Mohave Tui Chub (*Siphateles bicolor mohavensis*)

Legal Status

State: Endangered, Fully Protected
Federal: Endangered
Critical Habitat: N/A
Recovery Planning: Recovery Plan for the Mohave Tui Chub, *Gila bicolor mohavensis* (USFWS 1984)
Notes: California Department of Fish and Wildlife (CDFW) has adopted the genus *Siphateles* for the species, which was previously classified under the genus *Gila.*

Taxonomy

The Mohave tui chub (*Siphateles bicolor mohavensis*) is recognized as the only fish native to the Mojave River basin in San Bernardino County. It is a member of the minnow family (Cyprinidae). It was originally identified as *Algansea formosa* in 1857 by Girard, but in 1918 Snyder described it as a new species, *Siphateles mohavensis* (as cited in USFWS 1984). Miller (1961) and Bailey and Uyeno (1964) relegated the subgenus *Siphateles* to the genus *Gila*, and in 1973 Miller reclassified the Mohave tui chub to the subspecies *G. b. mohavensis* (as cited in USFWS 1984). Simons and Mayden (1998) published a paper addressing the classification of the North America genera of Cyprinidae and, based on ribonucleic acid (RNA) sequences, restored *Siphateles* from a subgenus to a full genus. The CDFW currently includes the species under the genus *Siphateles* (CDFW 2013), and the U.S. Fish and Wildlife Service (USFWS) intends to propose amending Part 17, Subchapter B of Chapter I, Title 50, of the Code of Federal Regulations to reflect the taxonomic change from *G. b. mohavensis* to *Siphateles bicolor mohavensis* (USFWS 2009). This taxonomic change will not affect its federal listing status. A physical description of the species can be found in the 5-Year Review (USFWS 2009).

The Mohave tui chub has a distinct lineage and is a separate subspecies from its closest relative, the Lahontan Lake and Lahontan

creek tui chubs (*Siphateles bicolor pectinifer* and *Siphateles bicolor obesa,* respectively). Mohave tui chub is least similar genetically to arroyo chub (*Gila orcutti*) (USFWS 2009).

Distribution

General

Historically, the Mohave tui chub is believed to have occurred throughout the Mojave River drainage (Miller 1946, cited in USFWS 1984). According to the Recovery Plan for the Mohave Tui Chub, *Gila bicolor mohavensis* (Recovery Plan) (USFWS 2009), the Mojave River drainage in the Mojave Desert originally consisted of the Mojave, Little Mojave, and Manix lakes; during the Pleistocene age, these lakes were connected through channels, and Mohave tui chubs were probably found throughout the drainage (Figure 2; USFWS 1984). As the climate became drier and the lakes receded, the Mohave tui chub was restricted to the Mojave River. During the 1930s, arroyo chubs were introduced into the Mojave River and likely hybridized with the Mohave tui chub, thus eliminating the genetically pure Mohave tui chub within the Mojave River (USFWS 1984). A small population of genetically pure Mohave tui chub persisted in isolated ponds near the terminus of the Mojave River at Soda Springs. Four populations of the Mohave tui chub have also been successfully introduced at the Lark Seep complex at China Lake Naval Weapons Station, Camp Cady Wildlife Area (USFWS 2009), the Lewis Center in Apple Valley, and Morning Star Mine at Mojave National Preserve. All of these populations are located within the Plan Area.

Distribution and Occurrences within the Plan Area

Historical

As described above, the Mohave tui chub was historically found within the Mojave River basin as the only native fish within this system. By 1970, the genetically pure Mohave tui chub had been eliminated from the Mojave River due to several factors, including hybridization; introduction of other non-native, competitive, and predatory aquatic species to its historical habitat (e.g., bass [*Micropterus* spp.], catfish [*Ictalurus* spp.], trout [*Oncorhynchus* spp.],

bullfrog [*Rana catesbeiana*], and crayfish [*Procambarus clarki*] [Miller 1969]); habitat alteration; water diversions; and pollution (USFWS 2009). At the time of listing in 1970, four populations were known to exist; three were located in San Bernardino County at Piute Creek, Two Hole Spring, and Soda Springs; and one was in Paradise Spa, Nevada (USFWS 2009). There are nine historical (i.e., pre-1990) records in the Plan Area contained in the California Natural Diversity Database, occurring in the eastern end of Mojave National Preserve and along the northern flank of the San Bernardino Mountains (Figure SP-F2) (CDFW 2013; Dudek 2013).

Recent

A population was established in 1978 at the Desert Research Station near Hinkley, California; however, in 1992 the pond dried up and the population was extirpated. As of 2011, there were five populations of genetically pure Mohave tui chubs: Soda Springs and Morning Star Mine at Mojave National Preserve, Lark Seep at China Lake Naval Air Weapons Station, Camp Cady Wildlife Area, and the Lewis Center in Apple Valley (Figure SP-F02). All of these locations are within the Plan Area. The Camp Cady Wildlife Area is managed by CDFW; Soda Springs Mojave National Preserve and Morning Star Mine are managed by the National Park Service; and the Lark Seep complex is located on a naval base managed by the Department of Defense.

Natural History

Habitat Requirements

Historically, within the Mojave River, the Mohave tui chub was associated with deep pools and sloughs of the river and was not found very far into small tributaries (USFWS 1984). Although the Mohave tui chub does not currently occupy the Mojave River, a few perennial stretches of the river remain that could support a fishery. The habitat requirements for this species include configuration, ecology, and water quality (Archbold 1996, cited in USFWS 2009). The configuration of a lacustrine pond or pool should include a minimum water depth of 4 feet with some freshwater flow for a mineralized and alkaline environment (USFWS 2009; NatureServe 2011). The pools or ponds should include some aquatic plants (e.g.,

Ruppia maritima, *Typha* spp., and *Juncus* spp.), which provide habitat for aquatic invertebrates consumed by Mohave tui chub and a substrate for egg attachment (USFWS 2009). Aquatic ditchgrass (*Ruppia maritima*) appears to be the preferred vegetation for egg attachment and thermal refuge in summer months (USFWS 1984). In addition, the Mohave tui chub is sensitive to predation from other fish species, and pools should be relatively free of arroyo chubs and other non-native aquatic wildlife species (USFWS 2009). Finally, to be suitable for Mohave tui chub, the water should have water quality parameters within the tolerable range for this species and be free of toxic substances or the threat of toxic substance spills (USFWS 2009). Water quality parameters include a temperature range from 37° Fahrenheit (F) to 97°F, dissolved oxygen at greater than 2 parts per million, a salinity of 40 to 323 milliosmols per liter, and a pH of up to 9 with 10 being tolerable for a short period of time (Feldmeth et al. 1985; Archbold 1996; and McClanahan et al. 1986, cited in USFWS 2009).

The current populations are located in primarily man-made or man-supported habitats. The population in Lark Seep is in a perennial body of water that is fed from the wastewater treatment facility in Ridgecrest, California. The population at Camp Cady is located in a man-made, lined pond that receives water from a pump. The populations at Soda Springs occur in two bodies of water, one is a man-made pond that receives water from a pump, and the other is an isolated spring on the edge of Soda Lake (USFWS 2009). The population at the Lewis Center is in two small man-made ponds with water supplied from a pump, and at Morning Star Mine, the population is in a man-made pond created by a perched aquifer. Table 1 lists primary habitat associations and parameters for Mohave tui chub.

Table 1. Habitat Associations for Mohave Tui Chub

Land Cover Type	Land Cover Use	Habitat Designation	Habitat Parameters	Supporting Information
Lacustrine ponds/pools	All life history phases	Primary	Minimum depth of 4 feet and water quality limitations	USFWS 1984, 2009

Foraging Requirements

Not much is known about the specific diet of the Mohave tui chub. They forage on a variety of aquatic invertebrates, including plankton and insect larvae, small fish and organic detritus (Archdeacon 2007, cited in USFWS 2009; NatureServe 2011). Ponds and pools that have aquatic vegetation provide habitat for these food sources, as discussed previously under Habitat Requirements (USFWS 2009).

Reproduction

Mohave tui chubs spawn after 1 year of age (USFWS 1984). Spawning begins during the spring in March and April when water temperatures are warm enough (64° F) (Vickers 1973, cited in USFWS 1984). Spawning may occur in the fall as well. Egg masses are laid in vegetation where they become attached after fertilization. The eggs are approximately 0.04 inch in diameter and hatch after approximately 6 to 8 days when water temperatures are between 64° F and 68° F (USFWS 1984).

Spatial Activity

Currently, the populations of Mohave tui chub are restricted to ponds and man-made channels where they do not have any connection to other populations. Past efforts to introduce or transplant additional populations generally have not been successful (USFWS 2009) with the exception of their current locations in Kern and San Bernardino Counties, California.

Ecological Relationships

The Mohave tui chub originated from the Mojave River basin where it was adapted to the perennial deep pools and slough-like areas of the Mojave River and an absence of aquatic predators. Several factors contributed to its decline and current status as a federal and state listed species. The introduction of arroyo chub into the Mojave River in the 1930s resulted in likely hybridization and elimination of genetically pure Mohave tui chub species. The arroyo chub was also a source of competition for food.

Flooding, changes in water quality, and the introduction of non-native plant and wildlife species have also affected this species (USFWS 1984). Flooding in the Mojave River in 1938 enabled arroyo chubs to disperse further throughout the Mojave River system, and because of their adaptation to waters with greater velocities, the arroyo chub was successful at surviving these floods. Mohave tui chubs, on the other hand, are adapted to lacustrine conditions and are not able to persist in conditions with high-velocity flow and warmer shallow channels (USFWS 2009). These adaptive differences have contributed to replacement of Mohave tui chub by arroyo chub (Castleberry and Cech 1986). In addition, changes in water quality and quantity have resulted in the loss of subpopulations at East Pond (Camp Cady) and Three Bats Pond (Soda Springs) (USFWS 2009). The introduction of non-native plants and aquatic and amphibious species into the Mojave River system has resulted in modification of the species' habitat. Predation by introduced aquatic species (e.g., bass [*Micropterus* spp.], trout [*Oncorhynchus* spp.], catfish [*Ictalurus* spp.], mosquitofish [*Gambusia affinis*], and bullfrogs [*Lithobates catesbeianus*]) contributed to the extirpation of the Mohave tui chub in the Mojave River (USFWS 2009). The establishment of salt cedar (*Tamarix* sp.), has altered water flow and geomorphology of the Mojave River system (Lovich 2006).

A study conducted at Fort Soda in 1981–1982 found that Mohave tui chub populations increased two to three times during the spring and summer months, and then decreased during the fall and winter months (Taylor 1982). A study examining the growth and population structure of the Mohave tui chub at a research station northwest of Barstow in the 1980s found that the population was highest in late summer and lowest in late winter (Havelka et al. 1982). Tui chubs gained weight in May, but lost up to 35% of their body weight from June to October before gaining weight again in November. This may be the result of higher metabolic rates during the summer coupled with a possible reduction in planktonic biomass (Havelka et al. 1982).

Population Status and Trends

Global: Critically imperiled (NatureServe 2011)
State: Same as above
Within Plan Area: Same as above

As described previously under Distribution, Mohave tui chub is only present at five locations, and remains extirpated from its historic habitat in the Mojave River. As concluded in the 2009 5-Year Review for the species, the Mohave tui chub "still meets the definition of endangered in the Act for the following reasons: (1) there are fewer populations of this subspecies now than at the time of listing; (2) the rare nature of this subspecies increases the risk of local extirpations from stochastic events; (3) all populations of the Mohave tui chub are threatened by one or more of the threats described in the Recovery Plan that contributed to its endangered status including habitat loss and alteration, predation from non-native species, with the additional, newly identified threats of parasitism, genetic drift, and extirpation from stochastic events; (4) the lack of consistent and reliable management and monitoring activities for these populations, which makes it difficult to identify and determine the magnitude and imminence of current threats, and therefore, to ensure that the threats will be identified in time and ameliorated; and (5) the failure to meet any of the downlisting or delisting criteria in the Recovery Plan" (USFWS 2009).

Threats and Environmental Stressors

The American Fisheries Society publication of its endangered, threatened, or of special concern fishes of North America identified two main threats to Mohave tui chub: 1) the present threatened destruction, modification, or curtailment of its habitat or range; and 2) other natural or man-made factors affecting its continued existence (hybridization, introduction of non-native or transplanted species, predation, or competition) (Williams et al. 1989, cited in USFWS 2009).

The Mohave tui chub is already extirpated from its historical distribution in the Mojave River. As one of the criteria for delisting the Mohave tui chub, the Recovery Plan includes the return of the Mohave tui chub into its historical range in the Mojave River. Over the years,

the aquifer of the Mojave River has been overdrafted, resulting in the loss of aquatic habitat. Many of the areas within the river are now shallow and lack the lacustrine conditions once characteristic of portions of the Mojave River drainage, thus reducing the suitable habitat available for Mohave tui chub reintroduction.

A parasitic Asian tapeworm was found in Lake Tuendae (Soda Springs), and it initially had a deleterious effect on the population there. It was found to contribute to a reduced growth rate of Mohave tui chub in captivity, but not the survival rate (Archdeacon 2007). Research on Asian tapeworm parasitism has shown no long-term debilitating impacts on Mohave tui chub populations (Archdeacon 2007, cited in USFWS 2009).

Non-native species, such as bullfrogs and sport fish (e.g., bass and catfish), were introduced into the river. Predation on Mohave tui chub from these species contributed to its extirpation within the Mojave River (Williams et al. 1989, cited in USFWS 2009). Mosquitofish were found in Lake Tuendae (Soda Springs) in 2001 and were found to reduce the survival rate of the chubs when no cover is provided in the environment (Archdeacon 2007). They also compete for food and other resources, which may pose a threat to the Mohave tui chub.

Other threats to the Mohave tui chub include regulatory mechanisms. For example, USFWS (2009) states that the military installations do not obtain incidental take permits under the California Endangered Species Act; however, China Lake Naval Air Weapons Station implements Section 7(a)(1) of the federal Endangered Species Act, which requires federal agencies to utilize their authorities in the furtherance of the purposes of the act by carrying out programs for the conservation of federally endangered and threatened species. It should be noted that at the time of the 5-Year Review, the only proposed activities that would result in the take of Mohave tui chub were for research permits, which is purposeful take (USFWS 2009).

Conservation and Management Activities

The USFWS and cooperating agencies have proposed establishing additional populations of Mohave tui chub in the Mojave River watershed and the California portion of the Mojave Desert in order

to contribute to the conservation of the Mohave tui chub (USFWS 2011). An environmental assessment has been completed to analyze the locations where these populations could be established (USFWS 2011).

Because all of the current populations of Mohave tui chub occur in man-made or man-supported environments, ongoing conservation and management activities are required. To ensure the long-term sustainability of the Mohave tui chub, the 5-Year Review indicates that habitat management, ecosystem restoration, monitoring, and adaptive management are needed (USFWS 2009).

All of the current populations require regular control of cattails (*Typha* spp.) in ponds to maintain open water environments and suitable water conditions. Other specific management considerations include the Asian tapeworm, mosquitofish, habitat loss and degradation, water quality and supply, and genetic drift (USFWS 2009). Genetic drift can result in a loss of alleles (i.e., genetic variation) at small, isolated populations and can result in increased risk of extirpation. Recent data indicate that populations at MC Spring (at Soda Springs) and Camp Cady have recently shown a loss of genetic diversity (S. Parmenter, pers. comm. 2007, cited in USFWS 2009).

Data Characterization

To better manage and recover the species, the 5-Year Review (USFWS 2009) suggests identifying the extent and magnitude of bird predation, determining spawning requirements and early life history, determining physiological tolerances of Mohave tui chubs and arroyo chubs to water quality parameters, and identifying genetic issues, such as founder effect and possible hybridization with arroyo chubs.

Recent genetic analysis indicates that all existing populations of Mohave tui chubs are genetically pure; they don't show genetic evidence of hybridization with arroyo chubs. While the Mohave tui chub populations at Lark Seep and the Lake Tuendae subpopulation of Soda Springs are heterogeneous, genetic drift, or a loss of alleles, has occurred at the MC Spring subpopulation of Soda Springs and Camp Cady (USFWS 2009).

Hybridization between Mohave tui chub and the Los Angeles Basin endemic arroyo chub was identified as a primary threat to the Mohave tui chub after arroyo chubs were introduced to the Mojave River in the 1930s. However, hybridization between these two fish has never been studied and documented. Mojave National Preserve has initiated research on the ability of these two fish to hybridize (USFWS 2009).

Management and Monitoring Considerations

Management and monitoring considerations are addressed in the Recovery Plan (USFWS 1984) and 5-Year Review (USFWS 2009) as actions necessary to downlist and delist the species. The overall objective of the Recovery Plan for delisting is to reintroduce a viable, sustainable population of Mohave tui chub into a majority of its historic habitat in the Mojave River (USFWS 1984). To achieve this objective, several management activities must occur, including management of introduced aquatic predators, hybridization with arroyo chub, water supply, water quality, and suitable habitat (e.g., deep, cool pools and sloughs).

In the interim, the Recovery Plan identified objectives to downlist the species from endangered to threatened. These objectives include establishing six populations of at least 500 Mohave tui chub in each population. Currently, there are only three populations that meet this criterion. Portions of the Mojave River that have been identified for additional potential reintroduction include the Mojave Narrows Regional Park area in Victorville, Camp Cady, portions of Afton Canyon, and an area downstream from the Victor Valley wastewater treatment facility in Oro Grande (USFWS 2009). However, it is likely that habitat management of these areas would be required because many of them have shallow flows rather than the preferred habitats of pools and sloughs.

Because all of these areas identified for potential reintroduction are located within the Plan Area, there should be careful consideration of future activities that could affect these areas.

Furthermore, the American Fisheries Society has published guidelines for introductions of threatened and endangered species that could be applied to Mohave tui chub (Williams et al. 2011). The guidelines

recommend restricting introductions to sites within the native or historic habitat, sites that are protected, sites where the potential for dispersal has been determined acceptable, sites that fulfill the species' life history requirements, and sites that contain sufficient habitat to support a viable population. In addition, introduction sites should be avoided where endangered or threatened fish could hybridize with other taxa or where other rare or endemic taxa could be adversely affected. The introduction stock should be from an appropriate source, should be examined for taxonomic status and presence of undesirable pathogens, should be of sufficient number and character, should be carefully and quickly transported, should be introduced under favorable conditions, and the translocation procedures should be documented. After translocation, the American Fisheries Society recommends systematic monitoring of introduced populations, which involves restocking if necessary, determining the cause of any failures, and documenting findings and conclusions reached during the post-introduction (Williams et al. 2011).

Species Modeled Habitat Distribution

This section provides the results of habitat modeling for Mohave tui chub, using available spatial information and occurrence information, as appropriate. For this reason, the term "modeled suitable habitat" is used in this section to distinguish modeled habitat from the habitat information provided in Habitat Requirements, which may include additional habitat and/or microhabitat factors that are important for species occupation, but for which information is not available for habitat modeling.

There are 360 acres of modeled suitable habitat for Mohave tui chub in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

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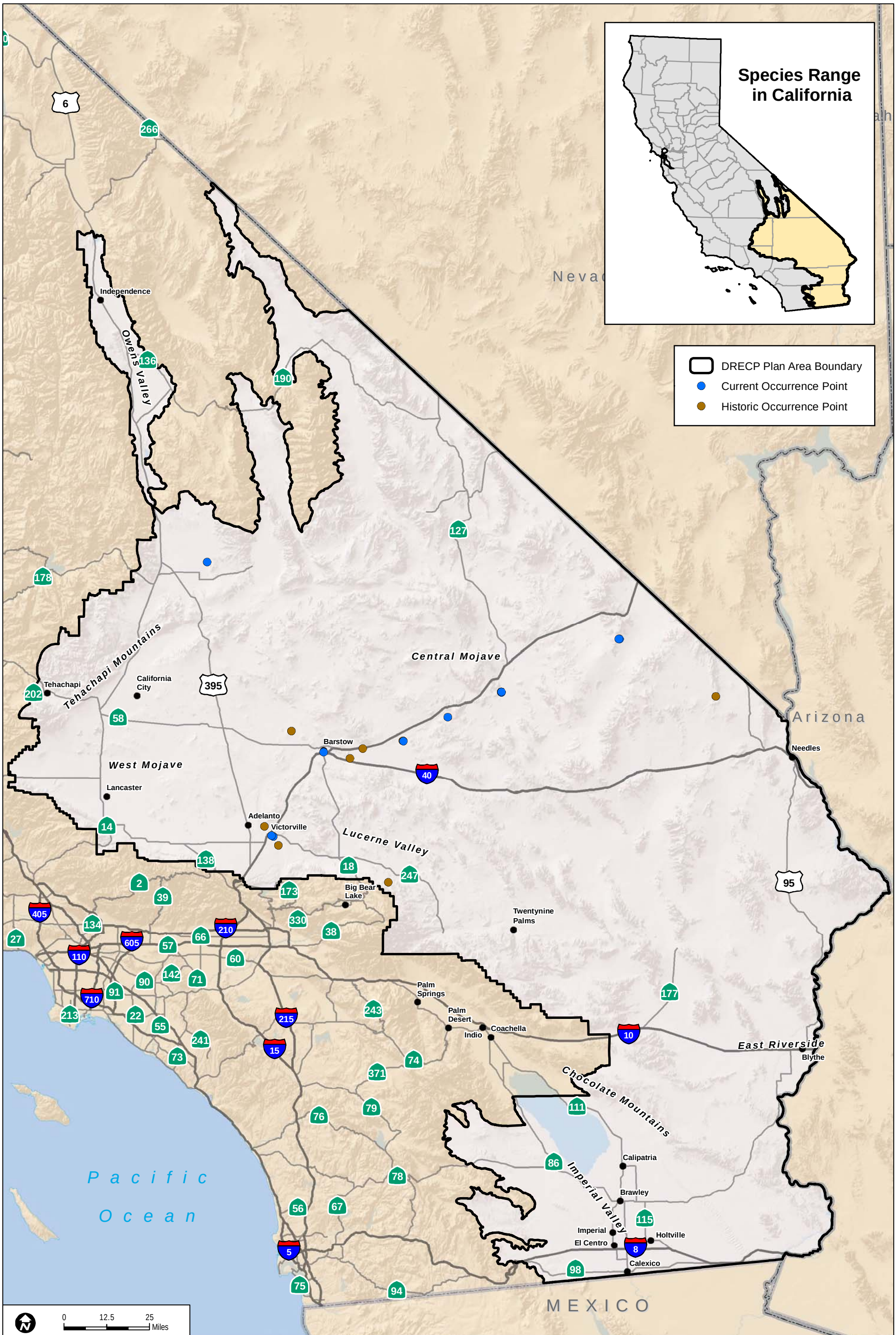

Sources: ESRI (2014); DRECP Species Occurrence Database (2013), CWHR (2008)

FIGURE SP-F02

Mohave Tui Chub Occurrences in the Plan Area