# Zzyzx Mineral Springs— Cultural Treasure and Endangered Species Aquarium

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## A Brief History of Zzyzx

Human use has been documented at Soda Dry Lake back to the early predecessors of the Mohave and Chemehuevi native peoples, who occupied the land when the Spanish explorers first explored the area early in the 19th century. Soda Springs lies in the traditional range of the Chemehuevi, who likely used and modified the area in pursuit of their hunter–gatherer economy. Trade routes existed between the coast and inland to the Colorado River and beyond for almost as long as humans have occupied this continent. These routes depended on reliable springs, spaced no more than a few days' walk apart, and Soda Springs has long been a reliable oasis in a dehydrated expanse.

The first written record of Soda Springs comes from the journals of Jedediah Strong Smith, written in 1827 when he crossed Soda Lake on his way to Mission San Gabriel. Smith was the first American citizen to enter California by land. He crisscrossed the western half of the North American continent by foot and pack animal from 1822 until he was killed by Comanches in 1831. In his journal, Smith wrote of his Soda Lake sojourn: "I came to border of a salt plain and at this place found some holes of brackish water. The water was in holes dug about two feet deep and quite brackish. Making some new holes I found the water some better."

The U.S. Army followed on Jedediah Smith's heels. Various government and, in particular, Army surveys were conducted in the 1850s. Lieutenant Robert S. Williamson provided one of the earliest written descriptions of Soda Lake in 1853. Lieutenant Amiel Weeks Whipple gave Soda Lake its name in 1854, and in 1857 Edward F. Beale laid out a wagon route through the Mojave Desert for emigrants bound for southern California. This route would eventually become known as the Mojave Road. Numerous massacres of these emigrant parties by the Mohaves led the Army to establish a permanent post in 1859 at Fort Mohave near present-day Needles. Shortly thereafter, they established a camp at Soda Springs, dubbed "Hancock's Redoubt" for Winfield Scott Hancock, the Army Quartermaster in Los Angeles at the time. The Army's presence provided a buffer between the emigrants from the East and dispossessed natives. California miners also traveled the Mojave Road on their way to the Colorado River in 1861. During 1867 and 1868, the army established "Soda Station," or "Fort Soda," an army outpost at Soda Springs subordinate to Camp Cady. From Soda Station, the army provided escorts to the stages and U.S. mail carriers along the Mojave Road (Casebier 1999). After the army withdrew in 1871, Soda Station and other similar posts were sporadically manned by civilian station keepers.

The early 20th century brought mining, railroads, and religious colonization to Soda Springs. The Pacific Salt and Soda Company ran a sporadic mining operation there between 1907 and 1911. Evidence of the Pacific Salt and Soda evaporation ponds is still apparent. In 1906, Francis Marion "Borax" Smith had built the Tonopah and Tidewater Railroad through Soda "Dry" Lake to serve his borax mines near Death Valley. From 1907 to 1940 the T&T averaged one train per day between Ludlow, California, and Goldfield, Nevada. The rails were for removed for raw material during World War II and the

graded bed now marks the boundary of Mojave National Preserve south to Crucero on the Union Pacific line.

Pastor Charles T. Russell founded the Watchtower Bible and Tract Society at Soda Springs in 1914. Only two written records of this religious colony, the "Russellite" sect of Jehovah's Witnesses, exist. Russell died October 30, 1916, and David G. Thompson, a geologist working for the U.S. Geological Survey, reported the site abandoned in 1917. Curtis Howe Springer and his wife moved onto the site in 1944, filing mining claims with the Bureau of Land Management and San Bernardino County for over 12,000 acres around Soda Springs. Springer built and operated the Zzyzx Mineral Springs and Health Resort at Soda Springs for 30 years until the Bureau of Land Management evicted him in 1974. His daily radio broadcast touted the miraculous healing powers of Jesus, mineral baths, and elixirs such as Hollywood Pep Tonic and Antediluvian Desert Herb Tea. Although the charges against him-invalid mining claims, tax evasion, and exaggerated advertising-are certainly true, his main activities may have been providing sermons and health food to lost souls and unintentionally supporting the Mohave tui chub. Springer claimed to have coined "Zzyzx" in order to have the last word in the English language.

Springer excavated an artificial pond in about 1955 and called it "Lake Tuendae." He stocked it with a minnow-sized fish that lived in a small limnocrene spring nearby, now called MC (for Mojave Chub) Spring. This spring is natural, but needs occasional clearing of cattails (Typha domengensis) and sedges (Scirpus olneyi) to maintain open water. Springer also enlarged a water-filled mine shaft near Lake Tuendae that became known as "Three Bats Pond" and, later, "West Pond." One version of the story is that Springer enlarged West Pond with dynamite to mine gold. Another version holds that he was constructing a swimming pool. Given that Springer needed to pretend to be mining in order to hold onto his claims, and that the gold he was mining actually came from the purses of his "guests," the truth is probably somewhere in the middle. The fish population in West Pond was killed in 1984 when water conditions became too bad, even for the incredibly tough Mohave tui chub. Hypoxia associated with algae blooms was blamed; this may have been triggered or exacerbated by sewage.

The present-day Desert Studies Center, operated by a consortium of California state universities, was conceived by Dalton Harrington at California State University–San Bernardino when it became apparent that the Bureau of Land Management was finally going to evict Springer. The Desert Studies Center hosts classes, field trips, and conferences in Springer's buildings, restored by the consortium.

### A Brief History of the Mohave Tui Chub

The Mohave tui chub (Gila bicolor mohavensis) is the only fish native to the Mojave River basin in California. It preferred quiet pools in the intermittently flowing Mojave River and tended to be swept downstream during floods. Sport fishermen introduced the arroyo chub (Gila orcutti) in the 1930s as live bait, and it interbred with the Mohave tui chub. A isolated relic population of genetically pure Mohave tui chub survived in MC Spring. How the fish got into MC Spring remains a mystery. The Soda Lake playa is a closed basin at the end of the Mojave River watershed and, during wet seasons, becomes a real lake with water. The fish could have been washed into the ephemeral lake during floods, with a few becoming trapped in MC Spring as the waters receded. An alternative explanation is that the fish somehow move underground through fractures in the limestone. The Bureau of Land Management excavated a pit adjacent to MC Spring to test this latter hypothesis. The pit filled with water but fish never appeared.

The Mojave River originates on the northerly slopes of the San Bernardino Mountains and flows northeasterly into the closed basin of Soda Lake about 100 miles away. Twenty-thousand-year-old fossilized fish remains in Lake Manix recall a time when

Mohave tui chub lived in its favored habitat (USFWS 1984). Lake Manix is now a flat stretch of desert along Interstate Highway15 north of Barstow. The Soda Springs area lies on the western shore of Soda Dry Lake at an elevation of 930 feet. Most of the buildings of the proposed Zzyzx/Soda Springs historic district lie on a shoreline outcropping of Permian metamorphic limestone. The Soda Mountains are Mesozoic granitic and metavolcanic rocks flanked by short, low-angle, alluvial fans and debris flows characteristic of extreme aridity. Mean annual precipitation at Soda Lake since 1980 is 3.5 inches, occurring mostly from July through September during the summer thunderstorm season (Mojave National Preserve 2002).

There are two distinct aquifer systems influencing Soda Springs. Groundwater below Soda Lake is part of the Mojave River Sink and is recharged from percolation through Afton Canyon and Kelso Wash. Another aguifer appears to be related to carbonate rocks in the Soda Mountains. Thompson, the U.S. Geological Survey geologist who surveyed the region in 1917 and 1919, observed two or more springs flowing from the east side of the limestone formation. He wrote of these as "appearing to seep directly from the rock about five feet above the surface of the playa. The largest spring flows into a concrete reservoir about 15 to 30 feet in area and 5 feet deep. A small ram pumped water from this reservoir to a domestic use tank in 1917 but, by 1919 had been removed" (quoted in Duffield-Stoll 1994). Water chemistry suggests that a fracture system through limestone provides a conduit for water flow to MC Spring. The spring tends to have a pH of around 8.5, as compared with 9.5-10 in Lake Tuendae, and low dissolved oxygen. The fact that cattails and sedges in MC Spring must be cut back about every 18 months or so suggests that the existence of this open pool of water, with a surface area of 250 square feet and a volume of 1,000 cubic feet, is anthropogenic.

Springer or his associates most likely introduced the tui chub into Lake Tuendae and West Pond. The oblong impoundment of Lake Tuendae is about 125 feet wide by 500

feet long in an east-west direction. Water is supplied to the lake from a well through a fountain in the lake center. Lake Tuendae is connected to the Soda Lake aquifer by seepage, which has probably prevented a long-term buildup of salinity. Lake Tuendae gradually fills in with sediments and cattails and must be dredged about every 10 years.

The tui chub was listed as endangered by U.S. Fish and Wildlife Service (USFWS) in 1970 and by the state of California in 1971. In addition to the original population in MC Spring and the population introduced into Lake Tuendae, populations of Mohave tui chub have been established in artificial impoundments at China Lake Naval Air Weapons Station and Camp Cady. Attempts to establish other populations at San Felipe Creek (San Diego, California), Rio Santo Tomas (Baja California, Mexico), Paradise Spa (Las Vegas, Nevada), Piute Creek (San Bernardino, California), South Coast Botanical Garden (Palos Verde, California), Spring (San Bernardino, Two Hole California), Dos Palmas Spring (Riverside, California), Lion Country Safari (Laguna Hills, California), Eaton Canyon Nature Center (Altadena, California), Busch Gardens (Van Nuys, California), and Lake Norconian (Norco, California) have all failed.

#### Where Do We Go from Here?

In the fall of 2001, the National Park Service dredged Lake Tuendae, which was becoming filled with silt and cattails. Some fish were killed when an inflatable dam, which was holding water in one half of the lake while the other half was being dredged, slipped. Ten dead fish were sent to the University of San Diego for necropsy and all were found to be infected with the Asian tapeworm. The Asian tapeworm is a parasite believed to have entered the U.S. in shipments of grass carp and spread to California by live baitfish. It is known to have deleterious effects on fish of the Cyprinid, or minnow, family of which the tui chub is a member. The Mohave tui chub shares Lake Tuendae with the Saratoga Springs pupfish (Cyprinodon nevadensis nevadensis) and the exotic mosquito fish (Gambusia affinis), native to southeastern U.S. Gambusia has traditionally been introduced to control mosquitoes but also may consume eggs and larvae of endemic fish. Spring 2003 saw an anomalous plankton bloom in Lake Tuendae, perhaps related to the dredging. Predation on zooplankton by Gambusia also could allow ecological release of phytoplankton in the lake and exacerbate an ecological imbalance. Tests of the water showed alkaline pH (9.5), total dissolved solids of 2130 mg/L, and salinity of 2.2%, still within the range tolerated by the chub.

Small, isolated populations are susceptible to extinction, commonly resulting from multiple stressors. Isolation, small population size (estimated at about 5,000 in Lake Tuendae and 500 in MC Spring), poor water quality, maintenance requirements reflecting an aquarium-like environment, and invasion of exotic species all stack the odds against the Mohave tui chub. Objectives in the recovery plan for delisting the species depend greatly on hope. The plan, which was approved on September 12, 1984, calls for establishing populations in Afton Canyon and Mohave Narrows where perennial ponds persist. Exotic species found in these habitats include black bullhead (Ictaluras melas), green sunfish (Lepomis cyanellus), fathead minnows (Pimephales promeloas), and the Mohave tui chub's old fecund nemesis, the arroyo chub. These species would have to be eradicated before Mohave tui chub could be reintroduced and expected to survive. Actions intended to destroy exotic species could spill over and impact other species such as the protected western pond turtle (Clemmys marmorata) in Afton Canyon. Assuming complications could be overcome, the reintroduced chub would still need to contend with floods. The recovery plan recognizes this and makes delisting contingent on the re-established populations surviving at least one flood.

In reality, Mohave tui chub populations will likely be maintained in aquarium-like environments for the foreseeable future, complicated, yet enhanced, by their presence within the fabric of the historic footprint. Efforts to

sustain and potentially recover the chub must consider the rich and varied history of human occupation that substantiates the National Register nomination and the calculated visitor attraction of Lake Tuendae. Here can be found a collection of structures comprising Zzyzx Mineral Springs and Health Resort, a beleaguered population of fish in Lake Tuendae, and the sole remaining source population of Mohave tui chub in the wild at MC Spring.

The National Park Service faces multiple challenges as steward of the endangered Mohave tui chub living on historic lands. There are presently no plans to reintroduce the chub into the Mojave River drainage or to increase artificial habitat at Zzyzx or elsewhere. The preserve is seeking funds for assessment of the Asian tapeworm impact and is working towards revisiting the recovery plan with USFWS and the California Department of Fish and Game. In the meantime, a die-off in any one of the existing impoundments would severely reduce both the remnant population and its potential for recovery.

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