Mohave tui chub
(*Gila bicolor mohavensis = Siphaletes bicolor mohavensis*)

5-Year Review:
Summary and Evaluation

(Photograph provided by China Lake Naval Air Weapons Station)

U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
Ventura, California

January 2009

5-YEAR REVIEW
Mohave tui chub
(Gila bicolor mohavensis = Siphateles bicolor mohavensis)

I. GENERAL INFORMATION

1.A. Methodology used to complete the review:

The Ventura Fish and Wildlife Office conducted this 5-year review for the Mohave tui chub (*Gila bicolor mohavensis = Siphateles bicolor mohavensis*) with the assistance of personnel from various local, State, and Federal agencies. The effort included compiling all the published literature and reports available on the Mohave tui chub through 2007 and using information from the *Recovery Plan for the Mohave Tui Chub, Gila bicolor mohavensis* (Recovery Plan) (U.S. Fish and Wildlife Service (Service) 1984). We also contacted species experts as a source of information to update the status and threats sections of this review.

I.B. Contacts

Lead Regional or Headquarters Office: Diane Elam, Deputy Division Chief for Listing, Recovery, and Habitat Conservation Planning, and Jenness McBride, Fish and Wildlife Biologist; Region 8, Sacramento, California, 916-414-6464.

Lead Field Office: Judy Hohman, Senior Biologist, Ventura Fish and Wildlife Office, Ventura, California, 805-644-1766.

I.C. Background

I.C.1. Federal Register Notice citation announcing initiation of this review

73 FR 11945, March 5, 2008. We received no information from the public in response to this notice.

I.C.2. Listing history

Original Listing
Federal Register Notice: 35 FR 16047
Date listed: October 13, 1970
Entity listed: Subspecies; Chub, Mohave tui (*Gila bicolor mohavensis)*
Classification: Endangered

I.C.3. Associated rulemakings

The Service has not designated critical habitat for this subspecies.

I.C.4. Review History

Updated information on status and threats was included in the 1984 Recovery Plan, but no formal five-factor analysis and status recommendation were included. The California Department of Fish and Game (CDFG), in coordination with the Service and others, conducted a 5-year status report in 1990 (California Department of Fish and Game 1990). The report provided information on historic and current distribution, status of habitat, historic and current abundance, species biology, habitat requirements, and current and recommended management. The only threats that were mentioned were threats to the habitat from a local fuel spill, cattail encroachment, and possible groundwater pumping. The report recommended that endangered status be retained.

I.C.5 Species' Recovery Priority Number at start of 5-year review

The recovery priority is 6 (based on a 1-18 ranking system where 1 is the highest recovery priority and 18 is the lowest), reflecting a high degree of threat, a low potential for recovery, and a taxonomic rank of subspecies.

I.C.6 Recovery Plan or Outline

Name of plan or outline: Recovery Plan for the Mohave tui chub (*Gila bicolor mohavensis*)

Date issued: September 12, 1984

Dates of previous revisions, if applicable: Not Applicable

II. REVIEW ANALYSIS

Species Overview

Much of the information in this section is summarized from the Recovery Plan (Service 1984). The Mohave tui chub (*Gila bicolor mohavensis = Siphateles bicolor mohavensis*), a member of the minnow family (Cyprinidae) (Miller 1969), is the only fish endemic to the Mojave River in San Bernardino and Kern Counties, California (see Figure 1). It is a stocky, large-scaled fish with a small, terminal mouth. This subspecies has a dark-olive-to-bright-brown back with a silver-to-bluish-white belly. The average size of an adult is 4 to 6 inches (in) (10 to 15 centimeters (cm)) in length with the upper range reaching 9 in (23 cm). Mohave tui chubs forage on insect larvae, small fish, and detritus. Spawning season is from March or April to October. Females deposit adhesive eggs over aquatic vegetation; each female produces from 4,000 to 50,000 eggs per breeding season. Upon hatching, the fry school in shallows; chubs 1 to 3 in (2.5 to 7.6 cm)) school in water 1 to 2 in (2.5 to 5.1 cm) deep. Large chubs are found in deeper water and are typically solitary.

The Mohave tui chub is rare and had apparently been extirpated from its historical habitat, the Mojave River, when it was listed in 1970. A major cause for extirpation was competition and

possible hybridization with the arroyo chub (*Gila orcutti*), a species native to the Los Angeles Basin but introduced illegally in the Mojave River in the 1930s as a baitfish (CDFG 1990). Other causes contributing to the extirpation of the Mohave tui chub include 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 diversion; and pollution.

II.A. Application of the 1996 Distinct Population Segment (DPS) policy

II.A.1. Is the species under review a vertebrate?

__X__ Yes
_____ No

II.A.2. Is the species under review listed as a DPS?

____ Yes
__X__ No

The Mohave tui chub was listed in 1970, prior to the Service adopting the DPS policy. The Service listed the entire subspecies under the 1970 rule.

II.B Recovery Criteria

II.B.1. Does the species have a final, approved recovery plan containing objective, measurable criteria?

__X__ Yes
____ No

II.B.2. Adequacy of recovery criteria.

II.B.2.a. Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

__X__ Yes,.
____ No

II.B.2.b. Are all of the five listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

_X_ Yes
___ No

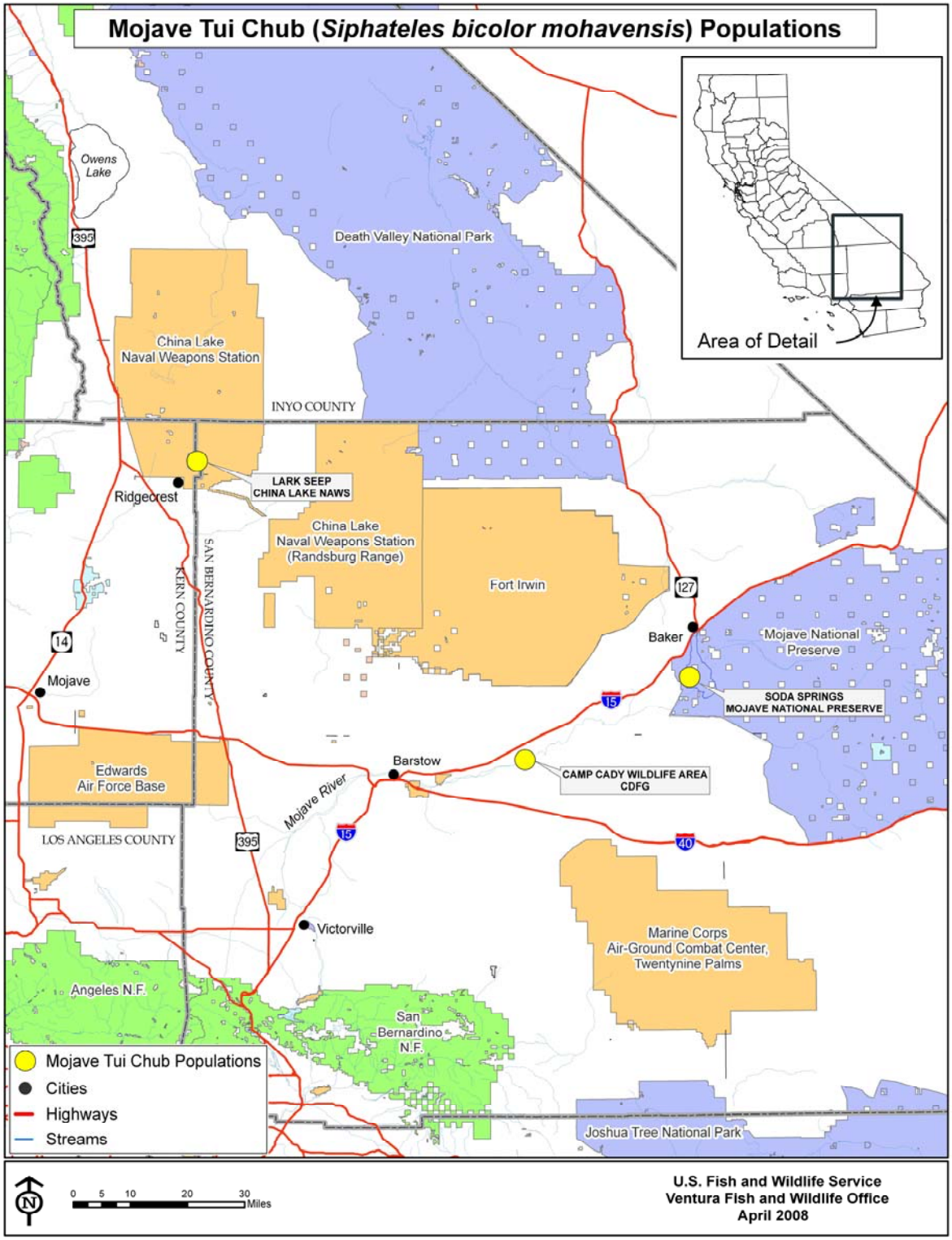

Figure 1. Map of all existing populations of Mohave tui chubs.

II.B.3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information (for threats-related recovery criteria, please note which of the five listing factors are addressed by that criterion. If any of the five listing factors are not relevant to this species, please note that here):

The primary objective of the Recovery Plan (Service 1984) is to delist the Mohave tui chub through successful establishment of viable chub populations in the majority of its historical habitat in the Mojave River. This effort requires focusing on removal of non-native faunal species that compete, hybridize with, and prey on the Mohave tui chub. The interim objective of the Recovery Plan is to downlist the chub to threatened status.

Downlisting/delisting criteria for the Mohave tui chub include:

To downlist the Mohave tui chub from endangered to threatened, the Recovery Plan states that three more populations (for a total of six) need to be established, with a minimum population of 500 fish at each location. These populations should be located adjacent to the Mojave River to be within or along the historical habitat of the Mohave tui chub. All six populations need to remain free of any threats to their integrity for 5 consecutive years and the populations should have been exposed to and survived a flood before reclassifying to threatened.

To delist the Mohave tui chub, the subspecies needs to be successfully re-established in a majority of its historical habitat in the Mojave River. Re-establishment means that the populations of Mohave tui chub are viable. Specific tasks to achieve delisting were not presented in the Recovery Plan but are to be developed pending evaluation of results on experimental reintroductions.

1. Preserve and enhance existing Mohave tui chub populations and their habitats.

This criterion addresses Factors[1] A and E.

The populations that existed at the time the Recovery Plan (Service 1984) was approved and are identified in the Recovery Plan to be preserved and enhanced are Soda Springs (Lake Tuendae, Three Bats Pond, and MC (Mohave Chub) Spring), China Lake Naval Weapons Station (Lark Seep), and the Desert Research Station.

Activities to accomplish this criterion are: a) manage and/or improve habitat through control of aquatic vegetation; b) deepen water bodies, as required; c) ensure water quality and quantity; and d) manage chub populations through conducting annual censuses and mixing populations, if necessary, to prevent genetic inbreeding.

[1]A) Present or threatened destruction, modification, or curtailment of its habitat or range;
B) Overutilization for commercial, recreational, scientific, or educational purposes;
C) Disease or predation;
D) Inadequacy of existing regulatory mechanisms;
E) Other natural or manmade factors affecting its existence.

Locations: As of December 2007, the Mohave tui chub currently exists at Soda Springs (Lake Tuendae and MC Spring), China Lake Naval Air Weapons Station, Lark Seep (North Channel, George Channel, and G1 Channel), and Camp Cady (Henkanththegedara and Stockwell 2007, S. Parmenter, California Department of Fish and Game, personal communication 2008). The Mohave tui chub has been extirpated from Three Bats Pond at Soda Springs and the Desert Research Station. Thus, since the approval of the Recovery Plan, we have lost one population of Mohave tui chub, part of another population (the Three Bats Pond subpopulation), and gained one.

- Activities: Activities implemented include control of aquatic vegetation at Lake Tuendae, MC Spring, and Lark Seep through removal of invasive cattails (*Typha latifolia* or hybrids), periodically monitoring water quality, conducting population surveys annually, studying the effects of the parasitic Asian tapeworm (*Bothriocephalus acheilognathi*) on individual and population survival, and analyzing the genetic composition of populations at existing locations. In general, aquatic vegetation control, primarily as cattail control, has resulted in larger populations of Mohave tui chubs. Mark-recapture sampling since 2003 indicates that the Mohave tui chub population at MC Spring has 255 fish (S. Parmenter, California Department of Fish and Game, personal communication 2008, Lake Tuendae has 1,318 fish (Henkanththegedara and Stockwell 2007), Camp Cady has 3,607 fish (Henkanththegedara and Stockwell 2007), and Lark Seep has 6,000 fish (Penix 2003). Research on Asian tapeworm parasitism has shown no long-term, debilitating impacts on Mohave tui chub populations (Archdeacon 2007). One researcher has also developed a safe method to purge this parasite from tui chubs (Archdeacon 2007). This method will be useful in establishing new populations of Mohave tui chubs that are free of Asian tapeworms. Genetic analysis indicates that the populations at China Lake and Soda Springs (Lake Tuendae) are heterogeneous whereas genetic drift or a loss of alleles has occurred at Soda Springs (MC Spring) and Camp Cady (Chen et al. 2007).

2. **Establish and protect Mohave tui chub populations in suitable new or restored habitats**.

This criterion addresses Factors[1] A and C.

Locations for establishing populations of Mohave tui chubs for downlisting are: Camp Cady Wildlife Area, Afton Canyon Campground Pond, and Mojave Narrows Regional Park. Populations established for delisting will be located within the mainstream Mojave River in a majority of its historical habitat, primarily the Afton Canyon and Victorville areas.

For downlisting, the actions include determining the suitability of a new site for introduction of a Mohave tui chub population; improving or constructing habitat, as needed; developing and implementing a land protection plan and land management plan; and controlling non-native species.

For delisting, the actions include re-establishing Mohave tui chub populations in the mainstream Mojave River by evaluating flood potential and effects on stream morphology; enhancing habitats; controlling non-native species; developing and implementing a management plan; monitoring transplants; and mixing populations, as necessary.

Currently, the Mohave tui chub occurs at three locations: Soda Springs (Lake Tuendae and MC Spring), Camp Cady Wildlife Area, and Lark Seep at China Lake Naval Air Weapons Station. Efforts are underway to establish new populations at the Lewis Center for Educational Research, Apple Valley Campus; Morningstar Mine pit on the Mojave National Preserve; and Coxey Pond, a tributary of the Mojave River in the San Bernardino National Forest.

Locations for downlisting: The Mohave tui chub occurs at a man-made pond at Camp Cady Wildlife Area. Although the Recovery Plan requires introduction of the subspecies at the Afton Canyon Campground Pond, we have been unable to re-locate this pond. The pond is not visible from aerial photography. It may be overgrown with cattails or may no longer exist because of sediment deposition during the 2005 high-flow event. Mohave Narrows Regional Park has perennial water but has the arroyo chub and numerous species of non-native, predatory, aquatic species including largemouth bass, bluegill (*Lepomis macrochirus*), crappie (*Pomoxis annularis*), bullfrogs, and crayfish.

Locations for delisting: The Mojave River in Afton Canyon contains little water in dry years. It has non-native arroyo chubs and bullfrogs, which compete with or prey on the Mohave tui chub. Arroyo chubs may also hybridize with Mohave tui chubs. Until we complete research to document whether Mohave tui chubs hybridize with arroyo chubs (see 3 below), any effort to re-establish Mohave tui chubs in any portion of the Mojave River would be ineffective because it may result in hybrids of chubs in the Mojave River rather than pure Mohave tui chubs. In addition, the Mojave River in the Victorville area and impoundments upstream are stocked by local agencies with non-native, predatory fish. The presence of these species in addition to bullfrogs and crayfish would make it difficult for Mohave tui chubs to survive and persist.

3. Determine Mohave tui chub life history and ecology to better manage and recover the species.

This criterion addresses Factors[1] A, C, and E.

This would be accomplished through 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.

Research has been conducted to determine the effects of cohabitating/competing with the non-native mosquitofish (*Gambusia affinis*). Results indicate that the Mohave tui chub can survive in the presence of mosquitofish, but the robustness of the individuals and the populations is adversely affected. Thus, the establishment of new populations of Mohave tui chubs would more likely succeed if mosquitofish were not present and not introduced later.

A threat to the Mohave tui chub was the introduction of the Asian tapeworm. A University of Arizona graduate student researched the effects of the Asian tapeworm on the Mohave tui chub and methods to rid the tui chub of this parasite (Archdeacon 2007). The results indicate that there is an initial adverse effect on health of individual chubs and the population, but after a few years, the percentage of individuals infected in a population declined substantially. This parasite does not appear to be a significant threat to otherwise healthy populations of Mohave tui chubs. In addition, the graduate research developed a safe, effective method to purge the Asian tapeworm from individual Mohave tui chubs (Archdeacon 2007). This research also discovered a methodology to breed Mohave tui chubs in an aquarium.

4. **Use existing regulatory methods to protect the Mohave tui chub and its habitats through enforcement of applicable laws, and evaluations of effectiveness of these laws.**

This criterion addresses Factor[1] D.

The Recovery Plan states that all activities threatening the Mohave tui chub or its habitat should be subject to law enforcement activities. The focus is on existing locations of the subspecies and includes a task to enforce all applicable State and Federal laws, evaluate their effectiveness, and if not effective, propose and enact any new laws or regulations to protect the Mohave tui chub or its habitat.

The Mohave tui chub has been a fully protected species under California Fish and Game Code since the 1960s and was listed as endangered under the California Endangered Species Act (CESA) in 1971. These designations prohibit the taking or possession of the Mohave tui chub at any time, and CDFG may not issue licenses or permits for the take of this species except for collecting for necessary scientific research or recovery. Regulatory mechanisms are further discussed in section II.C.2.d.

5. **Provide public outreach on the status of the Mohave tui chub and recovery efforts through media releases, preparation and distribution of brochures, publication of articles in popular and scientific journals, and creating and maintaining interpretive centers.**

This criterion implicitly addresses all listing factors.

The Recovery Plan notes that public awareness of the status of, and threats to, the Mohave tui chub should be improved. Through public education and outreach, we can garner increased public support to help recover the Mohave tui chub.

Although additional public outreach efforts are needed, this action has been initiated at one location. We have contacted the Desert Discovery Center in Barstow, California, to display the Mohave tui chub to visiting school groups and the public. We propose to provide information to these groups about the status of the Mohave tui chub, threats to its existence, and actions they can implement to help recover the subspecies. We recently issued a permit to the National Park Service to initiate this process with the Desert Discovery Center.

II.C. Updated Information and Current Species Status

II.C.1. Biology and Habitat

II.C.1.a. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased number of corridors, etc.) or historical range (e.g., corrections to the historical range, change in distribution of the species within its historical range, etc.):

Historically, the Mohave tui chub occurred in deep pools and sloughs of the Mojave River. Its occurrence in tributaries of the Mojave River that lacked these habitats was rare. As discussed above, the Mohave tui chub was extirpated from its original range before it was listed.

Although all existing populations are introductions outside the historical range with the exception of the MC Spring subpopulation, attempts to introduce or transplant Mohave tui chubs have generally not been successful. At the time of listing, only four populations were known to exist, Piute Creek, Two Hole Spring, and Soda Spring, San Bernardino County, California, and Paradise Spa, Las Vegas, Nevada. Piute Creek, Two Hole Spring, and Paradise Spa were introductions. In 1984, when the Recovery Plan was published, the Mohave tui chub had been introduced and persisted at Soda Springs (MC Spring, Lake Tuendae, and Three Bats Pond), and the Desert Research Station in San Bernardino County and Lark Seep in Kern County.

Since 1939, one or more attempts have been made to introduce Mohave tui chubs to the following locations: San Felipe Creek, Imperial County; Lark Seep, Kern County; South Coast Botanical Garden, Eaton Canyon Nature Center, and Busch Gardens, Los Angeles County; Dos Palmas Spring and Lake Norconian, Riverside County; Piute Creek, Two Hole Spring, Barstow Way Station, Lake Tuendae, Three Bats Pond (Soda Springs), Camp Cady, and Desert Research Station, San Bernardino County; Lion Country Safari, Orange County, California; Paradise Spa, Las Vegas,

Nevada; and Rio San Tomas, Baja California. All except for Lark Seep, Camp Cady, and Lake Tuendae were unsuccessful.

Currently there are only three populations of Mohave tui chubs, all of which are in California: Soda Springs and Camp Cady Wildlife Area in San Bernardino County, and Lark Seep at China Lake Naval Air Weapons Station, Kern County (Figure 1). All populations occur in small, man-made and/or man-maintained lacustrine habitats. Currently, the Soda Springs population has two subpopulations, MC (Mohave Chub) Spring and Lake Tuendae. Historically there was a third subpopulation, Three Bats Pond, at Soda Springs. The Camp Cady Wildlife Area population is at West Pond. Historically Camp Cady had a subpopulation at East Pond. The Lark Seep population has three subpopulations: North Channel, George Channel, and G1 Channel.

Mohave tui chubs were introduced in 1972 and 1976 at Lark Seep and in 1987 at Camp Cady. At Lake Tuendae, they were introduced after 1945 when the lake was excavated. Mohave tui chubs at MC Spring either are a relict population from the Mojave River or were introduced prior to the 1930s from the adjacent Mojave River terminus of Soda Lake. Lark Seep is a perennial body of water supplied by a wastewater treatment facility in Ridgecrest, California. The Mohave tui chubs at Camp Cady, a CDFG facility located immediately south of the Mojave River channel, are in a man-made, lined pond with water supplied by a pump. Soda Springs, a research facility located on Mojave National Preserve, has two bodies of water. Lake Tuendae is a man-made pond with a waterfall and pump to maintain water levels, and MC Spring is a small, isolated spring on the edge of Soda Lake, a dry lakebed and terminus of the Mojave River.

II.C.1.b. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.) or demographic trends:

The most recent population estimates for extant Mohave tui chub populations are:

- Soda Springs = 1,573 [Lake Tuendae = 1,318 fish(a reduction of about 50 percent from the October 2005 population estimate (Henkanththegedara and Stockwell 2007) and MC Spring = 255 fish (S. Parmenter, California Department of Fish and Game, personal communication 2008)]
- Camp Cady = 3,607 fish (Henkanththegedara and Stockwell 2007)
- Lark Seep = 6,000 fish (Penix 2003).

Genetic research has confirmed that all three populations of the Mohave tui chub are Mohave tui chubs and not hybrids (May et al. 1997) (see section II.C.1.e, below). Results of recent sampling to determine density estimates for all three populations indicate that population numbers fluctuate as much as 50 percent at Lake Tuendae but are stable at the other populations (Henkanththegedara and Stockwell 2007). No information is available on sex ratio or other demographic data.

II.C.1.d Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the ecosystem):

The Mojave River is the historical habitat of the Mohave tui chub. Currently, the Mojave River has four stretches of perennial flow, each of which can potentially support a fishery: the Mojave Narrows Regional Park area in Victorville, a limited stretch downstream from the Victor Valley wastewater treatment facility in Oro Grande, Camp Cady, and portions of Afton Canyon. Water flows are managed at two of the sites: Mojave Forks Dam supplies water to Mojave Narrows Regional Park and the wastewater treatment facility at Oro Grande releases water into the riverbed. The remainder of the Mojave River is dry except following large, winter storm events or rare, localized, intense thunderstorms. Water quality in perennial stretches of the river is variable; late summer is characterized by high water temperatures, low dissolved oxygen, low turbidity, and minimal velocities (except after localized, infrequent thunderstorms) as opposed to low water temperatures, higher dissolved oxygen, high turbidity, and higher velocities from storm events in winter.

Habitat requirements for the Mohave tui chub include configuration, ecology, and water quality (Archbold 1996).

Configuration: In lacustrine situations, the physical parameters of a pond or pool should have a minimum water depth of 4 feet (ft) (1.2 meters (m)) to reduce cattail invasion and stabilize dissolved oxygen and temperature fluctuation. Because of high evaporation rates and concentration of salts, which can be lethal to fish, fresh water flow into the pool or pond is necessary.

Ecology: Aquatic plants provide habitat for a variety of native, aquatic invertebrates, a primary food source for the Mohave tui chub. They also provide a substrate for fish egg attachment. Limited amounts of riparian or wetland vegetation are necessary to provide shade from sunlight and intense temperatures. A moderate amount of aquatic and wetland vegetation is needed to prevent excessive aerobic digestion of detritus and nocturnal plant respiration, which can produce anoxic conditions.

The Mohave tui chub is the only fish native to the Mojave River. Thus, this subspecies evolved without aquatic competitors or predators. The pool or pond should be free of excessive predation from arroyo chubs and other non-native, aquatic, faunal species.

Water Quality: Water should be free of toxic substances or the threat of toxic substance spills. Parameters such as temperature, dissolved oxygen, salinity, and pH should be within the long-term tolerable ranges for the Mohave tui chub. Mohave tui chub tolerances for certain water quality parameters range from 3 to 36 degrees C (37 to 97 degrees F) for temperature (Feldmeth et al. 1985, Archbold 1996), dissolved oxygen greater than 2 parts per million, and 40-323 milliosmols/liter for salinity (McClanahan et al. 1986). Archbold (1996) described a pH of 10 as the upper range tolerated by Mohave tui chubs.

II.C.1.e. Genetics, genetic variation, or trends in genetic variation:

Recent genetic analysis indicates that all existing populations of Mohave tui chubs (Soda Springs, Camp Cady, and Lark Seep) are genetically pure and do not show genetic evidence of hybridization with arroyo chubs (May et al. 1997). The Mohave tui chub populations at Lark Seep and the Lake Tuendae subpopulation of Soda Springs are heterogeneous, whereas genetic drift or a loss of alleles has occurred at the MC Spring subpopulation of Soda Springs and Camp Cady (S. Parmenter, CDFG, personal communication 2007).

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

Additional genetic analysis reveals that the Mohave tui chub has a distinct lineage and is a separate subspecies from its closest relative, the Lahontan lake and creek tui chubs (*Siphateles bicolor pectinifer* and *Siphateles bicolor obesa*); it is genetically least similar to arroyo chub (May et al. 1997).

II.C.1.f. Taxonomic classification or changes in nomenclature:

The Mohave tui chub has undergone a change in nomenclature. The genus has changed from *Gila* to *Siphateles*. Simons and Mayden (1998) have the most recent peer-reviewed paper addressing the classification of the North American genera of Cyprinidae. Using mitochondrial and ribosomal RNA sequences, they recognized *Gila* as a monophyletic genus (of primarily Colorado River fishes), and restored *Siphateles* from a subgenus to a full genus. The Mohave tui chub was previously recognized in the subgenus *Siphateles*. This usage was subsequently adopted by Moyle (2002), Baerwald and May (2004), Leunda (2005), and others. Additional non-peer-reviewed work by Hughson and Woo (2004), Scharpf (2005), and Garron (2002) also follow this usage. We are following the nomenclature recently used in the peer-reviewed literature and refer to the Mohave tui chub as *Siphateles bicolor mohavensis.*

Upon review and in agreement with available systematic literature and consultation with species experts, we intend to propose amending part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations to reflect the taxonomic change from *Gila bicolor mohavensis* to *Siphateles bicolor mohavensis*. This change does not alter the definition or distribution of the listed entity Mohave chub or Mohave tui chub.

II.C.2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):

The Service listed the Mohave tui chub as endangered on October 13, 1970, under the Endangered Species Conservation Act of 1969. This listing was prior to the passage of the Endangered Species Act of 1973 (Act). Section 4 of the Act established a rulemaking procedure that requires a five-factor analysis for determining whether to list a species as endangered or threatened. In 1989, the American Fisheries Society (AFS) published its list of endangered, threatened, or species of concern fishes of North America (Williams et al. 1989). The AFS identified the Mohave tui chub as endangered and identified two categories of threats: 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). Because of the magnitude of these threats the Mohave tui chub was extirpated from its historical habitat (the Mojave River), and current populations of Mohave tui chubs only exist in isolated, mostly man-made, small aquatic sites and one natural spring absent most or all of these threats.

II.C.2.a. Present or threatened destruction, modification or curtailment of its habitat or range:

Loss and degradation of aquatic habitat at historical occurrences: Historically, the Mohave tui chub was found in deep pools, slough-like habitats, and slow-moving areas of the Mojave River (Snyder 1919). The headwaters of the Mojave River are in the San Bernardino Mountains, and until recently, much of the Mojave River flowed above ground from the mountains to Victorville in the desert and beyond. Cedar Springs Dam, constructed in 1971 on the west fork of the Mojave River, impounds up to 7,600,000 cubic yards (5,810,617 cubic meters) of water and created Silverwood Lake (California Department of Water Resources 1996). The Mojave River Dam impounds up to 191,000 acre-feet (236 million cubic meters) of water on the river below the confluence of the Mojave River and Deep Creek (U.S. Army Corps of Engineers 2006). These recent structures have restricted and diverted water flow from reaching most of the desert portion of the Mojave River that historically provided habitat for the Mohave tui chub.

With damming and diverting of its water from the headwaters to near Afton Canyon, most of the Mojave River flow is now subsurface (CDFG 1990). Occasionally, during very high flows, the Mojave River reaches Soda Lake, the terminus of the Mojave River. Historically it reached Silver Lake, which is north of Soda Lake and Baker, California.

The Mojave River, its floodplain, and the regional aquifers are connected hydraulically. Overdrafting of the aquifer of the Mojave River has been ongoing for several decades (Stamos et al. 2001). The river and the aquifer system are hydraulically connected in many areas, and when one changes, the other is usually

affected (U. S. Geological Survey 2001). Because of this overdrafting, water levels in wells declined by 50 to 100 ft (15.4 to 30.8 m) from the 1940s to 1999, and correspondingly, there has been a major loss of riparian habitat (U.S. Geological Survey 2001). In the Mojave River basin, activities to dam, divert, and pump surface and ground water continue to increase to supply the demands of an ever-growing human population from the San Bernardino Mountains to the Victor Valley and Barstow. As a result, only a few perennial stretches of the river remain where Mohave tui chub could potentially be reintroduced. These areas are limited to the Mojave Narrows Regional Park area in Victorville, Camp Cady, portions of Afton Canyon, and an area of a few miles downstream from the Victor Valley wastewater treatment facility in Oro Grande. Many of these areas have shallow flows rather than pool or slough habitats where the Mohave tui chub historically occurred.

Because the Mohave tui chub evolved in a lacustrine environment, it is not adapted to flooding or high flow events with high water velocities (Hubbs and Miller 1943). Flooding can result in the loss of Mohave tui chubs and the introduction of arroyo chubs (see II.C.2.e below). As a lacustrine-adapted species, Mohave tui chubs are well adapted to tolerate cool, hypoxic conditions historically characteristic of the Mojave River but not warm, high-oxygen, shallow conditions that are now more typical (Castleberry and Cech 1986). They can tolerate high salinity (Feldmeth et al.1985, Archbold 1996) and alkaline conditions as high as a pH of 10.4 (Bureau of Land Management 1989 as cited in Archbold 1996). These environmental conditions would be expected in a lacustrine habitat in the Mojave Desert. Conversely, they are not well adapted to current stream conditions in the perennial reaches of the Mojave River.

Consequently, because of human alteration of water flows in the Mojave River and its aquifer, suitable habitat for the Mohave tui chub is now scarce.

Loss or degradation of habitat at current population locations: Presently there are three populations of Mohave tui chubs. All require regular control of cattails to provide open water for Mohave tui chubs (CDFG 1990). Without this control, the open waterways become clogged with emergent vegetation and accumulate detritus. This condition reduces water depth, elevates water temperature, and can result in severe anoxic conditions. Although Mohave tui chubs continue to exist at these locations, their continued survival depends on routine maintenance of their habitat. Three of the four ponds are man-made, therefore the water quantity and quality must be controlled and managed.

Habitat conservation needed to recover the subspecies: Beyond establishing additional populations and reducing or removing the current threats to each population, other conservation measures, such as habitat management, ecosystem restoration, monitoring, and adaptive management, are necessary to ensure the long-term sustainability of the Mohave tui chub. To delist the species, the Recovery Plan (Service 1984) calls for the re-establishment of the Mohave tui chub in the Mojave River. To accomplish this recovery task, ecosystem management of the Mojave

River is needed to reduce or remove threats from hybridization with, and predation from, non-native species. Habitat requirements of configuration and water quality need to be managed to ensure adequate, continuous reaches of suitable aquatic habitat in the Mojave River to minimize threats of climate change and genetic drift. Not all of the Mohave tui chub populations have written management plans for the subspecies. None of the populations has sufficient, guaranteed funding for systematic monitoring and adaptive management to determine habitat quality, population trends, presence of disease, or other threats that may appear but will not be detected and managed.

The Soda Springs population is located on lands managed by the Mojave National Preserve, the Camp Cady population is on lands managed by the California Department of Fish and Game, and the Lark Seep population is on lands managed by China Lake Naval Air Weapons Station. All three populations are managed by controlling human access to limit threats from direct human contact (e.g., fishing, pollution, introduction of non-native species, etc.) and periodic cattail removal. However, all three populations draw their water from artificial sources. Mohave tui chub populations at Lake Tuendae (Soda Springs) and Camp Cady depend on groundwater pumping to supply adequate quantities of water. The Lark Seep population depends on wastewater discharge from the municipal treatment plant which resurfaces downslope providing surface flows. If these man-made sources of water are altered in either quantity or quality, this could adversely affect the survival of these populations. Previously changes in water quality and quantity resulted in the loss of Mohave tui chub subpopulations at East Pond (Camp Cady) and Three Bats Pond (Soda Springs).

II.C.2.b. Overutilization for commercial, recreational, scientific, or educational purposes:

There is no information in the literature that suggests this factor is a threat to the Mohave tui chub. Therefore, overutilization for commercial, recreational, scientific, or educational purposes is not known to be a threat at this time.

II.C.2.c. Disease or predation:

Disease: The parasitic Asian tapeworm appeared in the Mohave tui chub population at Lake Tuendae at about the same time as mosquitofish (Archdeacon 2007). Asian tapeworms cause a marked enlargement of the fish's abdomen with severe hemmoragic enteritis and intestinal blockage. Initially, the Asian tapeworm had a deleterious effect on the Mohave tui chub population at Soda Springs (Lake Tuendae). In captivity, Asian tapeworms reduced the growth rate of Mohave tui chubs but not survival (Archdeacon 2007). The prevalence and intensity of infection of this parasite were both greater with warmer versus colder water temperatures. As indicated in Factor A, water depth in the few areas within the historical habitat of the Mohave tui chub that still have perennial flows is shallower than in the past resulting in higher water temperatures. Therefore, these conditions would likely further exacerbate the effect of the Asian tapeworm. Larger Mohave tui chubs are associated

with higher infection intensities and conversely smaller Mohave tui chubs are associated with lower infection intensities. Since high intensity infections might kill a small fish, this may explain why only small fish with low intensity infections may be more likely to survive. The prevalence of the Asian tapeworm in a Mohave tui chub population appears to decline within a few years after the initial infection (Archdeacon 2007).

Predation: The Mohave tui chub is the only fish native to the Mojave River (Miller 1969). Therefore, it evolved in an environment with little threat from aquatic predators.

Predation by introduced, aquatic species was one of the threats that contributed to the listing of the Mohave tui chub as endangered (Williams et al. 1989). Bullfrogs and non-native sport fish (e.g., bass, catfish, bluegills, etc.) were introduced to provide recreational fishing opportunities in the Mojave River and its impoundments. Stocking of these fish species continues by local groups. As a fish that evolved with no predation pressure, the reestablishment of the Mohave tui chub in the Mojave River is not likely to be successful until predation is reduced.

In approximately 2001, non-native mosquitofish appeared in Soda Springs (Lake Tuendae) (Hughson and Woo 2004). The origin of this introduction is unknown. Mosquitofish are native to the southeastern United States and are frequently introduced to control mosquitoes. Although it is still unclear, mosquitofish likely prey on Mohave tui chubs (Archdeacon 2007). When no cover is provided, mosquitofish are so aggressive that Mohave tui chub survival is reduced significantly (Archdeacon 2007). This suggests that mosquitofish prey on smaller chubs. Once Mohave tui chubs reach a larger size, the threat of predation by mosquitofish is likely reduced, especially when vegetated refuges are available. Conversely, under certain circumstances (e.g., limited food supply and presence of small mosquitofish) Mohave tui chubs may prey on mosquitofish (Archdeacon 2007). Ultimately, mosquitofish prey on Mohave tui chubs and compete with them for food, which threaten the Mohave tui chub.

There are no studies on the effects of avian predation on the Mohave tui chub. There have been casual observations of some bird species preying on fish in Lake Tuendae (S. Parmenter, California Department of Fish and Game, personal communication 2007). Because the Mohave tui chub and mosquitofish occur at Lake Tuendae, we are unable to say whether one or both species of fish have been taken by piscivorous birds.

II.C.2.d. Inadequacy of existing regulatory mechanisms:

The inadequacy of existing regulatory mechanisms was not identified as a threat to the Mohave tui chub at the time of listing in 1970 (see section II.C.2. above). The 1984 Recovery Plan did not identify inadequacy of existing regulatory mechanisms as a threat to the subspecies, nor did it identify any recovery tasks that would mitigate

this factor. We could find no information in the scientific literature that indicates this factor is a threat to the Mohave tui chub.

The Mohave tui chub was listed as endangered under the California Endangered Species Act (CESA) in 1971. Under CESA, the Mohave tui chub cannot be "taken" under CESA without first obtaining a permit. "Take" is defined in section 86 of the California Fish and Game Code as to "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." If the take is incidental, CDFG requires that the permit applicant fully mitigate for it. If the take is intentional or purposeful (e.g., for research purposes), the researcher must first obtain a Memorandum of Understanding (MOU) with the CDFG.

In the 1960s, the CDFG classified the Mohave tui chub as a fully protected species. A fully protected species may not be taken or possessed at any time and no licenses or permits may be issued for their take except for collecting for necessary scientific research. Hence, incidental take and purposeful take are not authorized for a fully protected species except for collecting for necessary scientific research and relocation of bird species for the protection of livestock.

The use of existing regulatory mechanisms to conserve and help recover the Mohave tui chub is ongoing. Regarding incidental take, we are unaware of any recently proposed or initiated activities that would incidentally take the Mohave tui chub with the exception of the recent introduction of mosquitofish by unknown parties at Lake Tuendae. Regarding purposeful take, the Service and the CDFG have recently issued three research permits/MOUs to individuals. One research project was to determine the effects of the Asian tapeworm on the health of the Mohave tui chub and develop a method to purge safely the tapeworm from chubs. The remaining two research projects are ongoing, one of which is to determine the effects of mosquitofish and lake clarity on the Mohave tui chub while the other is to determine if Mohave tui chubs and arroyo chubs hybridize and produce viable offspring.

Generally, military installations do not comply with the CESA by obtaining permits from the CDFG for incidental or purposeful take of State-listed species. However, military installations do comply with the Federal ESA and, in the case of China Lake Naval Air Weapons station, implement section 7(a)(1) of the ESA to utilize their authorities in the furtherance of the purposes of the ESA by carrying out programs for the conservation of federally endangered and threatened species. Therefore, the CESA is inadequate to protect the Mohave tui chub from take on military lands in California, and inadequacy of existing regulatory mechanisms is a threat to the Mohave tui chub.

II.C.2.e. Other natural or manmade factors affecting its continued existence:

The American Fisheries Society identified hybridization and competition as threats contributing to the endangered status of the Mohave tui chub (Williams et al. 1989).

Because of the high degree of isolation and small number of existing populations of this subspecies, genetic drift, competition with non-native species, climate change, and stochastic (random or unpredictable) extinction are also threats to the Mohave tui chub.

Hybridization: Hubbs and Miller reported that Mohave tui chubs hybridize with introduced arroyo chubs (Hubbs and Miller 1943, Miller 1961, Miller 1969). Native to the Los Angeles Basin, the arroyo chub was geographically isolated from the Mohave tui chub by the San Bernardino and San Gabriel Mountains. In the 1930s, it was illegally introduced to the headwater reservoirs of the Mojave River (CDFG 1990). Occasional severe downpours in the mountainous headwaters of the Mojave River can flush the entire river causing widespread change in stream conditions and aquatic organisms (Hubbs and Miller 1943). Such an event occurred in 1938 causing the Mojave River to flow from the San Bernardino Mountains north and east to Baker, California, filling Soda Lake (a playa) and overflowing into Silver Lake (a playa). This event dispersed arroyo chubs from the headwater reservoirs of the Mojave River downstream to the river's terminus. Hubbs and Miller (1943) mistakenly assumed that the arroyo chub was native to the upper reaches of the Mojave River (Moyle et al. 1985, C. Swift, Natural History Museum of Los Angeles County, personal communication 2008).

Hubbs and Miller (1943) compared several morphological characteristics of Mohave tui chubs and arroyo chubs sampled from the Mojave River. Several of the samples exhibited intermediacy in some morphological characteristics although there was no expression of intermediacy in others; They explained the non-expression of intermediacy in these cases as "heterosis" and likened the extreme development of the flesh causing a robust body and nape and high development of the fins to aquarium-produced hybrids in the Poeciliidae. Based on this circumstantial evidence, Hubbs and Miller (1943) concluded that hybridization between Mohave tui chubs and arroyo chubs had occurred in about 8 percent of the population. Mohave tui chubs, arroyo chubs, and individuals with hybrid characteristics were collected in nearly all parts of the Mojave River system (Hubbs and Miller 1943). During the 1938 flood more arroyo chubs were dispersed throughout the Mojave River, and because of their adaptation to riverine rather than lacustrine conditions, were more successful at surviving the flood flows. The one exception was at Soda Springs (MC Spring) on the edge of Soda Lake where genetically pure Mohave tui chubs remained.

Currently, Mohave tui chubs at Soda Springs remain genetically and geographically isolated from the Mojave River. All of the known stock of Mohave tui chubs in existence today emanate from Soda Springs (Service 1984). Genetically pure offspring from these chubs (May et al. 1997) are currently at locations isolated from the Mojave River, Lake Tuendae, Camp Cady, and Lark Seep. Most of these are less than 2 acres (0.8 ha) in size and are similar to zoo or captive environments. Similarly, fish sampled recently from the Mojave River are pure arroyo chubs with no indication of hybridization (May et al. 1997).

The verification of hybrids and the viability of their offspring has not been tested and confirmed through genetic analysis or scientific experimentation. Mojave National Preserve initiated a study in late 2007 in a controlled environment to determine if Mohave tui chubs will breed with arroyo chubs and if the F1 generation (the offspring produced by crossing two parental lines) can breed (D. Hughson, Mojave National Preserve, personal communication 2007; Service 2007). We do not have enough information at this time to state that hybridization with arroyo chubs is a threat.

Genetic Drift: Genetic drift is the occurrence of random changes in the gene frequencies of small isolated populations. Using 12 microsatellite loci developed by Meredith and May (2002) and Baerwald and May (2004), the genetic structure of the populations of Mohave tui chubs at Soda Springs Lake Tuendae and MC Spring), Camp Cady, and Lark Seep were characterized (Chen et al. 2007). The Mohave tui chubs at MC Spring and Camp Cady have recently shown a loss of genetic diversity (S. Parmenter, CDFG, personal communication 2007). This result is not surprising as genetic adaptation to captivity is influenced by selection intensity, genetic diversity, effective population size, and the number of generations in captivity (Frankham 2007). The Mohave tui chub has experienced decades of confinement at two small isolated sites at Soda Springs with initially a small population size. Although genetically diverse, the Mohave tui chub population at Soda Springs (Lake Tuendae) is different genetically from the population at Lark Seep (S. Parmenter, CDFG, personal communication 2007).

Competition: Competition resulting from man-caused changes in species composition and habitat in the Mojave River also threaten the Mohave tui chub. The introduced arroyo chub has replaced the Mohave tui chub in the Mojave River (Miller 1961). Humans have severely altered the water flows in the Mojave River. Historically, the Mojave River was generally deeper, with slow to moderate flow rates, cooler temperatures resulting from the greater depth and amount of shading, and occasional deep pools. Now, the river is mostly dry, but where perennial flows remain, it is shallower, with faster flow rates and higher water temperatures. The Mohave tui chub is better adapted to the former, more lacustrine conditions, while the arroyo chub is more adapted to the current, more stream-like conditions. Morphologically, the Mohave tui chub is more robust, has a wider caudal peduncle, and wide pharyngeal teeth with slight hooks and broad grinding surfaces for consuming plankton, a food source more abundant in a lake environment (Hubbs and Miller 1943). In turn, the arroyo chub is more streamlined, has a slender caudal peduncle, and strongly hooked and narrow pharyngeal teeth for consuming stream insects (Hubbs and Miller 1943). Because the introduced arroyo chub is better adapted than the Mohave tui chub to these current fluctuating water conditions and has a longer evolutionary history in fluctuating stream habitats, this adaptation has contributed to the replacement of the Mohave tui chub with the arroyo chub in the Mojave River (Castleberry and Cech 1986). This replacement of the one species for the other began in the late 1930s, when a flood washed arroyo chubs downstream from the tributaries and headwaters of the Mojave River to the lower portions of the river (Hubbs and Miller 1943, Service 1984).

Sampling for arroyo chub and Mohave tui chub before and after the 1938 flood showed that at the West Fork of the Mojave River, Deep Creek, and the Mojave River near Victorville, the arroyo chub increased in relative numbers by 78 percent while the Mohave tui chub decreased by 85 percent (Hubbs and Miller 1943). By the 1960s, Mohave tui chubs could no longer be found in the Mojave River system (Miller 1969).

The introduction of the non-native mosquitofish into Lake Tuendae at Soda Springs in the early 21st century has added the threat of a non-native fish species that competes with the Mohave tui chub for food and space (see II.C.2.c above). Mosquitofish have negative impacts on southwestern native fishes through competition and predation (Deacon et al. 1964, Courtenay and Meffe 1989). This competition is exacerbated when coupled with the presence of the parasitic Asian tapeworm (Archdeacon 2007) (see II.C.2.c above).

Climate Change: Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, Cayan et al. 2005, IPCC 2007). However, predictions of climatic conditions for smaller sub-regions such as California remain uncertain. It is unknown at this time if climate change in California will result in a warmer trend with localized drying, higher precipitation events, or other effects. Nonetheless, climate change is expected to affect hydrology in the Mojave Desert through changes in the amount and timing of precipitation supplied to the Mojave River and its aquifer (Field et al. 1999, Cayan et al. 2005, IPCC 2007). These changes include increases in precipitation extremes. The aquifer that supplies water directly to Soda Springs (MC Spring) and Afton Canyon is the source of pumped water at Soda Springs (Lake Tuendae) and Camp Cady. During extreme drought, the reductions in water levels in this aquifer, which are recharged by precipitation events, would likely decline. Water level declines in the few remaining Mohave tui chub habitats would have severe consequences to the future of the subspecies and potentially result in the reduction or loss of these habitats. The water source for MC Spring and Lake Tuendae is supplied by flow from Soda Springs, hence, Soda Springs is both the geographic name and name of the Mohave tui chub population. Soda Springs' source of water at the terminus of the Mojave River is the aquifer. The water for the Camp Cady population is pumped from the Mojave River aquifer. The demand for water in the Mojave Desert will continue to increase. In the future, as the demand for water increases and its availability decreases, a possible scenario is that water currently discharged from the wastewater treatment facility at China Lake, which created habitat for the Lark Seep population, may be recycled for reuse rather than discharged. This scenario already occurs at the facility in Long Beach and is being considered by other wastewater treatment facilities in southern California (Los Angeles County Sanitation District 2008). While we recognize that climate change is an important issue with potential effects to listed species and their habitats, we lack adequate information to make accurate predictions regarding its effects to particular regions or species at this time.

Stochastic Extinction: The Mohave tui chub occurs at three small, disjunct populations. One subpopulation (MC Spring) is a pool less than 20 ft (6.2 m) in diameter. The conservation biology literature commonly notes the vulnerability of taxa only occurring at one or a few locations (e.g., Shaffer 1981, 1987; Primack 2006; Groom et al. 2006). Such populations may be highly susceptible to extirpation due to chance events or additional environmental disturbance (Gilpin and Soule 1988, Goodman 1987), such as adverse effects from changes in hydrology or temperatures due to climate change, introduction of non-native species, failure to maintain habitat requirements at man-made locations, and others. If an extirpation event occurs in an isolated population, the opportunities for natural recolonization are reduced or impossible due to physical isolation from other populations.

II.C.2.f. Summary of threats

Threats to the Mojave tui chub at each of the three populations are listed below. All three populations are threatened by climate change and extirpation from stochastic events.

Soda Springs:

Lake Tuendae: Threats to this portion of the population in this man-made pond include predation from non-native mosquitofish, introduction of the parasitic Asian tapeworm with the mosquitofish, and habitat loss and degradation from improper maintenance of water flows and cattails.

MC Spring: Threats to this portion of the population include genetic drift and habitat loss from improper maintenance of water flows and cattails.

Camp Cady: Threats to the population in this man-made pond include genetic drift and habitat loss and degradation from improper maintenance of water flows and cattails.

Lark Seep: Threats to the population at this man-made location include habitat loss and degradation from improper maintenance of water flows and cattails.

Although the three populations of Mohave tui chubs are located on public lands that include general management plans for the lands, the long-term sustainability and viability of these populations of Mohave tui chubs is uncertain. The science of conservation biology teaches that a few isolated populations are not adequate to prevent extinction from stochastic events and will likely experience reductions in genetic diversity. Additional populations, especially populations that are interconnected, have a higher probability of both long-term survival and maintaining genetic diversity. Therefore, three isolated locations that are currently support the Mohave tui chub are insufficient to ensure the species' survival despite ongoing management at each. The Recovery Plan echoes this conclusion as it calls for

establishment of a minimum of six sustained populations each with a minimum population size of 500 to downlist the Mohave tui chub.

II.D. Synthesis

When listed as endangered in 1970, there were four populations of the Mohave tui chub (Paradise Spa, Piute Creek, Two Hole Spring, and Soda Springs). Since listing, three of these populations have failed. From the time of listing to now, 10 populations of Mohave tui chubs have been introduced at other locations, some more than once. Only two have been successful, Lark Seep and Camp Cady. Thus, despite numerous efforts to establish additional populations, the number of populations of Mohave tui chubs has declined from four to three (Soda Springs, Camp Cady , and Lark Seep) since 1970.

Threats to the Mohave tui chub were not described in the listing rule. The Recovery Plan discusses several threats to the subspecies including hybridization with the arroyo chub, habitat alteration and loss, and predation from non-native, aquatic species. Most of these threats occurred and continue to occur in the historical habitat of the Mohave tui chub, the Mojave River. One of the purposes of the Act is to provide a means whereby the ecosystems upon which endangered species depend may be conserved. The Mojave tui chub has been extirpated from the Mojave River, but in keeping with the purpose of the Act, the Recovery Plan calls for returning the Mohave tui chub to the Mojave River as a delisting criterion. All of the threats listed in the Recovery Plan, in addition to climate change and parasitism from the Asian tapeworm, are threats to the Mohave tui chub if re-established in the Mojave River. Beyond establishing additional populations and reducing or removing the current threats to each population, other conservation measures, such as habitat management, ecosystem restoration, monitoring, and adaptive management, are necessary to ensure the long-term sustainability of the Mohave tui chub.

We conclude that 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 of 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. Therefore, we recommend no status change at this time.

III. RESULTS

III.A. Recommended Classification

____ Downlist to Threatened

____ Uplist to Endangered

____ Delist (Indicate reasons for delisting per 50 CFR 424.11):

____ Extinction

____ Recovery

____ Original data for classification in error

__X__ No change is needed

III.B. New Recovery Priority Number: N/A

We recommend that the recovery priority number remain 6, reflecting a high degree of threat and a low recovery potential for this subspecies.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

The following recommendations for future actions are from the 1984 Recovery Plan and the results of discussions on the status of the subspecies and its needs with several recognized Mohave tui chub experts:

1. Continue to manage existing populations of the Mohave tui chub and their habitats. Identify possible new locations for new populations; assess their likelihood for success; and establish, manage, and monitor all populations.

2. An outreach or public education plan should be developed, implemented, and coordinated with law enforcement to promote the successful establishment of the Mohave tui chub at additional locations including the Mojave River and address ongoing threats including introduction of non-native fish species.

3. Include the Mojave River watershed in the areas for consideration for establishment of Mohave tui chub populations. This should include tributaries of the Mojave River, including Deep Creek, where the subspecies historically occurred.

4. Develop management plans for each of the existing and future introduced populations of Mohave tui chubs. Management plans would include procedures to deal with genetic drift; diseases; and standardized monitoring for population and habitat parameters such as population size, population distribution, reproduction, recruitment, unusual mortality, signs of disease or anomalies, introduction of other non-native species, habitat configuration, and water quality.

5. Conduct research to determine whether the Mohave tui chub hybridizes with the arroyo chub; if so, determine if the F1 and F2 generations are fertile or sterile.

6. Conduct research to determine under what habitat conditions the Mohave tui chub can persist in the Mojave River given the threats of hybridization, predation, and introduction of disease and parasites from non-native aquatic species.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW

Mohave Tui Chub
(Gila bicolor mohavensis = Siphateles bicolor mohavensis)

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

____ Downlist to Threatened

____ Uplist to Endangered

____ Delist

_X_ No change needed

Appropriate Listing/Reclassification Priority Number: N/A

Review Conducted By: Judy Hohman

FIELD OFFICE APPROVAL:

Field Supervisor, U.S. Fish and Wildlife Service

Approve Diane K Noda Date 1/14/09

REGIONAL OFFICE APPROVAL:

Assistant Regional Director, U.S. Fish and Wildlife Service

Approve _____ Date 2-4-09