A century of progress in Lake Cahuilla studies

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Lake Cahuilla was a great freshwater lake that arose several times during the Archaic, Late Prehistoric, and Protohistoric periods, when the Colorado River diverted its flow into the Mexicali, Imperial, and Coachella valleys (Figure 1). Native traditions remembered its existence, and travelers recognized its traces at least 150 years ago. During the twentieth century, archaeologists, geologists, and ethnologists were able to make substantial progress toward reconstructing various aspects of its chronology, the lifeways of the people who lived on its shores, and the consequences of its appearances and disappearances within the wider region of southern California, northern Baja California, and western Arizona.

Chronology

The outlines of a chronology for Lake Cahuilla during the Late Prehistoric (ca. A.D. 500-1540) and Protohistoric (ca. 1540-1774) periods emerged during the course of the twentieth century. However, the chronological picture has changed considerably even within the last two decades, and it can be expected to continue being refined and perhaps significantly modified in the years ahead.

As far as is known, no literate person ever set eyes on Lake Cahuilla, but its existence was not entirely forgotten among local Native Americans. The Kumeyaay and the Cahuilla, at least, preserved oral traditions relating to the lake throughout the succeeding centuries, although the factual core of those memories was becoming substantially encrusted with mythic elements (Laylander 2004).

Visitors to the region, including Spanish explorers in the 1770s and Anglo-Americans in the 1850s, recognized that a great body of water had formerly filled the Salton Basin. From archaeological remains, such as pottery and arrow points, some of the early observers were able to deduce that the lake had existed in the relatively recent past, contemporaneously with Indians whose material culture was similar to that of the groups still living in the region.

In the early years of the twentieth century, heightened attention was given to the former lake by geographers, in particular D. T. MacDougal (1907, 1914) and Godfrey Sykes (1937). No doubt this interest was aroused at first by the opening of the lake's former bed after 1901 to irrigation agriculture and settlement on both sides of the international frontier, and subsequently by the sudden creation of Lake Cahuilla's latter-day successor, the Salton Sea, in 1905-1907. However, during this period the lake's chronology could still be situated only vaguely, as lying sometime in the recent prehistoric past.

An initial chronological framework for the region's prehistory began to emerge during the 1920s and 1930s, in particular through the work of Malcolm J. Rogers of the San Diego Museum of Man. Rogers and others examined the archaeological remains associated with the lake, compared them with artifacts found elsewhere in the region, and began to fit the settlements on

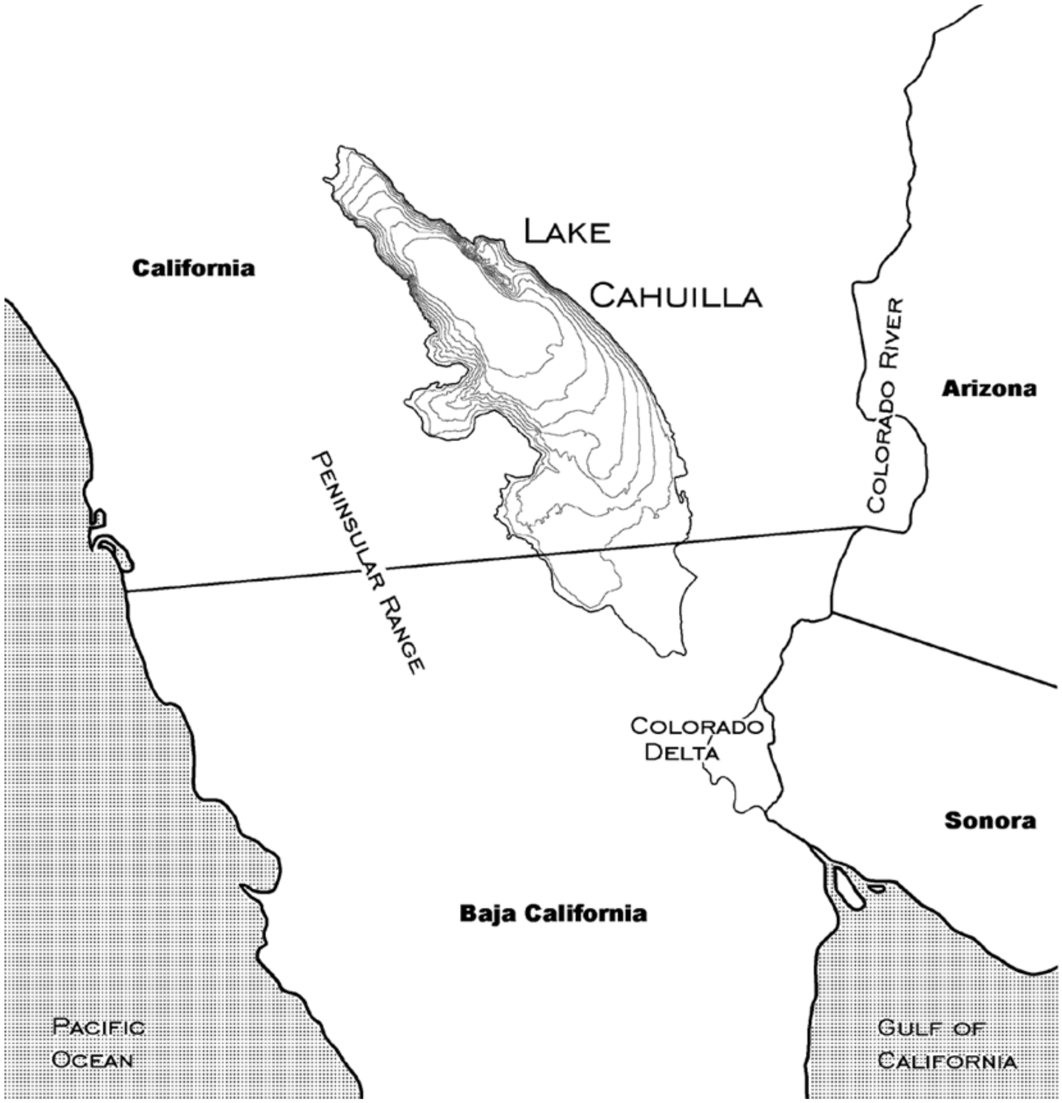

Figure 1. Lake Cahuilla and its region.

the lake's shoreline into a wider chronological sequence. As a result of these efforts, by 60 years ago there was a basis for thinking that a single late prehistoric stand of Lake Cahuilla had occurred, that it had begun sometime around A.D. 900-1000, and that it ended by around A.D. 1500, just prior to the entry of the first Europeans into the Colorado River's delta. Such were the conclusions reached by Rogers (1939, 1945), and they were also supported by Desmond Smith (1942), a graduate student who did some archaeological investigations in the 1930s and wrote a master’s thesis addressing the subject.

Throughout the second half of the twentieth century, there was an accelerating attrition of Lake Cahuilla's archaeological sites, as a result of modern development. At the same time, more precise chronological definition for the lake was becoming possible, thanks to the emergence of radiocarbon measurement as a new tool for absolute dating. Among the earliest suites of radiocarbon dates measured in the 1950s and 1960s were several obtained by Carl L. Hubbs and his associates, including G. M. Stanley and Benjamin E. McCown, from archaeological and geological sites in both Alta and Baja California, either associated with Lake Cahuilla's maximum shoreline or lying on its bed (Crane and Griffin 1958; Fergusson and Libby 1963; Hubbs et al. 1960, 1963, 1965; Hubbs and Bien 1967). In addition to evidence for Pleistocene bodies of water in the basin, Hubbs's radiocarbon readings seemed to document the existence of the lake at various times during the later Archaic, Late Prehistoric, and Protohistoric periods, and hinted at a series of fillings rather than a single inundation.

In the 1970s, Philip J. Wilke (1978) conducted archaeological investigations and synthesized information on Lake Cahuilla in unprecedented detail. By this time, evidence was accumulating that the lake’s full stand had not lasted continuously for half a millennium, as Rogers had thought, but had been interrupted by one or more partial or complete recessions. Wilke supported starting and ending dates for the Late Prehistoric lake (ca. A.D. 900 and 1500, respectively) that were similar to Rogers’s, but he also posited that a complete desiccation had occurred during the late thirteenth century.

Shortly after Wilke, Michael R. Waters (1980, 1983) made new geological observations and reviewed the older historical and radiocarbon evidence. As a result of Waters’s study, the orthodox interpretation of Lake Cahuilla's chronology now became that there had been four Late Prehistoric stands, punctuated by brief, partial or complete recessions. The end of the last full stand was pushed slightly forward, into the 1500s, in order to reconcile the existence of some very late radiocarbon dates with the absence of the lake at the periods of Spanish visits.

During the late 1980s and early 1990s, additional archaeological evidence and analysis fairly clearly established that there had indeed been at least four late-period cycles of filling and recession. However, the most recent appearance of the lake was now put in the Protohistoric period, subsequent to Spanish expeditions reaching the Colorado delta on at least four occasions in 1539-1540 and 1604-1605, and after at least one Spaniard, Melchior Díaz, had probably set foot within the Salton Basin itself. Several dozen radiocarbon dates now attest to a post-1600 stand of the lake (Cleland 1999; Gurrola and Rockwell 1996; Laylander 1997).

Growing recognition is also being given to the imprecise character of what is securely known about Lake Cahuilla's chronology. Rogers, Wilke, and Waters did not hesitate to put forward exact scenarios for the lake's rises and its falls, on the basis of a scattering of radiocarbon dates (with substantial error ranges), comparisons with imperfectly-dated ceramic types, and extrapolated rates of sediment accumulation. A realistic summation of the present state of chronological knowledge would have to be more tentative. The facts that now seem to be known are that (a) there were at least four Late Prehistoric and Protohistoric lake stands, but there may also have been additional ones; (b) the last three known full stands can be placed roughly in the twelfth or thirteenth century, the fifteenth century, and the seventeenth century; and (c) there was at least one earlier Late Prehistoric stand, some time late in the first millennium A.D. The chronology of the basin prior to the Late Prehistoric period is still almost unknown, although there is a small but growing body of archaeological evidence for one or more earlier lake stands (e.g., Love 2002).

Within this chronological framework, hydrological models have been developed that suggest some of the time constraints imposed upon the cycles of lake filling and recession (Laylander 1997; D. Weide 1976; Wilke 1978). Assuming that climatic conditions were similar to those prevailing during the early twentieth century, it would have taken at least 18 years for the lake to fill completely, and at least 55 years for it to disappear again. These figures represent minimum times. Jerry Schaefer (1986) reported archaeological evidence that Colorado River water had reached a receding lake on at least one occasion; some spilling of river water into the dry basin occurred several times during the late nineteenth century. Such episodes of partial diversion of the river, going either into or away from the basin, may have been common prehistorically, and they may have substantially lengthened the processes of filling and desiccation. Considering the Late Prehistoric centuries as a whole, it is not yet known whether the lake was full throughout most of the period, with only intermittent recessions, as Rogers, Wilke, and Waters assumed; whether, alternatively, it was usually dry, with only intermittent fillings; or whether it might even have existed most of the time at an intermediate stage, either rising or falling.

Settlement system and resource use

A second theme of Lake Cahuilla research has dealt with the conditions of human settlement in the basin when the lake was present. Investigators have attempted to determine whether Lake Cahuilla, with its varied hydrological, floral, and faunal resources, acted as a magnet to draw in permanent settlements with substantial populations, or whether it played only a minor and peripheral role within adaptive systems that were essentially non-lacustrine in their orientation.

Archaeological studies were gradually able to document that the range of resources harvested from the lake and its vicinity was considerable. Early investigators, such as Hubbs, recognized that Late Prehistoric peoples had collected fish from the lake. That conclusion was supported by Native American oral traditions and by the fish bones observed at lakeside archaeological sites. It was also supported by the remnants of stone fish traps below the maximum shoreline, although the function of these features was sometimes questioned (Treganza 1945). Hubbs and his collaborators (1960:215-216) found evidence they interpreted as showing the intentional burning of tule in order to drive game; this suggests an intensified exploitation of non-lacustrine resources in the lakeshore setting. Subsequent investigators, in particular Wilke, studied faunal remains and human coprolites, and were able to document the focused exploitation not only of fish (particularly bonytail and razorback sucker) but also of water birds (mudhens, grebes, ducks, etc.), freshwater mollusks (*Anodonta dejecta*), and a variety of plants (such as tule and cattail) that were associated with the lake's marshy shorelines (Laylander 1997; Sutton and Wilke 1988; Wilke 1978).

Permanent settlements with large populations at the lake were taken for granted by many of the early investigators. For example, Homer Aschmann (1959) reported estimates ranging from 20,000 to 100,000 for the number of people who had lived by the lake. Hubbs interpreted the archaeological evidence as reflecting a “dense population” along the maximum shoreline (Hubbs et al. 1960:203, 216). This assumption probably arose in part from the numerous and conspicuous artifact scatters that were observed around much of the lake's periphery. It may not have been fully appreciated that surface sites tended neither to be eroded nor buried on the relatively stable landforms that are common along the lake's margin, and that they may have been misleadingly conspicuous, compared to archaeological sites in other settings. The common assumption that Late Prehistoric Lake Cahuilla had enjoyed an uninterrupted 500-year lifespan also made such high population estimates seem more reasonable than would be the case with the checkered chronology for the lake that has subsequently been put forward.

In recent decades, the issue of the extent and character of settlement at Lake Cahuilla has been framed in terms of two competing models proposed in the 1970s. These are commonly known as the Weide Model and the Wilke Model, after Margaret L. Weide (1976) and Philip J. Wilke (1978) respectively. The Weide Model suggested that the level of the lake had been unstable, and that its associated resources had consequently been less rich and less reliable as a subsistence base than most earlier investigators had thought. The Wilke Model, in contrast, stressed the importance and diversity of the lake's resources and argued that large communities had lived for extended periods on its shoreline. In support of the latter view, seasonality data from human coprolites at lakeside sites in the Coachella Valley seemed to indicate that at least some sites had been occupied throughout the year. More recently, Jerry Schaefer (1994) reviewed the growing body of archaeological evidence on settlement and arrived at conclusions essentially supporting the Weide Model: that most occupation at the lake was merely seasonal. According to Schaefer, archaeological survey and excavation data indicated that settlement along the maximum lakeshore was unevenly distributed, varying with the local topography and with the consequent patterns of lake depths, water circulation, and winds. Although sites were numerous, in Schaefer's view they were also typically very shallow and had relatively low densities of artifacts, with limited functional diversity compared to true permanent village sites. No doubt the debate about the intensity of prehistoric adaptation to the lake will continue and will be refined with additional data in the years ahead.

Less attention has been given to the condition of the Colorado River delta and the possible effects on settlement there resulting from the cycles of Lake Cahuilla. The ethnographer William H. Kelly (1977:2) envisioned the delta as having been essentially uninhabitable during the five centuries of the lake's presence. That conclusion was evidently based on the suppositions that there had been a single, centuries-long stand of the lake and that no surplus of water had overflowed from it into the delta. As discussed above, radiocarbon and stratigraphic evidence subsequently established that the lake's presence was not continuous, and that therefore the Colorado River flowed directly south into the delta at least intermittently during the Late Prehistoric period. Hydrological modeling suggested that only about half of the Colorado River's water would have been lost to evaporation from Lake Cahuilla, at least under climatic conditions similar to modern ones. The remainder of the water entering the lake would have flowed out again into the delta, where it probably would have maintained at least a semblance of the environmental richness that characterized the delta when it was receiving all of the river's flow.

People living in the delta may have undergone much greater stress during the intervals when Lake Cahuilla was in the process of filling. It is possible that a branch of the river continued to flow directly south even while the lake was rising, but this seems unlikely, given the tendency of the river to entrench itself into the soft sediments of the basin's steeper northward gradient. More likely, the lake appropriated virtually the entire flow of the Colorado River for a period lasting as long as two decades. If the people living in the delta were practicing subsistence strategies at all similar to those of the ethnographic Cocopa, who were dependent on natural and cultivated deltaic resources, they would have been unable to adapt in place to the transformation of their territory from a garden into a sterile desert for a generation. Temporary or permanent migration out of the delta may have been the only option for thousands of residents. The cycles in resource availability in the Salton Basin and in the delta were thus at least partially synchronized in such a manner as to complement each other, and settlement changes in the two areas may well have been linked.

Regional consequences

Attempts to discern the repercussions that arose from the cycles of Lake Cahuilla throughout the wider region embracing southern California, northern Baja California, and western Arizona have been much more speculative than the attempts to reconstruct the lake's chronology or to characterize the lifeways of the basin's residents. Nonetheless, the picture of regional ethnography, documented primarily by studies during the first half of the twentieth century, contains many tantalizing hints at such repercussions. The issues are examined in more detail in a separate paper (Laylander 2007); here it is only possible to note briefly some of the arguments that have been put forward. Most of the hypothesized effects would have been closely linked to the severity of the displacements caused by the lake's rises and its falls, and consequently to the degree to which the region's inhabitants committed themselves to lakeshore resources when those were available. If the Wilke Model, discussed above, is essentially correct, major regional consequences from the lake's cycles are much more likely than if the Weide Model is substantially correct.

One of the earliest suggestions, put forward by Malcolm Rogers (1939, 1945), was that the rise of the lake had coincided with the spread of ceramic technology into the Colorado Desert west of the Colorado River, and that the lake's subsequent fall had coincided with the spread of ceramics farther west to the Peninsular Range and the Pacific coast. Subsequent studies tended to put the initiation of ceramic production in the western areas earlier than at least the later stands of Lake Cahuilla. Anthropological interpretations also became less predisposed to assume that expansions of technology were linked with human migrations, rather than with processes of intercultural diffusion. The peoples of southwestern California and northwestern Baja California must have been aware of ceramic technology soon after its arrival on the Colorado River, and their decisions at various periods either to adopt the technology themselves or not to adopt it were probably responses to adaptive needs that were not directly connected with the status of the lake.

Through the late nineteenth and twentieth centuries, anthropologists and linguists gradually refined their picture of the distribution and relationships of aboriginal languages in the region. Some of the distinctive linguistic patterns may perhaps have been consequences of Lake Cahuilla's cycles. Phenomena that called for explanation included the geographical extensiveness of Yuman, which is the largest family within the Hokan phylum with respect to its area, its population, and the number of constituent languages; patterns in the differentiation of the Yuman family into branches, languages, and dialects; and possibly the differentiation of Cahuilla, a Uto-Aztecan language, into dialects. All of these developments evidently occurred during the later part of the Holocene, although relationships above the level of closely linked languages and of dialects must have predated the Late Prehistoric period. Particularly worth considering in this context are the differentiation of Diegueño into several closely-related languages or dialects (Tipai, Kumeyaay, Ipai, etc.); a possible similar divergence between Cocopa, Halyikwamai, and Kahwan; the striking geographical separation of Paipai from its sister language, Upland Yuman; and the incipient fission of Upland Yuman into Yavapai, Walapai, and Havasupai. These linguistic patterns may have been related to territorial expansions that were triggered by one or more of the recessional phases of Lake Cahuilla, although such a connection is still merely speculative.

Late Prehistoric and Protohistoric changes or anomalies in the use of non-lacustrine subsistence resources, documented either ethnographically or archaeologically during the twentieth century, constituted another set of possible effects from the lake's cycles. Several of the patterns involved intensification in the food quest, such as might have occurred among populations that had been abruptly cut off from lacustrine resources. A particularly noted case in point was the adoption of agriculture, which certainly occurred prehistorically along the

Colorado River and in the delta, probably also in areas reached by river's overflow into the Alamo and New Rivers in the Mexicali and Imperial Valleys, and more questionably in the Coachella Valley and the Peninsular Range. Other significant Late Prehistoric subsistence changes in the areas west of the Salton Basin appeared to have included the focused exploitation of agave, acorns, and perhaps pine nuts. Along with changes in the use of particular resources, there may have been changes in general subsistence strategies, such as the maintenance of a generalized rather than an optimized approach as a hedge against environmental instability, an increased use of storage to bridge periods of stress, and perhaps a loosening of restrictions on the non-sustainable exploitation of resources. Most such anomalies could probably have been responses to a general growth in population throughout most of the Californias, unrelated to Lake Cahuilla. Nonetheless, the possible role of pressures arising from the lake cycles in stimulating subsistence change merits further investigation.

An increased reliance on intra- and interregional trade networks may have been another response to environmental instability. Such networks could have served both to alleviate immediate subsistence stress and to build up the extensive social links that would be useful for accommodating displaced populations. Twentieth-century studies of the region’s archaeology, ethnography, and early history established the existence of exchange systems connecting the Pacific coast with the Colorado River valley and areas still farther east. To judge from early accounts of Mohave visitors to the Santa Barbara coast in southern California, the geographical range of direct trade within this region was wider than was generally true elsewhere in the aboriginal Californias.

Permanent increases in population within the surrounding region, as a result of the disappearance of the lake, were suggested by Homer Aschmann (1959), James F. O'Connell (1971), and Philip Wilke (1974). Unfortunately, population sizes during the Archaic, Late Prehistoric, and Protohistoric periods could be only vaguely estimated. Late Prehistoric archaeological sites in the western areas seemed to be proportionately more numerous and larger than earlier sites (e.g., Christenson 1990), suggesting population growth, but similar increases were also observed in areas well removed from any potential effects of Lake Cahuilla.

Settlement and social organization are another area in which to look for possible influences from the lake's cycles. Despite the relatively intensive ethnographic studies that were carried out during the early twentieth century, many aspects of aboriginal social organization remain uncertain (Laylander 1991). There is some support for the hypothesis that the basic, underlying cultural ideal throughout the region was for people to live within nucleated, seasonally transhumant communities consisting of patrilineal descent groups. Communities organized on this basis were recorded ethnographically in the Takic-speaking (Uto-Aztecan) portion of southern California, among the Cahuilla, Luiseño, and Serrano. In contrast, the communities of the Yumans on the Colorado River were not nucleated, and their weak patrilineal descent groups were not localized. In the western Yuman area, there seems to have existed a cultural ideal for residence similar to the Takic pattern, but in practice the western Yuman communities often incorporated multiple descent groups, and a single descent group might be scattered among several communities. Frederic Hicks (1974) attributed the settlement pattern of the Yumans on the Colorado River to the exigencies of floodplain agriculture, and Roger Owen (1965) ascribed the practices of the western Yumans to the need for adaptive flexibility. It is also possible that these patterns of non-nucleated settlements and local intermixture of descent groups arose, at least in part, as a consequence of population displacements associated with the lake.

Warfare and nation-level political organization were also proposed as possible consequences of population displacements associated with the cycles of Lake Cahuilla (Aschmann 1959). The Yumans living on the Colorado and Gila rivers gave a cultural emphasis to interethnic warfare that was highly anomalous, viewed within the context of western North America as a whole (Jorgensen 1980). A variety of explanations, both ideological and material, have been advanced to explain the anomaly; the role of displacements associated with the lake also merits consideration in this context.

Conclusions

Investigations during the twentieth century were gradually able to sketch a picture of Lake Cahuilla that was considerably more complex and more accurate than the images that were available at the start of the century. The lake came to be seen not as a single episode occurring sometime late in prehistory, but rather as a complex sequence of events that were repeated on several occasions, from late Archaic into Protohistoric times, perhaps recurring at intervals of about 200 years. It became established beyond challenge that native people had lived besides the lake, that they had harvested fish, shellfish, water birds, marsh plants, and other resources, and that they had followed the retreating waters far down into the basin with each recession. Still unresolved was the issue of whether the lakeside settlements included home bases for populous communities or only seasonal encampments of groups whose primary residences lay elsewhere, in the Peninsular Range or on the Colorado River. Such diverse phenomena as population growth, subsistence intensification, linguistic expansions, and interethnic warfare throughout the surrounding region were hypothesized as possible repercussions from the cycles of the lake's rises and falls, but the critical evaluation and testing of those hypotheses against empirical evidence had scarcely begun.

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