

SUBMERGED TREE STUMPS AS INDICATORS OF MID-HOLOCENE
DRYING TRENDS WITHIN THE LAKE TAHOE REGION

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ABSTRACT

Sixteen radiocarbon dates taken from submerged tree stumps in ancient underwater forests at South Lake Tahoe indicate a Mid-Holocene drying trend for at least a period of 1,300 years, between 4800 and 6300 years B.P. Further support for Tahoe's lower lake levels in response to climatic variables is provided by soils, geomorphological, dendrochronological, and pollen evidence, in addition to historic records and the presence of submerged archaeological features. Documentation of lower lake levels, which persisted anywhere from a few years to several hundred years, deserves serious consideration by archaeologists. Our present site inventories reflect the modern geomorphology and a current artificial water level which is at least 18 feet higher than the 6300-years B.P. lake level. Evidence of prehistoric occupation from the early through mid Holocene may go undetected, and the intensity to which the lakeshore and its fish resources were used by prehistoric populations may be underemphasized.

INTRODUCTION

Several lines of evidence from the Tahoe Sierra point to dramatically lower levels in Lake Tahoe. Lake level fluctuations are supported by paleoenvironmental evidence, to include a series of radiocarbon dates taken from tree stumps drowned beneath the waters of Lake Tahoe (Table 1), by the presence of submerged archaeological features in the lake and by historic documentation. These data deserve serious attention by archaeologists studying Tahoe's shore zone. Evidence of prehistoric occupation from the early through mid-Holocene may go undetected under Tahoe's current artificially high water level. For example, Davis et al. (1974:41, 56) was first to point out that few sites around the lakeshore appear to contain archaeological remains older than around 4000 years B.P. Earlier sites, once located upon Tahoe's lower and older shorelines, may now be inundated by water, lost by stream channel erosion or buried by marsh sediments. Consequently, our site inventories, which are conducted upon the modern geomorphology, may underemphasize the intensity to which the lakeshore was used by prehistoric populations. This has direct implications for studying human foraging behavior, especially with regard to the

Table 1. List of radiocarbon dates of submerged tree stumps at Lake Tahoe and Independence Lake.

Calibrated ^a Years B.P.	Uncorrected Years B.P.	Elevation ^b	Location	Lab #	Source
6304	5510 ± 90	6212.00'	Baldwin Beach	Beta-33878	Lindstrom 1989
5730	4980 ± 80	6218.64'	Emerald Bay	Beta-32851	Lindstrom 1989
5640	4870 ± 60	6220.70'	Tallac (Kiva) Point	Beta-13654	Lindstrom 1985
5527	4790 ± 200	6222.75'	Tallac (Kiva) Point	-	Harding 1965
5380	4720 ± 70	6218.64'	Emerald Bay	Beta-32852	Lindstrom 1989
5324	4650 ± 70	6219.00'	Baldwin Beach	Beta-33879	Lindstrom 1989
5313	4610 ± 90	6225.50'	Al Tahoe	Beta-32847	Lindstrom 1989
5313	4610 ± 90	6223.25'	Al Tahoe	Beta-32848	Lindstrom 1989
5300	4580 ± 60	6223.25'	Al Tahoe	Beta-32846	Lindstrom 1989
5157	4520 ± 60	6220.70'	Tallac (Kiva) Point	Beta-13655	Lindstrom 1985
5126	4500 ± 60	6222.50'	Al Tahoe	Beta-32849	Lindstrom 1989
5149	4460 ± 250	6223.00'	Tallac (Kiva) Point	-	Harding 1965
4931	4370 ± 80	6222.50'	Al Tahoe	Beta-32850	Lindstrom 1989
4846	4250 ± 200	6222.75'	Tallac (Kiva) Point	-	Harding 1965
modern	110 ± 60	6225.00'	Emerald Bay	Beta-32853	Lindstrom 1989
modern	50 ± 60	6225.00'	Emerald Bay	Beta-32854	Lindstrom 1989
669	690 ± 50	-	Independence Lake	Beta-32857	Lindstrom 1989
modern	170 ± 50	-	Independence Lake	Beta-32856	Lindstrom 1989
modern	100.3 ± 0.7	-	Independence Lake	Beta-32855	Lindstrom 1989

^aRadiocarbon years calibrated with bristlecone pine radiocarbon dates (Marty Rose, personal communication, 1990).

^b6223.00 feet is elevation of natural rim of Lake Tahoe; 6229.00 feet is elevation of current mean summer water level.

prehistoric use of the Tahoe fishery.

PHYSIOLOGY

The Truckee River drainage basin is an exception to other watersheds within the Lahontan system. It is the largest in volume and is subject to less fluctuation. The Truckee River joins two great lakes, Tahoe and Pyramid, the only lakes within the Lahontan system that did not dry up during the Holocene. Throughout the Holocene, Lake Tahoe served as a reservoir of enormous water capacity, and even when it ceased to drain, the Truckee River flow could have still been sustained by the numerous tributaries which serve to equalize its volume.

At an average elevation of 6,225 feet, Lake Tahoe is one of the largest lakes in the world at this high altitude, being about 22 miles long by 12 miles wide with a surface area covering 191 square miles. The volume of water in the lake is 122 million acre feet, enough to cover a flat area the size of the state of California to a depth of more than 14 inches. The lake is the tenth deepest in the world, with a maximum depth of 1,640 feet and an average depth of 1,000 feet. Its 500-square-mile drainage basin is supplied by about 100 affluents, with the Truckee River as its only outlet. The Truckee River is Pyramid Lake's primary source of water (Crippen and Pavelka 1970).

Tahoe's lake levels are naturally controlled by a single outlet, where water spills over into the Truckee River from its northwest corner at Tahoe City. The restricted capacity of its natural rim (at an elevation of 6,223 feet) has been regulated by the construction of a small dam. Since the early 1870s, its fluctuations have been artificially regulated within a 6-foot range.

AN ANCIENT SUBMERGED FOREST

Some of the most compelling evidence of substantially lower lake levels comes from an ancient submerged forest, which was first observed by Harding (1965), when Lake Tahoe's water level was at a record low during the drought of 1931. He reported upon a cluster of 11 well-rooted stumps along Lake Tahoe's south shore near the mouth of Taylor Creek. Harding extracted three C-14 samples from 2 exposed stumps located at the elevation of Tahoe's natural rim (6,223 feet) and dated them between about 4300 and 4800 years B.P. These dates have since been corrected to between 4846 and 5527 calibrated years B.P. (Marty Rose, personal communication, 1990). Harding's rough tree ring counts indicated that these pine trees were between 100 and 150 years old when they were drowned around 5,000 years ago by Tahoe's rising waters.

As part of archaeological excavations in 1985 at a prehistoric site located along Tahoe's lakeshore near the mouth of Taylor Creek, other dates were obtained from 2 more submerged stumps, one dating at about 5640 and another at 5157 calibrated years B.P. (Lindstrom 1985). During 1989 more stumps were relocated, including some new discoveries elsewhere in the South

Lake Tahoe area between Emerald Bay and Stateline (Lindstrom 1985-1989). To date, a total of 27 submerged stumps have been inventoried. These are located at elevations ranging from 6,225 feet down to 6,210.8 feet, the deepest being rooted nearly 13 feet below the natural rim and over 18 feet below Lake Tahoe's normal high water level. Radiocarbon dates from these stumps at or below Tahoe's rim range between 4846 and 6304 calibrated years B.P. (Table 1).

Most of these stumps are in an excellent state of preservation, with the deepest stumps so well preserved as to remain over 7 feet tall and 3½ feet in diameter. The stumps located farthest below Tahoe's rim have probably not been exposed to air for any continuous period since they were first submerged; otherwise, they would have since decayed and disappeared.

PALEOCLIMATIC INDICATIONS

Two alternative hypotheses have been offered to account for drops in Tahoe's lake level, one climatic and one tectonic (Harding 1965). The tectonic argument assumes a physical rise in the elevation of Tahoe's rim and/or subsidence of the entire south end of the basin. Tectonics is a less likely prospect, however, as evidence for faulting around the rim or tilting of the south shore within the last 6,000 years is currently lacking. The climatic argument seems most plausible, given the existence of a mid-Holocene drying trend, which is well documented elsewhere in the western Great Basin (Davis et al. 1974:44; Davis, personal communication 1990). A related climatic factor which may account for Tahoe's rise is the increase in the height of its natural rim, due to accumulated sediments which may have resulted from reduced outflow from the lake (James West, personal communication 1991).

Favoring the climatic explanation, it is possible that a prolonged drought may account for the presence of these submerged stumps. A correlation exists between the elevation and age of these stumps, with those stumps occurring at progressively lower elevations roughly corresponding to earlier dates. Such relationships tentatively suggest that Lake Tahoe may have remained below its current rim elevation for at least a period of 1,500 years, between about 6300 and 4800 years B.P. The actual rate at which Tahoe rose and the extent to which rising lake levels truly represent the alleviation of drought conditions in the Tahoe Sierra are presently unclear and require more study, especially in light of the new and unanalyzed data which suggest an increase in the height of its outflow channel due to sedimentation.

OTHER EVIDENCE FOR LAKE LEVEL FLUCTUATIONS

In addition to the C-14 dates obtained from submerged tree

stumps, other independent and collaborative evidence argues for Tahoe's uniform lake fluctuations in response to climatic variables.

1. Three additional C-14 samples were extracted from submerged stumps at the western end of Independence Lake, also located in the Truckee River watershed and about 18 miles northwest of Lake Tahoe. Three out of a cluster of 10 stumps, all rooted well below the natural rim of Independence Lake, date between 670 years B.P. and modern times (Lindstrom 1985-1989). These data are not yet fully interpreted but also support fluctuating lake levels.

2. Certain features of Tahoe's geomorphology, such as drowned shorelines, sand dunes (Harding 1965), submarine canyons, and marshes dammed by sand spits (Davis et al. 1974:45), may have had their origins during a period when Tahoe was either below or above its current level.

3. Drought conditions are further implied by fluctuations in precipitation and runoff in the Truckee River watershed, as indicated by variations in tree rings and stream flow (Hardman and Reil 1936).

4. A sediment core taken from the bottom of Lake Tahoe (Goldman and Byron 1986:4; Byron, personal communication 1990) and pollen cores extracted from bogs and marshes within the Tahoe Basin (Adam 1967; West 1985) suggest both an increase and decrease in precipitation within the last 10,000 years, with a shift from a cooler/drier period during the early Holocene, a mid-Holocene drying trend, and then a return to cooler but moister conditions.

5. During archaeological excavations along Taylor Creek, a buried A-horizon was discovered in association with a sand lens, both of which may indicate a depositional period within the last 1,100 years, possibly caused by a rise in lake level (Blackard 1985).

6. During low-water periods, numerous bedrock milling features have been identified off Tahoe's present shorezone. Many are submerged several feet below Tahoe's current mean water level and down to $\frac{1}{2}$ foot below Tahoe's natural rim. A total of 6 separate groupings of at least 12 submerged bedrock mortar features, containing about 46 grinding cups, were found at Sugar Pine Point State Park, Tahoe City, D.L. Bliss State Park, Tallac (Kiva) Point, Elks Point, and Glenbrook (Lindstrom 1985, 1989; Woodward, personal communication 1990).

7. Historic regional newspapers sporadically document Tahoe's fluctuating lake levels since the 1860s. Official measurements, maintained since 1900, show a lake level fluctuation 2 feet below and 8 feet above Tahoe's natural rim. Thirty-one droughts have been recorded over the past 90 years,

during which time the level of Lake Tahoe dropped below the rim 11 times (Tahoe World 1988). In the 1930s, the level dropped below the rim for 6 consecutive years. Tahoe is currently below its rim, the second time in 2 successive years.

These new data not only bear upon paleoclimatic studies within the Tahoe Sierra but deserve the attention of archaeologists studying Tahoe's shore zone, in that earlier sites once located upon its lower and older shorelines may now be inundated by Tahoe's current artificially high water level.

NOTES

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