifacts were taken to the field laboratory where they were cleaned, sorted, measured, recorded, given a unique catalog number (either written on the artifact itself and/or on its corresponding bag), and entered into a catalog database. Photographs and digital images of individual artifacts were also made.

## **Geoarchaeology**

A recent paper by L. G. Davis (2003) reinterpreted stratigraphic and geomorphic

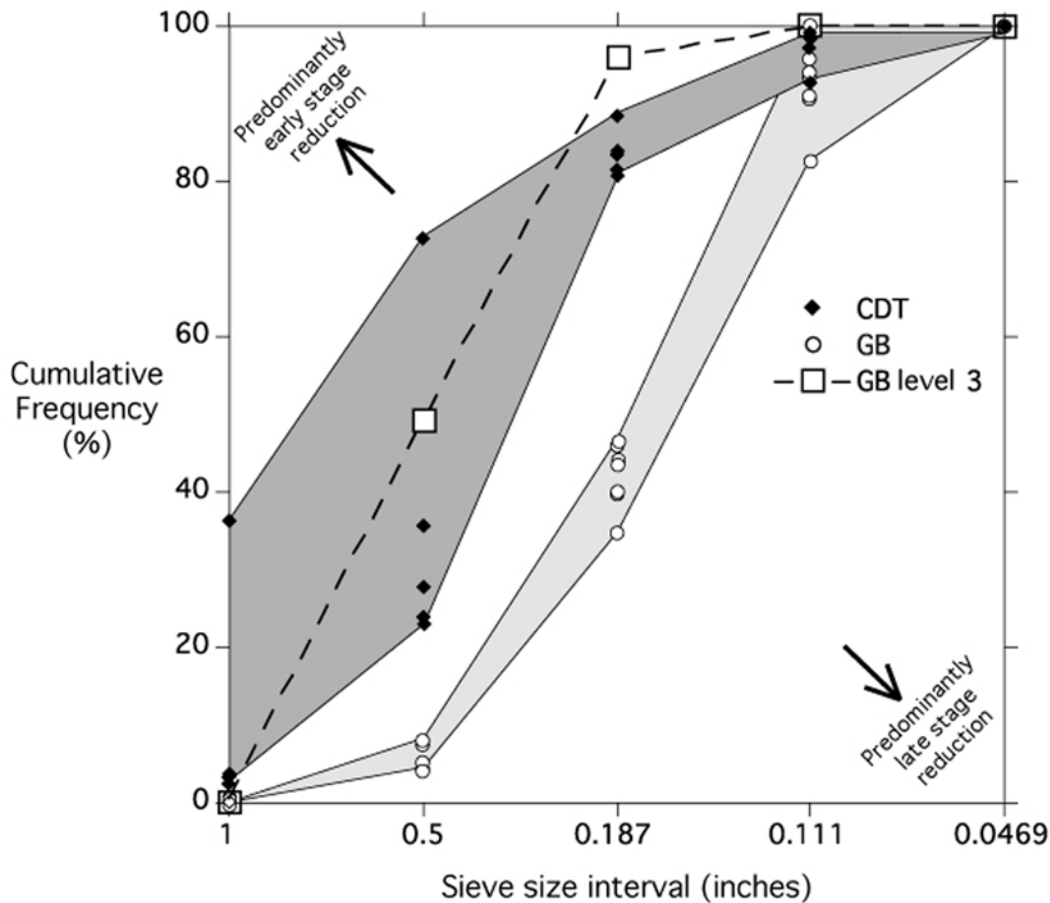


Figure 2. Model of lithic production activities used to interpret debitage assemblages at excavated Laguna Chapala basin sites. Cumulative frequencies of sieved debitage quantities in Cueva del Taller (CDT) and Granite Bay (GB) site assemblages show different production trajectories within a continuum of lithic reduction (c.f. Stahle and Dunn 1982). Plotted curves that fall along the left side of the graph predominantly reflect early-stage activities of primary decortication and reduction. Assemblages with higher proportions of smaller debitage produced during secondary and tertiary stages of lithic reduction plot along the right side of the graph, and correspond to all but one lithic assemblage from Granite Bay.

evidence in the Laguna Seca Chapala basin and reported a detailed record of geochronology and environmental change. Results of this research are summarized here in relation to tested archaeological sites.

### *Stratigraphy and geochronology*

The stratigraphy of Laguna Seca Chapala sites DS-1, GB, and RRx is mainly comprised of poorly sorted, light brown, medium loamy sand and coarse sand deposits (designated by L. G. Davis (2003) as Hae1) that are widespread along the southeastern and eastern edges of the Laguna Seca Chapala playa. Charcoal samples from a hearth discovered at DS-1 and charcoal fragments recovered in Hae1 dune sands from all three sites returned a vertically discontinuous series of radiocarbon dates ranging between  $70 \pm 60$  B.P. (Beta-115413) to  $1170 \pm 100$  B.P. (Beta-115414), pointing to extensive bioturbation. In each site, Hae1 sands unconformably overlie hard lacustrine marl, which retains a highly irregular surface, suggesting that erosion occurred prior to its burial by late Holocene dune sand. Stratigraphic correlation between the DS-1, GB, RRx, and

Abrigo Paredón sites helps to establish a late Holocene age for cultural occupation in the Hae1 dune sands (Davis 2003).

### *Paleoenvironmental change*

The geologic record of surficial deposits in the Laguna Chapala basin reflects significant Holocene environmental change from wet pluvial lake conditions to hyper-arid desertification (Davis 2003). At its maximum extent prior to 9070 B.P., Pluvial Lake Chapala had a surface area of ca. 66 km<sup>2</sup> and a depth of ca. 9 m. Soon after ca. 7450 B.P., Pluvial Lake Chapala rapidly receded, probably due to bedrock faulting that lowered the bathymetric limits of the basin (Arnold 1957; Davis 2003). Desiccation of Pluvial Lake Chapala is signaled by the growth of large sand dunes in parts of the basin. Although the largest dune deposits date between ca. 7600 to ca. 2000 B.P., formation of the lower-elevation Hae1 dunes appears to be limited to the last 1,200 years B.P. Although lake deposits relating to a late Holocene-age lake stand were not identified in the Laguna Seca Chapala basin (Davis 2003), the presence of erosional features along the immediate edge of the Laguna Seca Chapala playa have been attributed to transitory water bodies (Arnold 1957; Ritter 1976). During the decline of Pluvial Lake Chapala, abundant clastic materials were exposed and reworked into the large aeolian dunes that flank the southern margin of the Laguna Seca Chapala playa (Davis 2003). Formation of Hae1 dunes probably occurred under similar scenario: a shift to wetter climate conditions after 2000 B.P. produced a shallow (ca. 50 cm) lake that underwent a series of desiccation and refilling cycles. These wet-dry cycles produce conditions necessary for the creation of dunes in the basin: surficial runoff accompanying wet periods moved sediments down slope toward the playas; during subsequent dry periods, winds transported the finer sediments into dune deposits in various parts of the landscape. Stratigraphic evidence of increased precipitation during the late Holocene is probably associated with the appearance of modern El Niño weather patterns after ca. 3000 B.P. (Markgraf and Diaz 2000). Atmospheric and oceanic conditions associated with El Niño cycles tend to produce anomalously wet winters in northwestern Mexico (Barry and Chorley 1992:269) and promote the formation of eastern Pacific hurricanes (Landsea 2000); an example of this was observed by the author in 1997, following the landfall of Hurricane Nora in Baja California, which contributed an estimated 1,000,000 m<sup>3</sup> of water onto the Laguna Seca Chapala playa (Mayer 2000:209).

### **Archaeological assemblages**

Collections of artifacts and faunal materials were recovered from four sites in the basin. In all sites, lithic debitage dominates the material record, while formed stone tools occur in varying frequencies.

Five types of lithic raw materials were seen in tested archaeological sites, three of which can be found in the Laguna Seca Chapala basin, whereas two are exotic to the immediate area. Large, prominent intrusive dikes of fine-grained, highly siliceous metavolcanic rock, commonly termed felsite (cf. Arnold 1957; Ritter 1976), are associated with granitic bedrock formations throughout the basin and are highly visible in local sites. Quartz and quartzite rocks probably occur in limited quantities, associated with all bedrock types. Obsidian and cryptocrystalline silica (CCS) are found in volcanic and metamorphic geologic contexts beyond the study area.

### *Dune Site 1*

Contained in low-elevation dunes of Hae1 sand, DS1 is positioned along the southern edge of the Laguna Seca Chapala playa. Two 2-x-2-m test pits (Units A and B) and a 1-x-2-m pit (Unit C) were placed in areas with surficial scatters of lithic artifacts. Cultural materials recovered from DS1 include modest amounts of debitage, bone, shell and lithic tools. Felsite debitage dominated (n = 421), followed by quartzite (n = 22), quartz (n = 17), obsidian (n = 2) and CCS (n = 1). Bone fragments (n = 341) largely represent small and very small animals (e.g., rabbits and rodents), with a small percentage from larger mammals (e.g., artiodactyl) and birds. Shell fragments (n = 71) are marine species (e.g., *Mytilus californianus*) typically consumed for food, while a single cowrie (*Cypraea* sp.) and olivella shell were found, suggesting personal adornment or trade items. Lithic tools (n = 29) included bifaces (n = 2, both of which are projectile points), blades (n = 10), cores (n = 4), ground stone (n = 2), a hammer stone, modified flakes (n = 9) and a uniface.

A concentration of fire-cracked rock (FCR) and charcoal was encountered in the excavation of Unit A, and profiled in the north and west walls. Large, well-preserved charcoal fragments were very similar in appearance to yucca, which grows close to the site today. An estimated 5.6 m<sup>3</sup> of Hae1 sediments were excavated from Units A, B and C. Considering the quantities of cultural materials discussed above, DS1 yielded 82.9 debitage pieces, 5.2 lithic tools, 60.9 bone fragments, and 12.7 shell fragments per m<sup>3</sup>.

### *Granite Bay*

The Granite Bay (GB) site is located near the southeastern corner of the Laguna Seca Chapala playa, in low Hae1 dunes that have blown against the edges of a large granitic embayment. A single 2-x-2-m test pit (Unit A) was placed at the top of the dune in an area with modest amounts of surficial artifacts. Artifacts and faunal materials were recovered in higher quantities at GB than in all DS1 units. Felsite flakes (n = 12,137) overwhelm the total debitage population, whereas quartzite (n = 546) and quartz (n = 143) are more common than CCS (n = 41) and obsidian (n = 3) flakes. A total of 76 lithic tools were found, including bifaces (n = 32; 3 are projectile points), cores (n = 28), hammer stones (n = 5), modified flakes (n = 3), and unifaces (n = 4). Bone weighed 238.8 g (including a single fish bone), while shell weighed 4.1 g. FCR occurred in high quantities (4,858.9 g). Considering the volume of excavated materials from GB Unit A (5.2 m<sup>3</sup>), artifact yields were very high, including: 2,475 debitage pieces, 14.6 lithic tools, 45.9 g of bone fragments, 0.8 g of shell fragments, and 934.4 g of FCR per m<sup>3</sup> of excavated Hae1 sediment.

### *Cueva del Taller*

The Cueva del Taller (CDT) site is located within a bouldery granitic outcrop located near the southeastern corner of the Laguna Seca Chapala playa. The CDT site lies within a highly fractured granitic outcrop; such outcrops are common in the mountainous spine of northern Baja California. A simple scenario is offered to help explain the formation of boulder rock shelter sites: through time, granitic bedrock, which forms deep in the earth's crust, can be exposed at the surface. As overlying bedrock units are removed, these granites develop horizontal fractures, or joints, in response to the release of loading pressures (Park 1989:6).



Contemporaneous faulting and folding of bedrock associated with various local and regional structural movements produce other kinds of fractures in the granite, which serve to break the bedrock into blocks. Over time, processes of mechanical and chemical weathering round the corners of these blocks, while earthquakes, faulting, and gravity work to create a pile of large boulders from what was once an intact granitic formation. Because the boulders in these highly altered granite piles are so large, the spaces between stacked rocks is often more than large enough to allow a person to scramble deep within the rock pile, and this commonly produces large multi-chambered spaces that can be best termed as boulder rock shelters. In certain areas of the Laguna Seca Chapala basin, highly fractured dikes of felsite occur within boulder rock shelters, offering easy access to large quantities of highly siliceous tool stone. This situation was seen in the CDT site.

To enter the CDT, one must either climb up an interlocking pile of granite boulders and enter at the same level as the site (671.7 m above sea level), or squeeze through a series of narrow passages from below and emerge in the southern floor of the site. Inside, the CDT is contained in a large main chamber roughly 6 m wide, 9 m long, and up to ca. 5 m high in several places, with several platforms that lead upwards to the north like broad steps. The fragmentary remnants of a dike of felsitic rock can be seen in the northern walls of the chamber, and large blocks of dike rock litter the floor throughout the site. A single 1-x-2-m test pit was placed in the northern half of the chamber, in an area with abundant surficial artifacts. The sedimentary matrix of the site is largely composed of angular and subangular granite, unmodified felsitic dike rock and fine reddish-brown dust, the latter of which probably accumulated in the site from outside aeolian inputs and chemical weathering of the surrounding granites.

Lithic debitage and lithic production tools dominate cultural materials from CDT. CDT debitage was comprised of felsitic material ( $n = 2,242$ ) and a single quartzite flake. The lithic tool assemblage included bifaces ( $n = 5$ ), cores ( $n = 14$ ), a hammer stone, and a modified flake. Although only  $0.8 \text{ m}^3$  of sediment was excavated at CDT, artifact yields were very high, suggesting intensive use, relatively slow rates of sedimentation, or both. Rodent-sized bones were found during excavation; however, their origin is not suspected as human. Instead, owls are thought to have introduced these small bones. Evidence of owls living in the boulder rock shelter can be seen in a small adjacent chamber to the north of CDT, where many thousands of rodent bones litter the floor.

### *Red Rocks*

The Red Rocks (RRx) site, named after the extensive oxidation of surrounding rocks, lies in a similar setting as the DS1 and GB sites: set in Hae1 dune sands east of the large granitic outcrop that bounds the Laguna Seca Chapala playa to the southeast. Two 2-x-2-m test pits (Units A and B) were excavated in areas with a surficial scatter of artifacts. Of all sites tested, RRx produced the smallest amounts of debitage (felsite = 71; quartz = 3) and faunal material (bone = 3.3 g; shell = 0.9 g). Notably, quantities of FCR were relatively high (3,078.1 g) and the site produced a single piece of ground stone. A tubular clay pipe was found on the surface of the dunes, about 20 m to the east of Unit B. A cluster of FCR was found in association with oxidized sand and small charcoal fragments in Unit A, level 2, and is interpreted as a hearth feature. A total of  $9.52 \text{ m}^3$  of Hae1 sediments were excavated from RRx Units A and B. Proportionally, excavated sediments yielded the lowest quantities of artifacts and faunal materials of any investigated site, including 7.8 debitage pieces, 0.4 g of bone, 0.1 g of shell and 323.3 g of FCR

per m<sup>3</sup>.

## Discussion

### *Testing Arnold's model of prehistory*

L. G. Davis (2003) raised several questions regarding the veracity of Arnold's (1957) geologic and archaeological models. In particular, the timing of pluvial lake conditions and their correlation with Arnold's different cultural components is rejected, based on the collection of several radiocarbon and thermoluminescence dates and new stratigraphic interpretations. Archaeological excavation of sites located in dunes served to test Arnold's assertion that SPA occupations predate a late Pleistocene-age 6-7.5-m lake level (664.86-666.36 m above sea level) (Arnold 1957:Map 6). This hypothesis has been disproven here, as excavations at all sites revealed cultural materials in late Holocene-age Hae1 dune sands, which date between 220 ±50 B.P. (Beta-115412) and 1170 ±100 B.P. (Beta-115414) (Table 2).

### *Technology and typology: problems for interpretation*

Arnold's (1957) model of Laguna Seca Chapala prehistory is strongly reliant on the use of an artifact taxonomy wherein lithic tool traditions represent temporal markers. To reiterate, these traditions include the Elongate Biface Assemblage (EBA), the Scraper-Plane Assemblage (SPA), and the youngest Flake-Core-Chopper Assemblage (FCCA). On the basis of the archaeological results reported here, Arnold's cultural taxonomy seems apparent, not real. Arnold (1957, 1984) claimed that large bifaces (e.g., Arnold 1984:Figure 2; Ritter 1976:Figure 3) of the EBA type are limited to higher-elevation areas of the eastern embayment of the Laguna Seca Chapala basin. This spatial distribution is presented as evidence for association of the EBA with high lake stands of Pluvial Lake Chapala, and as support for its great antiquity (Arnold 1957, 1984). This argument is rejected for several reasons. First, the locations of EBA sites are exclusively associated with the distribution of Mesozoic granitics and appear to be located in the immediate vicinity of felsite dike outcrops, which we now know were used as a lithic tool stone into the late Holocene. Second, no EBA sites occur among the volcanic terrains in the western portion of the Laguna Seca Chapala sub-basin or in the western playa sub-basin, which raises further doubts about the purported association of EBA sites and an ancient lake margin. Third, and last, several large bifaces identical to those shown by Arnold (1957; 1984:Figure 2) and Ritter (1976:Figure 3) were found in association with late Holocene Hae1 dune sands at the GB site, and in undated CDT deposits that lie at an elevation below Arnold's projected high lake stand.

Technologically, large bifaces of the EBA are most likely bifacial cores, an observation advanced by Arnold, where he states their production included "removal of large thick flakes from either side of a core... Supplementary flaking of edges is minor, and physical evidence of use is not clearly established" (Arnold 1957:250). Comparing the lithic artifact assemblages and results of a size-graded aggregate analysis of debitage (cf. Stahle and Dunn 1982) from the CDT and GB sites led to several observations. Given the high frequency of large bifacial cores and primary reduction debitage, the absence of other kinds of occupational evidence (e.g., faunal remains, activity features), and the presence of abundant siliceous dike rock suggests CDT probably acted as a quarry. The creation of large bifacial cores was probably an efficient use of

certain felsitic raw material shapes. Efficiency is argued as felsite dike tool stone naturally occurs as plates and tabular slabs in CDT and throughout the eastern Laguna Seca Chapala embayment, and contrasts with raw material in the form of spheroidal nodules, which favor or allow other core reduction techniques. Although Arnold (1957) considered large bifaces to be a defining characteristic of the EBA, this author has observed bifacial, unidirectional, and multidirectional cores in close proximity on the eastern flanks of the Laguna Seca Chapala basin, suggesting a greater diversity of lithic reduction methods is present in EBA sites than previously suggested.

Cumulative frequency analysis of GB debitage shows an increase in smaller flakes as compared to the CDT assemblage, which reflects a shift toward later-stage lithic reduction activities. The frequencies and artifact types support these debitage patterns, as CDT excavations produced many cores (n = 14) and few tools (n = 5), while GB contained a greater proportion of tools (n = 48) than cores (n = 28). Differences in debitage and formed artifact patterns between the two sites show what is interpreted as a technological continuum: prepared felsite cores and blanks are transported from quarry sites like CDT to a camp for further reduction in the process of tool manufacture. The GB level 3 debitage pattern shows overlap with CDT debitage assemblages, suggesting similar primary reduction activities occasionally occurred at camp locales. The recovery of a bifacial core fragment from GB level 5 suggests the technology continued into the late Holocene. Given the dating of the GB site and the relative shallowness of the CDT site, the production of large bifacial cores clearly occurred within the last two millennia and probably throughout local prehistory. While bifacial core technology may eventually be dated much earlier in the basin, this technological tradition was apparently time-transgressive and fails to provide a temporally sensitive typological marker as Arnold (1957) argues.

#### *Where are late Pleistocene-age sites located?*

Late Pleistocene sites may yet be found in the Laguna Seca Chapala basin but will probably be buried beneath younger sediments at higher elevations along its margins. L. G. Davis (2003) showed that the Abrigo Paredón site was submerged before 9000 B.P. beneath a large pluvial lake, echoing Arnold's (1957) previously stated views that early sites might be located on the edges of the basin. Considering the Holocene geologic history of the basin, it is unlikely that early sites will be found at the surface. The possibility that deeply buried early sites may be found the basin is supported by information provided by local ranchers. Long-time resident Sr. Eugenio Grosso Peralta of Rancho Chapala told the author about the discovery of large bones, possibly from mammoth or mastodon, during excavation of water wells in the southwestern portion of the Laguna Seca Chapala basin and in the northern end of the Tinaja de Villegas. Fragments of fossil bone from extinct mammals can be found on the surface of the Laguna Seca Chapala playa and the neighboring Laguna La Guija playa (Ritter et al. 1978; L.G. Davis, unpublished data); however, the in situ position and age of these remains is presently unknown.

Both Arnold (1957, 1978) and Ritter (1976) have expressed interest in further examination of artifacts associated with desert pavements located above the projected high lake stand limit as a means of evaluating the early period of basin occupation. In these areas, lithic artifacts, including large bifaces, are present as surficial lithic scatters, and are often covered with a heavy coat of desert varnish. Although Arnold (1978) and Ritter (1976) suggested study of the varnish patinas as a potential route for assessing the age of these desert pavement lithic

scatters -- an approach that has received a great deal of attention in recent decades -- it was not previously possible to establish reliable age assessments from desert varnish (Beck 1998; Bierman 1994; Dorn 1991, 1996; Krinsley 1990; Malakoff 1998; Watchman 2000). More recently, Liu (2000, 2003) and Broecker and Liu (2001) describe an approach that holds promise for elucidating relative age estimates from desert varnish microstratigraphy. In 2006, the author revisited a desert pavement area in the eastern embayment of the Laguna Seca Chapala basin and collected several noncultural rocks bearing heavy desert varnish in an attempt to develop a microstratigraphic sequence for varnish geochemistry, following the methods described by Broecker and Liu (2001). If a replicable varnish microstratigraphic record can be established and related to the known paleoclimatic history of the Laguna Seca Chapala basin from noncultural rocks, it should be possible to use this method to generate relative age estimates on desert varnish coated artifacts in the basin. Using this method, it may be finally possible to fully assess Arnold's (1957) and Rogers's (1966) claims for great antiquity of human occupation in the Laguna Seca Chapala basin.

## Conclusions

Although archaeological evidence presented here fails to support Arnold's (1957) model of prehistory, new insights are gained on the archaeology of the Laguna Seca Chapala basin and the Central Desert of Baja California. The late Holocene occupation of the DS1, GB, CDT, and RRx sites reflects a generalized lifeway associated with the ethnographic Cochimí. Use of aggregate analysis and a divergence from previously held taxonomic models of local artifacts provides new means of interpreting prehistoric technological activities. While this study does not present confirmation of earlier claims for great antiquity of human occupation in the Laguna Seca Chapala basin, suggestions for new research directions are offered.

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