Owens Tui Chub
(Siphateles bicolor snyderi = Gila bicolor snyderi)

5-Year Review:
Summary and Evaluation

(Photograph courtesy of Steve Parmenter, California Department of Fish and Game, Bishop, California)

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

May 19, 2009

5-YEAR REVIEW

Owens tui chub (*Siphateles bicolor snyderi = Gila bicolor snyderi*)

I. GENERAL INFORMATION

Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

Species Overview:

The information in this section on the Owens tui chub (*Siphateles bicolor snyderi = Gila bicolor snyderi*) is summarized from the *Draft Recovery Plan for the Owens tui chub, Gila bicolor snyderi* (Service 1990) (Draft Recovery Plan) and the *Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties, California* (Service 1998) (Recovery Plan), which includes the Owens tui chub. The Owens tui chub is a member of the minnow family (Cyprinidae) and is endemic to the Owens Basin, Mono and Inyo Counties, California. It is restricted currently to six isolated sites, all of which have been artificially created or altered in some fashion. The Owens tui chub prefers slow-moving water, with the presence of submerged vegetation and cover (e.g., rocks, undercut banks) (Jenkins 1990, McEwan 1990, Leunda et al. 2005). It is an opportunistic omnivore, consuming aquatic insects, vegetation, and detritus (McEwan 1991). Life expectancy is likely several years (Scoppettonne 1988), with sexual maturity reached by age 2 (McEwan 1990). Spawning occurs from late winter to early summer, usually over gravel substrate or aquatic vegetation. Females can produce large numbers of eggs (McEwan 1989), and there are multiple spawning bouts. Recent genetic analysis of several Owens tui chub populations revealed that there are two distinct lineages within the Owens tui chub, an Owens lineage and a Toikona lineage (Chen et al. 2007). Threats to the Owens tui chub include: habitat loss and alteration, predation, disease, competition, inbreeding depression, genetic drift, hybridization, population loss from stochastic events, and climate change.

Methodology Used to Complete This Review:

The Ventura Fish and Wildlife Office (VFWO) prepared this review, following the Region 8 guidance issued in March 2008. We used information from the Draft Recovery Plan and the Recovery Plan, published journal articles on the species, reports from experts who have been monitoring various populations of this species, dissertations and theses from universities, and the California Natural Diversity Database (CNDDB) maintained by the California Department of Fish and Game (CDFG). We received no information from the public in response to our *Federal Register* notice initiating this 5-year review (73 FR 11945). This 5-year review contains updated information on the species' biology and threats, and an assessment of that information compared to that known at the time of listing. We focus on current threats to the species that are attributable to the Act's five listing factors. The review synthesizes all this information to evaluate the listing status of the species and provides an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions be completed or initiated within the next 5 years.

Contact Information:

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Federal Register (FR) Notice Citation Announcing Initiation of This Review: A notice announcing initiation of the 5-year review of this taxon and the opening of a 60-day period to receive information from the public was published in the *Federal Register* on March 5, 2008 (73 FR 11945). We received no information from the public in response to this notice.

Listing History:

> **Original Listing**
> **FR Notice:** *Federal Register* Volume 50, Number 150, pp. 31592-31597
> **Date of Final Listing Rule:** August 5, 1985
> **Entity Listed:** *Gila bicolor snyderi*, a fish subspecies. The genus was changed to *Siphateles* in 1998, with the publication of genetic data for the family Cyprinidae in the western United States by Simons and Mayden (1998).
> **Classification:** Endangered
>
> **State Listing:** The Owens tui chub, *Gila bicolor snyderi*, was listed by the State of California as endangered on January 10, 1974.

Associated Rulemakings: The Service designated critical habitat for the Owens tui chub in 1985 in the *Federal Register* Volume 50, Number 150, pp. 31592-31597.

Review History: Although this is the first 5-year status review for the Owens tui chub since it was listed in 1985, updated information on status and threats was included in the 1998 Recovery Plan.

Species' Recovery Priority Number at Start of 5-Year Review: The recovery priority number for *Siphateles bicolor snyderi* is 9 according to the 2008 Recovery Data Call for the Ventura Fish and Wildlife Office, based on a 1-18 ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). This number indicates that the taxon is a subspecies that faces a moderate degree of threat and has a high potential for recovery. Based on the information obtained during the preparation of this 5-year review, we believe the recovery priority number should be changed to 3. Please see the "New Recovery Priority Number and Brief Rationale" section below for our reason for making this change.

Recovery Plan or Outline

Name of Plan or Outline: *Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties, California*
Date Issued: September 30, 1998
Dates of Previous Revisions, if applicable: There have been no revisions to this recovery plan.

II. REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) Policy

The Endangered Species Act defines "species" as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listing as distinct population segments to species of vertebrate fish or wildlife. The 1996 Policy Regarding the Recognition of Distinct Vertebrate Population Segments under the Endangered Species Act (61 FR 4722, February 7, 1996) clarifies the interpretation of the phrase "distinct population segment" for the purposes of listing, delisting, and reclassifying species under the Act.

The Owens tui chub was listed as a subspecies with no mention of a DPS. Recent genetic analyses of this subspecies and various populations suggest that the Owens tui chub could be considered a separate species. Within this possible species designation there are there are two distinct genetic lineages, the Owens lineage and the Toikona lineage. Researchers have not proposed a formal taxonomic split of these lineages until more information on meristic (counting quantitative features of fish, such as the number of fins or scales) and osteological characters are available. Each of these lineages could potentially be classified as a DPS. However, we do not believe it is crucial to the recovery of the Owens tui chub to conduct a formal DPS analysis at the present time. The Service and the CDFG are developing and implementing a management plan to ensure that both lineages are managed for and maintained.

Information on the Species and its Status

Species Biology and Life History

The Owens tui chub evolved in the Owens River watershed with only three other smaller species of fishes, Owens pupfish (*Cyprinodon radiosus*), Owens speckled dace (*Rhinichthys osculus* ssp.), and Owens sucker (*Catostomus fumeiventris).* These species are not predators of other fish species. Thus, the Owens tui chub evolved in an environment with no aquatic predators.

Little is known about the life history of the Owens tui chub. It likely has similar requirements as other subspecies of tui chubs to which it is closely related (Service 1990). As with other tui chubs, the Owens tui chub prefers water with low velocities such as portions of the Owens River, associated tributaries, springs, sloughs, drainage ditches, and irrigation canals (Service 1990), with dense aquatic vegetation for cover and habitat for insect food items (McEwan 1990).

The Owens tui chub is an opportunistic omnivore, consuming aquatic insects, vegetation, and detritus (Cooper 1978; McEwan 1990, 1991). Owens tui chubs feed mainly by gleaning and grazing among submerged vegetation. Its diet varies seasonally (McEwan 1990); the dominant items in its diet are chironomid larvae and algae in spring, chironomid larvae in summer, hydroptilid caddisflies in fall, and chironomid larvae in winter (McEwan 1990, Geologica 2003).

Life expectancy is likely several years. At Hot Creek Headwaters (see Figure 2), the age of the oldest fish captured was estimated to be at least 7 years (McEwan 1989, 1990). However, age determination for fish that occupy spring habitats with constant water temperatures is difficult because growth is relatively constant year-round, and annular marks on otoliths, scales, or bones used to determine age are either absent or unreliable (McEwan 1990).

For Owens tui chubs in springs with constant water temperature, sexual maturity is reached at 2 years of age for females and 1 year of age for males (McEwan 1989, 1990). At other sites with varied temperatures, both male and female Owens tui chubs likely become sexually mature at age 2 (McEwan 1990). Spawning occurs from late winter to early summer at spring habitats (McEwan 1990), with spawning likely triggered by day length. In riverine and lacustrine or lake-like habitats where water temperatures fluctuate seasonally, the Owens tui chub spawns in spring and early summer (McEwan 1989), with spawning triggered by warming water temperatures. Spawning usually occurs over gravel substrate or aquatic vegetation, with the eggs adhering to these features. There are multiple spawning bouts during the breeding season (Moyle 1976), and each female produces large numbers of eggs at each bout (McEwan 1989). Similar species of tui chubs produce 4,000 to 5,000 eggs per season (Service 1984). Hatching time is likely influenced by water temperature, with eggs hatching earlier in warmer water (Cooper 1978). Fry congregate in areas with cover (Moyle 1976). Growth during the first summer is rapid, with yearling fish ranging in size from 22 to 42 millimeters (mm) (0.9 to 1.8 inches (in)) (Moyle 1976).

Taxonomy and Morphology

The Owens tui chub is a member of the minnow family (Cyprinidae). Individuals range from 15 mm (0.6 in) to 180 mm (7 in) in length (Miller 1973). This fish is dusky-olive in color from

above with a gold-colored head. The sides of the body are blue and gold. The fins are olive-brown to reddish-brown. The Owens tui chub is distinguished from other tui chubs by the presence of lateral radii on the scales with a rounded or shield-shaped scale base (Miller 1973, Madoz et al. 2005). It is similar morphologically to the Mohave tui chub (*Siphateles bicolor mohavensis*), which occurs to the south of the Owens tui chub in the Mojave Desert, and the Lahontan tui chub (*Siphateles bicolor obesa*), which occurs to the north in the Walker River. The similarity of these three subspecies plus hydrographic evidence suggest that the drainages where these species currently occur were once connected, although not contemporaneously.

Distribution and Abundance

The Owens tui chub is endemic to the Owens Basin (Owens Valley, Round Valley, and Long Valley) of Inyo and Mono Counties, California (Service 1998) (see Figure 1). Historically, the Owens tui chub occurred in large numbers in suitable habitat throughout the Owens Basin, including the Owens River and associated tributaries, springs, drainage ditches, and irrigation canals. Capture efforts by researchers in the late 19th and early-to-mid 20th centuries suggest that the Owens tui chub was common in the Owens Valley floor (Gilbert 1893, Snyder 1917, Miller 1973). However, when Miller published the official scientific description of the subspecies in 1973, the population size and range of the Owens tui chub had been drastically reduced.

When listed in 1985, only two populations of Owens tui chub were believed to exist (50 FR 31592, Chen et al. 2007). One is the Hot Creek Headwaters population, which is located at the headwaters of Hot Creek above the Hot Creek Fish Hatchery (Figure 2). The site consists of two springs, AB Spring and CD Spring. The second population is in the Upper Owens Gorge located below Long Valley Dam and above the town of Bishop (Figure 2).

Subsequent to listing, a third population at Cabin Bar Ranch (owned by the Anheuser Busch Company) was discovered in 1987 (Miller 1997). The Cabin Bar Ranch population consisted of fish occupying irrigation ditches fed by a spring on the southwest shore of Owens Dry Lake (Chen 2006). Predation from introduced largemouth bass (*Micropterus salmoides*) and sunfish (*Lepomis macrochirus*) and failure to maintain adequate water quality and quantity extirpated the Cabin Bar Ranch population of Owens tui chub in 2003.

Prior to 2003, individuals from the Hot Creek Headwaters, Upper Owens Gorge, and Cabin Bar Ranch populations were translocated to establish additional populations of Owens tui chubs. Currently, the Owens tui chub is limited to six isolated sites (Figure 2): Hot Creek Headwaters (AB Spring and CD Spring), Little Hot Creek Pond, Upper Owens Gorge, Mule Spring, White Mountain Research Station (operated by the University of California), and Sotcher Lake, the last of which is outside the historical range of the species in Madera County. The populations at these six sites are genetically pure Owens tui chubs (see Genetics section). The current populations of the Owens tui chub and the origins of the fish stock from relict populations are listed in Table 1 (Conservation Management Institute 1996, Service 1998, Potter 2004, Chen et al. 2007, and Parmenter *in litt.* 2007).

The population that may have expanded its range is the Upper Owens Gorge population. Individuals thought to be Owens tui chubs were observed in the Lower Owens Gorge in 1995

Figure 1. Historical Distribution of Owens Tui Chub Populations

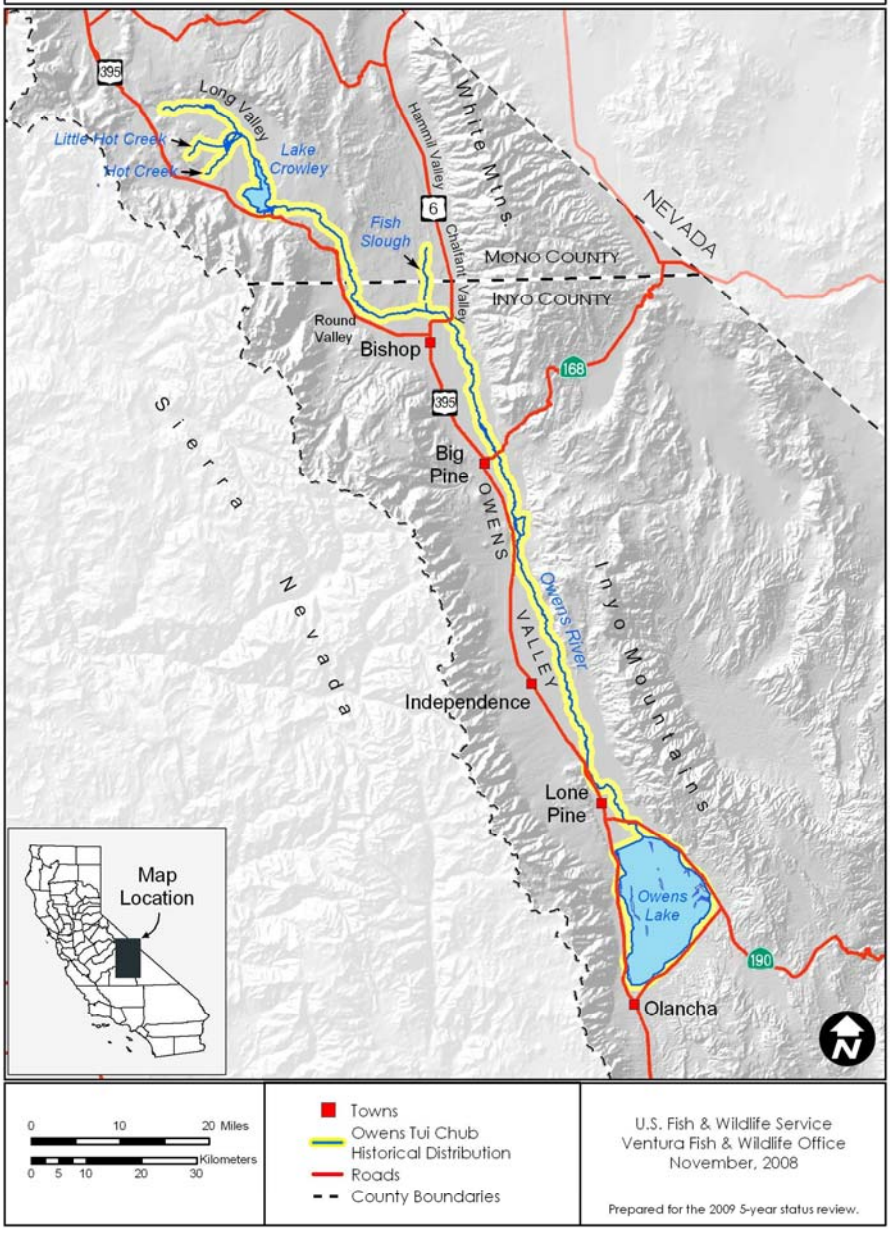


Figure 2. Current Distribution of Owens Tui Chub Populations.

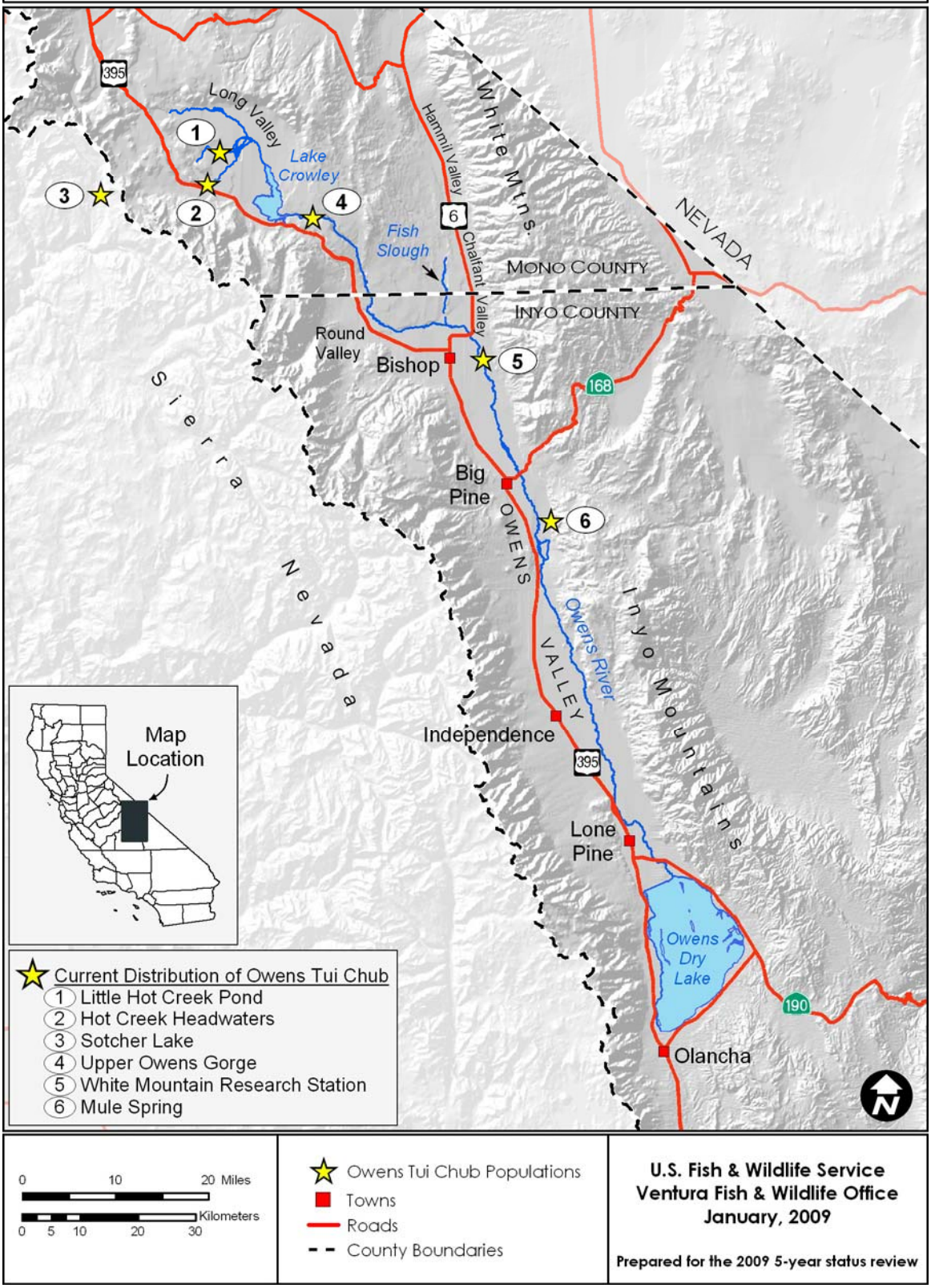


Table 1. Owens tui chub (*Siphateles bicolor snyderi*) populations at the time of listing in 1985, current populations, land ownership, and estimated population size.

Populations at the Time of Listing	Current Populations	Land Ownership	Initial Population Count and Date	Most Recent Population Count and Date
Owens Tui Chub Lineage				
Hot Creek Headwaters AB Spring CD Spring	Hot Creek Headwaters AB Spring CD Spring	LADWP[1]	 334 ± 105 (1988) 523 ± 146 (1988)	 180-245 (1999) None observed in 1998-99
	Little Hot Creek Pond	Inyo National Forest	811 transplanted (1988)	No count
Upper Owens Gorge	Upper Owens Gorge	LADWP	2818 (1989)	28 observed (1999)
	White Mountain Research Station (3 ponds)	LADWP	40 transplanted (1999)	No count
	Sotcher Lake	Inyo National Forest	No count	No count
Toikona Tui Chub Lineage				
Cabin Bar Ranch		Anheuser Busch Co.	No count	Extirpated
	Mule Spring	BLM[2]	59 transplanted (1991)	250-338 (2007) 214-305 (2008)
	White Mountain Research Station (1 pond)	LADWP	24 transplanted (1987)	No count

[1] LADWP = Los Angeles Department of Water and Power
[2] BLM = Bureau of Land Management

and 2008 in a portion of the Owens Gorge re-watered since 1992 (Fransz 1997, Hill *in litt.* 2008). However, no Owens tui chubs were captured in the Lower Owens Gorge in 1998 despite extensive trapping and electrofishing efforts (Malengo 1998). We need to conduct a genetic analysis of these fish to determine whether they are pure Owens tui chubs or hybrids.

The Hot Creek Headwaters (AB and CD Springs), Upper Owens Gorge, and White Mountain Research Station populations of the Owens tui chub are on lands owned by the Los Angeles

Department of Water and Power (LADWP). The Sotcher Lake and Little Hot Creek Pond populations are on lands managed by the Inyo National Forest, and the Mule Spring population is on land managed by the Bureau of Land Management (Chen and May 2003).

Information on Owens tui chub abundance or changes in population size is limited or unknown for these populations (Table 1), and when counts have been made, the methodologies used to estimate population size have varied (Malengo 1999, Geologica 2003, Eckland and McKee 2007, and Holmes et al. 2008). While we know that these populations currently exist, we are unable to determine whether they are increasing, decreasing, or stable. No information is available on population age structure, sex ratio, or mortality.

Habitat or Ecosystem

Much of the aquatic habitat in the Owens Valley has been eliminated or modified since the early 1900s. Water has been dammed, diverted, and transported to Los Angeles for human consumption, or is used locally for agriculture and human consumption. Of the remaining perennial aquatic habitat in the Owens Valley, much of it contains the abiotic features (e.g., water velocity, water quality, cover) needed by the Owens tui chub but not the biotic features (e.g., absence of non-native aquatic species that prey on or hybridize with Owens tui chubs) (see Five Factor Analysis, C: Disease or Predation section).

The Owens tui chub occurs in low-velocity waters with well-developed beds of aquatic vegetation, rocks, and undercut banks (Leunda et al. 2005). Jenkins (1990) observed Owens tui chubs only in the lacustrine habitats of a weir pool and beaver pond in the upper portion of the Owens Gorge. These areas had mud bottoms and aquatic vegetation. Riffle and run habitats of the Owens River in the Gorge were devoid of chubs. Vegetation is likely important to Owens tui chubs for predator avoidance, reproduction, food, and reduced water velocity (McEwan 1990, 1991, Conservation Management Institute 1996, Geologica 2003). Aquatic vegetation is especially important as it provides plant food and habitat for aquatic invertebrates, the main food item of the Owens tui chub (McEwan 1990, 1991). Water temperature is usually fairly constant at spring sites (e.g., 59 degrees Fahrenheit (°F) (15 degrees Centigrade [°C])) at Hot Creek Headwaters, but can fluctuate from 36 to 78 °F (2 to 25 °C) in a river (e.g., Owens Gorge) (Geologica 2003). The pH ranges from 6.6 to 8.9 (McEwan 1989, Geologica 2003), dissolved oxygen varies from 5 to 9.3 milligrams/liter (mg/l or parts per million (ppm)) (Malengo 1999, Geologica 2003), and alkalinity varies from 68.0 to 88.4 parts per million (McEwan 1989).

In 1997, a Memorandum of Understanding (MOU) among the litigants (LADWP and Inyo County) and interveners required LADWP to release a permanent base flow of 40 cubic feet per second in the lower Owens River. This action was accepted, and stipulated by the Superior Court of the State of California, County of Inyo. The LADWP initiated this release and in 2007, the court determined that LADWP had complied with the permanent base flow release requirement in the MOU. This release increased the availability of runs, riffles, and pools in the lower Owens River, much of which was historical habitat for the Owens tui chub. However, this increase in habitat has not benefited the Owens tui chub; rather, it has benefited the non-native largemouth bass and other non-native aquatic species (Hill *in litt*. 2008), which prey on or compete with the Owens tui chub (see Factor C: Disease or Predation and Factor E: Other

Natural or Manmade Factors Affecting Its Continued Existence sections).

We provide a description of the habitat at each of the extant populations below.

Hot Creek Headwaters (AB and CD Springs): Both springs are the headwaters for Hot Creek, a tributary of the Owens River. The habitat for the AB Spring subpopulation has four spring discharge locations among its 123-meter (m) (400-foot (ft)) long, flowing channel (McEwan 1991). The habitat for the CD Spring population has five spring discharge locations and is about 178 m (600 ft) long (McEwan 1990, 1991). Both springs are similar in width, 6.3 m (20.5 ft), and depth, 0.15 to 0.77 m (0.5 to 2.5 ft) (McEwan 1990, 1991). Both springs have a profuse growth of emergent and submergent vegetation (McEwan 1990). Rainbow trout (*Oncorhynchus mykiss*), a competitor with the Owens tui chub for food and a predator of its eggs and fry, are present.

Little Hot Creek Pond: This population occupies a man-made pond constructed by the U.S. Forest Service in 1986 to enhance waterfowl habitat. The stream channel was impounded about 0.4 kilometer (km) (0.25 mi) downstream from the thermal headsprings of Little Hot Creek (Moskowitz 1989). The pond is shallow; covered with muskgrass (*Chara* sp.), an invasive alga which provides cover for the chubs; and cattail (*Typha* sp.) is abundant. Mosquitofish (*Gambusia affinis*) are also present. Mosquitofish prey on the eggs and fry of Owens tui chubs and compete for aquatic insects.

Owens Gorge: This portion of the Owens River, which supports the Upper Owens Gorge population, is located below Crowley Lake and Long Valley Dam. The water source for the upper gorge is seepage through the Long Valley Dam. Owens tui chubs are located downstream of the dam and upstream of a weir (a low dam built across a stream to raise water level or divert water), which is 1,610 m (5232 ft) below the dam. The dam and weir function as barriers to movement of non-native fish species from Crowley Lake above the dam and the Owens River below the weir.

The aquatic habitat in the Upper Owens Gorge consists of narrow, heavily silted channels (Bogan et al. 2002). Lacustrine habitat for the chub is confined to a long pond created by a beaver dam. The banks of the pond and channel are heavily vegetated with willow (*Salix* sp.), cattail, grasses, stinging nettle (*Urtica* sp.), and wild rose (*Rosa californica*). Pondweed (*Potamogeton* sp.) is abundant along the banks (Bogan et al. 2002). Non-native fish present in the Owens Gorge include brown trout (*Salmo trutta*), which prey on Owens tui chubs, and Lahontan tui chub, which hybridize with Owens tui chubs (Malengo 1998).

White Mountain Research Station: This population is at the University of California's White Mountain Research Station, a facility leased from the LADWP near the Owens River and the town of Bishop, California. The facility includes three 18.5 by 18.5 m (60 by 60 ft) lined, square, man-made ponds and one small, unlined, rectangular, man-made pond (Parmenter *in litt*. 2007). The small ponds are fed by ground water. The square ponds have submerged tires to provide cover for fish and the rectangular pond is bordered with cottonwood trees that provide cover. Each pond has a drain at the bottom center to allow water to flow through the ponds (Bogan et al. 2002). Non-native fish are not present.

Mule Spring: This population occupies a small, 9 by 13 m (30 by 42 ft) man-made pond (Bogan et al. 2002). The spring that feeds the pond flows from a nearby old mine site. A dense stand of cattail dominates most of the pond, leaving about 30 percent open water. Muskgrass grows around the pond edge and willows grow in the channel below the pond. Non-native fish are not present, but non-native bullfrogs (*Rana catesbeiana*) are present (Bogan et al. 2002).

Sotcher Lake: This is a 26-hectare (ha) (64-acre (ac)) alpine lake located in the Upper San Joaquin River watershed of the western Sierra Nevada. The lake elevation is 2,332 m (7,651 ft). Non-native rainbow and brown trout are present. There is no additional information available about the habitat at Sotcher Lake.

Genetics

Since the time of listing and approval of the Recovery Plan, research has been conducted on the genetics of the Owens tui chub. The Owens tui chub is the most distinct of the tui chubs based on both allozymes and amplified fragment length polymorphisms (AFLP) data and could probably be considered a separate species (May 1999).

One reason the Owens tui chub was extirpated throughout most of its range was from introgression (i.e., hybridization) with the introduced Lahontan tui chub (50 FR 31594) (Chen et al. 2007). Introgression is the movement of a gene from one species into the gene pool of another species. Recent genetic analyses of various populations of presumed pure (i.e., non-introgressed) Owens tui chubs revealed that some populations were introgressed (Chen 2006). These include June Lake, Mammoth Creek, Hot Creek below the fish hatchery, Twin Lakes-Mammoth, Owens River Upper Gorge Tailbay (the area downstream of a dam where water is released into the river after passing through the turbines of a generating station), A1 Drain, C2 Ditch, and McNally Canal. Chen (2006) determined that the following populations, which were sampled in 2002, were non-introgressed Owens tui chubs:

Hot Creek Headwaters - AB Spring and CD Spring subpopulations
Little Hot Creek Pond
Owens Gorge – Upper Owens Gorge
White Mountain Research Station
Mule Spring
Sotcher Lake
Cabin Bar Ranch (extirpated after sampling)

These remaining non-introgressed populations of Owens tui chubs persist in a small number of fragmented habitats. Chen et al. (2007) compared populations of introgressed and non-introgressed Owens tui chubs based on microsatellite DNA loci (Meredith and May 2002) and genomic screening (Chen 2006). Using factorial correspondence (a statistical analysis of data), Chen et al. (2007) discovered that the differences between the Cabin Bar Ranch population and other populations of Owens tui chubs are much greater than between the recognized subspecies of *S. bicolor snyderi* and *S. bicolor obesa*. Thus, the Owens tui chubs and Cabin Bar Ranch tui chubs (translocated to Mule Spring and one pond at the White Mountains Research Station prior

to the Cabin Bar Ranch extirpation) represent distinct, independent lines of evolution in the Owens Basin (Chen 2006).

Changes in Taxonomic Classification or Nomenclature

Nomenclature: The most recent peer-reviewed paper to address the classification of the North American genera of Cyprinidae is Simons and Mayden (1998). 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 Owens tui chub was previously classified in the subgenus *Siphateles*. This usage was subsequently adopted by Smith et al. (2002), Moyle (2002), Baerwald and May (2004), Leunda et al. (2005), Chen et al. (2007), Chen et al. (2008), and others. Additional non-peer-reviewed work by Hughson and Woo (2004), Scharpf (2005), and Garron (2006) also follow this usage. Based on this recent information, we suggest a nomenclature change from *Gila bicolor snyderi*, the scientific name used in the final rule and the Recovery Plan, to *Siphateles bicolor snyderi*.

Taxonomy: Based on his genetic research (see Genetics section), Chen (2006) proposed that the Cabin Bar Ranch population is a separate lineage, the Toikona tui chub lineage, from the Owens tui chub lineage. Fish from the Cabin Bar Ranch population have been translocated and populations established at Mule Spring and the White Mountain Research Station; the Cabin Bar Ranch population has subsequently been extirpated (Parmenter *in litt.* 2008). Chen does not propose making a formal taxonomic split from the Owens tui chub until more information on meristic and osteological characters becomes available. However, this information cannot be collected at this time because, in their present small pond locations (Mule Spring and White Mountains Research Station), Toikona tui chubs do not attain sufficient body size at maturity for the indicative characters to develop fully (Miranda and Escala 2000).

Five-Factor Analysis

The following five-factor analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

The listing rule identified extensive habitat destruction and modification as threatening the Owens tui chub (50 FR 31594). These continue to be threats. Currently, most streams and rivers in the Owens Basin have been diverted and some impounded. The Owens tui chub, which used to occur throughout the Owens River and its tributaries in the Owens Basin, is restricted to six isolated populations, five of which are within the historical range of the species. Of these five populations, three (Hot Creek Headwaters, Little Hot Creek Pond, and Upper Owens Gorge) are located in small, isolated, man-altered portions of these waterways. The other two populations (Mule Spring and White Mountain Research Station) exist in man-made ponds at upland sites with water supplied by artificial methods. The occupied habitat at Hot Creek Headwaters, Little Hot Creek Pond, White Mountain Research Station, and Mule Spring is 0.8 ha (2 ac) or smaller at each site. The habitats for these five populations are threatened by water diversions, failure of

infrastructures that deliver water to these habitats, and/or emergent vegetation.

Most of the water rights in the Owens Basin are owned by the city of Los Angeles. Currently, the demand for water from the Owens Basin is high and growing as Los Angeles continues to grow. The LADWP operates and maintains dams, diversion structures, groundwater pumps, and canals to capture and convey much of the water from the Owens Basin to Los Angeles. The remaining ground water, which provides water to isolated springs and springs that are the headwaters of streams in the Owens Basin, and surface water are used extensively for agriculture and municipal purposes in the Owens Basin. These man-made changes to aquatic habitat in the Owens Basin dramatically reduced suitable aquatic habitat for the Owens tui chub. They reduced the occurrence of the Owens tui chub from a common, wide-ranging species in the Owens Basin to a rare species occurring at a few sites, representing less than 1 percent of the fish's historical range (50 FR 31594).

In addition to the increasing water demands for the greater Los Angeles area, areas adjacent to the Owens Valley (e.g., Round, Chalfant, and Hammil Valleys) are growing, and the demand for water is growing. This increased demand has resulted in an increased withdrawal of ground and surface water from the Owens Valley Groundwater Basin (see Factor D: Inadequacy of Existing Regulatory Mechanisms), which affects springs and other surface waters in the Owens Basin (Pinter and Keller 1991).

As mentioned above, two of the populations (White Mountain Research Station and Mule Spring) are confined to small, man-made ponds with artificial water sources. The survival of these two populations is dependent upon the continual maintenance of the artificial water supply and ensuring adequate water quality. When water flow is not maintained, aquatic habitat and/or water quality will likely degrade rapidly because the ponds are so small. This loss of habitat or degradation of water quality could result in the loss of a population of Owens tui chubs. This scenario almost occurred at Mule Spring when the pipe supplying water from Mule Spring to the Owens tui chub pond was plugged by calcic deposits. Fortunately, the plugged line was quickly discovered and the deposits were removed (Bogan et al. 2002). Currently, there is no routine maintenance program for this population of the Owens tui chub and its habitat.

In the upper portion of the Owens Gorge, the water gradient is mostly riffle and run habitat and is not suitable for Owens tui chubs. Water is supplied by leakage through Long Valley Dam, an earthen structure. This dam does not have outlet gates to control the release of water into the upper gorge. The only occupied or suitable habitat in the upper gorge is at a pool created by a beaver dam. The limited habitat created by the beaver dam is eroding resulting in a reduction of lacustrine habitat for Owens tui chubs (Jenkins 1990).

Habitat requirements for the Owens tui chub include aquatic submerged vegetation but not large amounts of emergent vegetation. At the spring sites (Hot Creek Headwaters, Little Hot Creek Pond, and Mule Spring), invasive emergent plants (e.g. cattail) have altered the aquatic habitat. Cattail proliferation results in deposition of large amounts of organic biomass, eventually converting aquatic habitat to upland habitat (Potter 2004). This conversion results in a loss of habitat for the Owens tui chub. In addition, dense emergent vegetation provides cover for non-native predators of Owens tui chubs, such as bullfrogs and crayfish (*Procambarus* sp.), which

enables non-native predators to thrive at these sites (see Factor C: Disease or Predation). CDFG has installed a device in the waterway between the Hot Creek Hatchery and Hot Creek Headwaters to help remove emergent vegetation. This device requires routine, manual cleaning. No structures to remove emergent vegetation occur at the other population sites. These sites rely on routine, manual clearing of emergent vegetation. At Mule Spring, cattail has been removed by hand from littoral zone or nearshore aquatic areas. Currently, there is no formal program or management plan to conduct this activity by the land management agencies.

Of the five populations within the historical range of the Owens tui chub, two (Mule Spring and White Mountain Research Station) require routine management of water quantity and water quality and three (Mule Spring, Hot Creek Headwaters, and Little Hot Creek) require routine removal of emergent vegetation. One (Upper Owens Gorge) has been severely altered by the construction of a dam, with no mechanism to manage adequate releases of water downstream of the dam; thus, there is no way to manage water quantity, water quality, and water velocity in the Upper Gorge. Given the dependency of these populations of the Owens tui chub to the routine maintenance of their habitats, the continued existence of these restricted habitats and the associated populations of Owens tui chubs are tenuous.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization for commercial, recreational, scientific, or educational purposes was not identified as a factor in the 1985 final listing rule (50 FR 31594). Since listing, only five individuals/entities, including the Service and the CDFG, have received recovery permits to take the Owens tui chub for scientific purposes (Marquez *in litt*. 2008). The permits authorized capture and release; no mortality was permitted. Thus, there has been limited use of the Owens tui chub for scientific purposes but no evidence that overutilization is a threat to the species.

There is no information in the literature that suggests that the Owens tui chub is or has been used for commercial, recreational, or educational purposes since listing in 1985. Therefore, overutilization for commercial, recreational, scientific, or educational purposes is not known to be a threat at this time or expected to be a threat in the future.

FACTOR C: Disease or Predation

Disease

The final rule listing the Owens tui chub as endangered did not identify disease as a factor (50 CFR 31594). Since listing, evidence of disease has been observed in some populations of the Owens tui chub. One Owens tui chub from Cabin Bar Ranch had 183 Asian tapeworms (*Bothriocephalus acheilognathi*) (Bogan et al. 2002). However, Bogan et al. (2002) did not find any evidence of parasites in 15 Owens tui chubs from Hot Creek Headwaters (seven from AB Spring and eight from CD Spring). Bogan et al. (2002) did find evidence of infection in six of the seven Owens tui chubs from AB Spring that were collected for genetic analysis. Five of the six had intraperitoneal fluid and hypertrophied livers, four had lesions around the anal opening, one had red eyes, and one had a curved spinal cord. Most of these symptoms are characteristic

of either bacterial or viral infections or water pollution (Bogan et al. 2002). Since disease has been identified in Owens tui chubs, it is considered a threat. However, the magnitude of this threat is unknown.

Predation

The final listing rule (50 FR 31594) identified predation by introduced non-native fish, specifically brown trout, as a major threat to the Owens tui chub. Chen and May (2003) identified predation by non-native largemouth bass and brown trout as eliminating Owens tui chubs from much of their historical range in the Owens River. These species (Table 2) are abundant in the Owens River system (Chen and May 2003). The presence of non-native aquatic predators in the Owens Basin has greatly limited the locations in which the Owens tui chub can survive and persist. Subsequent to the listing of the Owens tui chub as endangered in 1985, a new population of Owens tui chubs was established at Fish Slough (Figure 2). This population was lost within a short time due to introduction of and predation by largemouth bass (Parmenter *in litt.* 2009). The Cabin Bar Ranch population of the Owens tui chub was lost shortly after the discovery of largemouth bass and sunfish in this population (see Distribution and Abundance section).

Table 2. Occurrence of aquatic predators of the Owens tui chub at current and historical locations.

	Hot Creek Head-waters	**Little Hot Creek Pond**	**Upper Owens Gorge**	**White Mtn Research Station**	**Mule Spring**	**Sotcher Lake**	**Cabin Bar Ranch**	**Histor-ical Range**
Brown trout	X		X			X		X
Rainbow trout	X		X			X		X
Largemouth bass			X				X	X
Bluegill sunfish							X	X
Sacramento perch			X					X
Mosquito-fish		X						X
Bullfrog					X			X
Crayfish								X

Much of the recreation-based economy of the Owens Basin depends on recreational fishing, primarily for trout and largemouth bass. Because of the miles of riverine habitat and the historical and current practice of angling in the Owens Basin, it is unlikely that curtailing stocking these species would eliminate them from the Basin. Consequently, restoring the Owens tui chub to most of the Owens River or its connected tributaries is unlikely to occur.

At the Hot Creek Headwaters, predation by rainbow trout, which escape from the Hot Creek Fish Hatchery, does not seem to be a threat (McEwan 1990, 1991). Although rainbow trout eat Owens tui chub eggs, an examination of stomach contents of 109 rainbow trout in CD Spring revealed no Owens tui chub. McEwan (1990, 1991) hypothesized that this absence of evidence of predation on hatched Owens tui chubs may be due to the less piscivorous (fish-eating) nature of rainbow trout and/or the small size of the hatchery trout.

Mosquitofish are abundant at Little Hot Creek Pond. Data are not available regarding their interaction with the Owens tui chub (Moskowitz 1990). However, we do know that mosquitofish will prey on small individuals of Mohave tui chub (Archdeacon 2007).

Brown trout occur in both the upper and lower portions of the Owens Gorge (Bogan et al. 2002). In 1989, Jenkins sampled the fish population in the first 9 km (5.6 mi) of the upper portion of the Gorge downstream from Crowley Dam. Population estimates were 2,818 for the Owens tui chub, 5,961 for the Owens sucker, and 50,000 for brown trout (Jenkins 1990). The Upper Owens Gorge population receives protection from the movement of introduced brown trout upstream from the Lower Owens Gorge by a landslide and concrete weir making upstream movement unlikely (Fransz 1997). During a survey of the Lower Owens Gorge in 1998, 19 brown trout ranging in length from 65 to 120 mm (2.5 to 4.7 in) (forklength) were captured (Malengo 1998). Bogan et al. (2002) believed that the Owens tui chub did not occur in the Lower Owens Gorge; however, individuals thought to be Owens tui chubs were observed there in 2008 (Hill *in litt*. 2008). Sacramento perch (*Archoplites interruptus*), another non-native predatory species, also occur in the lower portion of the Owens Gorge.

At Mule Spring, bullfrogs are present and probably prey on Owens tui chubs. Although there is no report in the literature of direct observations of bullfrog preying on Owens tui chubs, bullfrogs prey on many species of fish, including other subspecies of tui chubs (Parmenter *in litt.* 2009).

Although avian predation on Owens tui chubs has not been observed, McEwan (1990) hypothesized that birds occasionally prey on them at Hot Creek Headwaters. Predation by black-crowned night herons (*Nycticorax nycticorax*) and great blue herons (*Ardea herodias*) on rainbow trout at the Hot Creek Fish Hatchery immediately downstream from Hot Creek Headwaters has been documented.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

The inadequacy of existing regulatory mechanisms was identified as a threat to the Owens tui chub at the time of listing in 1985 and, in the absence of the protections afforded by the Act, would continue to be a threat. The final rule noted that as a State-listed endangered species, the California Endangered Species Act (CESA) and California Fish and Game Code 2080 protected

the Owens tui chub from take. Take is defines in section 86 of the California Fish and Game Code as "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. However, CESA does not protect the species' habitat, and habitat destruction and alteration were identified as factors threatening the Owens tui chub (see Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range).

The Endangered Species Act (Act) is the primary Federal law providing protection for this species. Since its listing, the Service has analyzed the potential effects of Federal projects under section 7(a)(2), which requires Federal agencies to consult with the Service prior to authorizing, funding, or carrying out activities that may affect listed species. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its reproduction, numbers, or distribution (50 C.F.R. § 402.02). A non-jeopardy opinion may include reasonable and prudent measures that minimize the amount or extent of incidental take of listed species associated with a project. Incidental take refers to taking of listed species that results from, but is not the purpose of, carrying out an otherwise lawful activity by a Federal agency or applicant (50 C.F.R. § 402.02). In cases where some incidental take is unavoidable, the Service works with the agency to include additional conservation measures to minimize negative impacts. For projects without a Federal nexus that may take a listed species, the Service may issue incidental take permits pursuant to section 10(a)(1)(B). To qualify for an incidental take permit, applicants must develop, fund, and implement a Service-approved habitat conservation plan (HCP) that details measures to minimize and mitigate the project's adverse impacts to listed species. Regional HCPs in some areas now provide an additional layer of regulatory protection for covered species, and these HCPs are coordinated with the related Natural Communities Conservation Program, a State program.

The Recovery Plan did not identify inadequacy of existing regulatory mechanisms as a threat to the Owens tui chub; therefore, it did not identify any recovery tasks that would mitigate this factor. There is no information in the literature that suggests this factor is a direct threat to the Owens tui chub, but there is a concern about indirect effects to the Owens tui chub and its habitat from actions that are not regulated. The unregulated actions are those that may result in the overdrafting of the aquifer in the Owens Valley Groundwater Basin area, which underlies the Benton, Hammil, and Chalfant Valleys in Mono County and Round and Owens Valleys in Inyo County. Groundwater withdrawal is an activity under state jurisdiction. However, in California, groundwater withdrawal is controlled and monitored only in those areas that have been adjudicated (settled by judicial procedure). The aquifer in the Owens Basin has not been adjudicated; therefore, its use is not regulated. Without regulated groundwater use, groundwater pumping could result in reduced or no water flow to existing isolated springs and headwater springs of streams in the Owens Basin. This change would result in a reduction or loss of aquatic habitat for the Owens tui chub. For example, from the early 1900s to the 1960s, there was a 40 percent decrease in water flow from the springs at Fish Slough near Bishop (Pinter and Keller 1991). The reduction was greater than could be explained by natural, aboveground processes, such as evaporation and transpiration losses from phreatophytes (deep-rooted plants that obtain water from a permanent ground supply or from the water table). The decrease in

water flow at Fish Slough may have been related to increased groundwater pumping in the Owens Valley Groundwater Basin (Pinter and Keller 1991, MHA 2001).

The Recovery Plan identified protecting spring discharge as a recovery task for the spring-fed Conservation Areas (see Strategy of Recovery – Conservation Areas section). Springs are supplied by ground water, and the State of California is responsible for regulating ground water. However, California has not issued groundwater regulations for the Owen Valley Groundwater Basin. The Recovery Plan noted that the City of Los Angeles and Inyo County had recently agreed to manage groundwater resources to minimize the effects of groundwater pumping on Owens Valley vegetation (EIP Associates 1991). This agreement covers only the Owens Valley. It does not include areas outside the Owens Valley but within the Owens Valley Groundwater Basin, such as the Long, Chalfant, and Hammil Valleys. Long Valley was identified as a Conservation Area for downlisting and delisting the Owens tui chub. Recently, the amount of groundwater pumping in the Chalfant and Hammil Valleys for agricultural use exceeded the amount of water that was recharged by precipitation and snowmelt (MHA 2001). Ground water in the Long, Chalfant, and Hammil Valleys provides water to Owens tui chub Conservation Areas. Any reduction in flow from springs in the Owens Basin would result in further reductions of habitat quality and quantity for the Owens tui chub at springs and tributaries of the Owens River. Therefore, inadequacy of existing regulatory mechanisms is a threat at this time.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

The final listing rule identified introduction of the Lahontan tui chub and subsequent hybridization and competition as major threats to the Owens tui chub. Hybridization and competition continue to be threats; although not discussed in the listing rule, stochasticity (i.e., random events), catastrophic events, and climate change are also potential threats.

Hybridization

Until recently, the Owens tui chub and the closely related Lahontan tui chub were isolated from each other. Lahontan tui chubs were introduced as baitfish into many of the streams in the Owens Basin. This was first observed at Crowley Lake in 1973, where fishermen illegally introduced the Lahontan tui chub (Miller 1973). Since that time, hybridization between the Owens tui chub and Lahontan tui chub has been documented for populations in Mono County at Hot Creek (downstream from the hatchery), Mammoth Creek, Twin Lakes-Mammoth, June Lake, and Owens River Upper Gorge Tailbay, and in Inyo County at A1 Drain, C2 Ditch, and McNally Canal (Madoz et al. 2005, Chen 2006). At the time of listing, only three populations of genetically pure Owens tui chubs existed, while at the present time, there are six genetically pure populations (see Spatial Distribution section).

Using Lahontan tui chubs in the Owens Basin as baitfish is not allowed under fishing regulations. However, Lahontan tui chubs and hybrids are present in the Owens Basin including Crowley Lake, Hot Creek and tributaries, including Little Hot Creek, and the lower portion of the Owens Gorge (Malengo 1998, Chen 2006). If man-made barriers isolating the Owens tui chub populations at these sites are degraded or removed, this degradation/removal could result in the loss of the pure populations of Owens tui chubs at Hot Creek Headwaters, Little Hot Creek

Pond, and the Upper Owens Gorge. In addition, the opportunities to establish new populations of Owens tui chubs in the Owens Basin is limited by the presence of hybrids in the Owens River and tributaries, the historical habitat for the Owens tui chub. Currently, the only viable locations for establishing the Owens tui chub are isolated springs or the headwaters of streams with downstream barriers to upstream movement of Lahontan tui chubs or hybrids.

Competition

The final listing rule identified competition with non-native fish species as a threat to the Owens tui chub. However, little specific information on the impact of competition on the Owens tui chub is available in the literature.

Non-native insectivorous fish occur at Hot Creek Headwaters (rainbow trout) and Little Hot Creek Pond (mosquitofish) (McEwan 1989). A major part of the diets for these non-native species is the same aquatic insects consumed by Owens tui chubs. Although information is not available for rainbow trout, mosquitofish are known to affect some southwestern native fishes through competition and predation (Deacon et al. 1964, Courtenay and Meffe 1989).

Stochasticity

The creation and maintenance of small, often intensively managed, populations have prevented extinction of the Owens tui chub. Only six populations of the Owens tui chub exist, and they are isolated from each other. Species consisting of small populations, such as the Owens tui chub, are recognized as being vulnerable to extinction from stochastic (i.e., random) threats, such as demographic, genetic, and environmental stochasticity and catastrophic events (Shaffer 1981).

Demographic stochasticity refers to random variability in survival and/or reproduction among individuals within a population (Shaffer 1981). Random variability in survival or reproduction can have a significant impact on population viability for populations that are small, have low fecundity, and are short-lived. In small populations, reduced reproduction or die-offs of a certain age-class will have a significant effect on the whole population. Individuals vary naturally in their ability to produce viable offspring; for example, a particular male may be sterile or a female may produce fewer eggs than average. Although of only minor consequence to large populations, this randomly occurring variation in individuals becomes an important issue for small populations.

Currently Owens tui chub populations are small, between 100 and 10,000 individuals; therefore, random events that may cause high mortality, or decreased reproduction may have a significant effect on the viability of Owens tui chub populations. Furthermore, because the number of populations is small (six) and each is vulnerable to this threat, the risk of extinction is exacerbated.

Genetic stochasticity results from the changes in gene frequencies caused by founder effect, random fixation, or inbreeding bottlenecks (Shaffer 1981). Founder effect is the loss of genetic variation when a new population is established by a very small number of individuals. Random fixation is when some portion of loci is fixed at a selectively unfavorable allele because the

intensity of selection is insufficient to overcome random genetic drift. Random genetic drift happens when only a portion of alleles in the population is transmitted from one generation to the next, because only a fraction of all possible zygotes become breeding adults. A bottleneck is an evolutionary event in which a significant percentage of a population is killed or prevented from breeding.

In small populations, such as the Owens tui chub, these factors may reduce the amount of genetic diversity retained within populations and may increase the chance that deleterious recessive genes are expressed. Loss of diversity could limit the species' ability to adapt to environmental changes and contributes to inbreeding depression (i.e., loss of reproductive fitness and vigor). Deleterious recessive genes could reduce the viability and reproductive success of individuals. Isolation of the six remaining populations preventing any natural genetic exchange will lead to a decrease in genetic diversity.

Long-term prospects for the conservation of rare fishes depend on the availability of genetic variation within a population. This is the raw material to respond to natural selection and allow for continued evolutionary change (Meffe 1990). The remnant Toikona tui chubs descended from 24 founder fish that were relocated from Cabin Bar Ranch in 1987; their extant populations are confined to two small artificial ponds (Mule Spring and White Mountain Research Station) (Chen 2006).

Environmental stochasticity is the variation in birth and death rates from one season to the next in response to weather, disease, competition, predation, or other factors external to the population (Shaffer 1981). Drought or predation in combination with a low population year could result in extinction. The origin of the environmental stochastic event can be natural or human-caused. The Owens tui chub has experienced population loss from environmental stochastic events and will likely do so in the future. The Cabin Bar Ranch population was lost because of an apparent failure to maintain adequate water quality and quantity and the introduction of non-native predators (largemouth bass and sunfish) (Parmenter *in litt*. 2006). Owens tui chubs have also disappeared from the Owens Valley Native Fishes Sanctuary (Fish Slough). Reasons for the loss of this population are not known, but the small, isolated nature of this population likely contributed to their extirpation.

Catastrophic events are an extreme form of environmental stochasticity. Although they generally occur infrequently, catastrophic events, such as severe floods or prolonged drought, can have disastrous effects on small populations and can directly result in extinction.

All three of these factors may also act in combination. One possible scenario of how these factors in combination could increase the risk of extinction for the Owens tui chub would be the loss of one or two populations during a drought period at the same time a predator is introduced to one of the remaining populations. Although one or two of the populations may survive and be a source for future reintroductions, the resulting loss of genetic diversity would further increase the risk of extinction.

Climate change

Impacts to the Owens tui chub under predicted future climate change are unclear. However, a trend of warming in the Sierra Nevada and Inyo Mountains is expected to increase winter rainfall, decrease snowpack, hasten spring runoff, reduce summer stream flows, and reduce ground water recharge (Cayan 2008). Increased summer heat may increase the frequency and intensity of wildfires (Parmesan and Matthews 2005, Intergovernmental Panel on Climate Change 2007). Loss of upland and riparian vegetation leads to soil erosion, increased sedimentation, downcutting of waterways, loss of bank stabilization, and decreased ability of soils to hold moisture and slowly release it into nearby waterways, all of which would negatively affect Owens tui chub habitat. While it appears reasonable to assume that the species may be affected, we lack sufficient certainty regarding: the magnitude and intensity of these impacts; the timing of these effects to the species; the extent of average temperature increases in California/Nevada; or potential changes to the level of threat posed by drought, fire regime, or heavy rainfall events. The most recent literature on climate change includes predictions of hydrological changes, higher temperatures, and expansion of drought areas, which would result in a northward and/or upward elevation shift in range for many species (Intergovernmental Panel on Climate Change 2007). While northward and/or higher elevation habitats could be important factors in the future conservation of this species, currently the isolated populations of the Owens tui chub are unable to access these habitats because of other threats, including a lack of connectivity of habitats caused by physical barriers (e.g., dams and diversion structures); habitat destruction and alteration; and predation, competition, and hybridization with introduced species. We have no knowledge of more detailed climate change information specifically for the range of the Owens tui chub.

III. RECOVERY CRITERIA

Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, over all, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was issued may provide better ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, follow fully the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

The Recovery Plan describes the recovery criteria for the Owens tui chub. Although the five factors are not mentioned specifically, the Recovery Plan addressed factors A, C, and E. Listing

factors B and D were not identified specifically as threats to the species at the time the Recovery Plan was prepared.

The Recovery Plan states that the Owens tui chub will be considered for downlisting to threatened status when the following goals have been achieved:

1. Reproducing and self-sustaining populations of the Owens tui chub must exist throughout six Conservation Areas. Two of the Conservation Areas must be in the Long Valley and four in the Owens Valley. The Conservation Areas are Little Hot Creek, Hot Creek, Fish Slough, Round Valley, Warm Springs, Blackrock, and Southern Owens (see Figure 3).

   This criterion addresses Factors A and E.

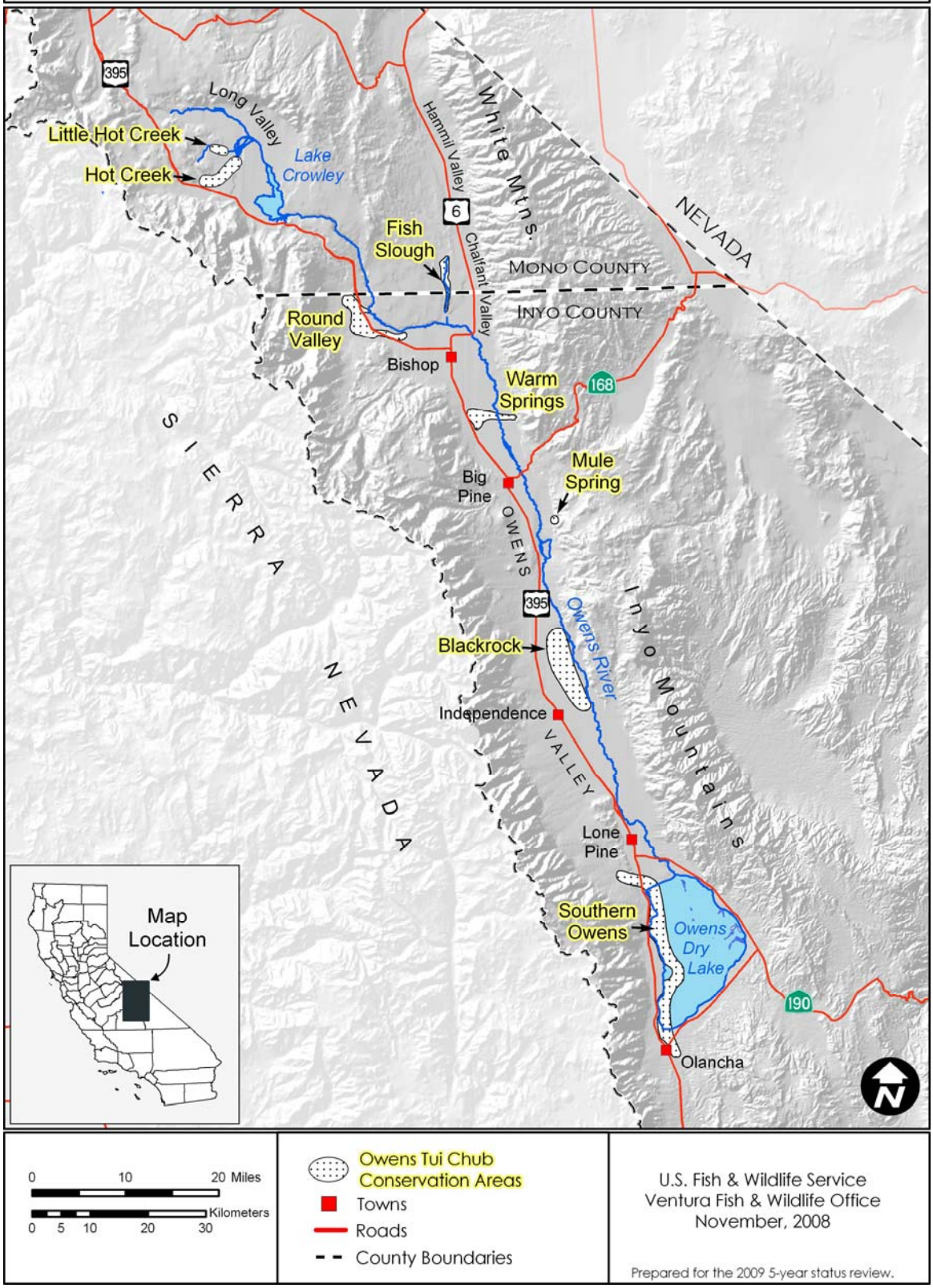
   The concept behind the Conservation Area approach is that the past approach of managed refuges that are wholly or partially isolated from non-native fish and severe habitat alteration has successfully averted extinction of the species, but the populations continue to experience extirpation or deleterious effects from demographic, genetic, and environmental stochasticity. Consequently, reliance on small, isolated refuges cannot accomplish recovery of the Owens tui chub (Service 1998). Instead, the Recovery Plan focuses on protection and management of Conservation Areas, which are landscape units that include habitat for the Owens tui chub and sufficient buffers to maintain ecological and geological processes necessary to protect aquatic ecosystems. They were selected because the impacts of existing land and water uses are minimal and chances for recovery of the Owens tui chub are greatest. If population abundance can be increased and if new populations can be established, the amount of stochasticity from inbreeding depression, genetic drift, and other sources will decrease, allowing for more genetic variation and preventing the loss of alleles (Holmes et al. 2008).

   When the Recovery Plan was approved, the Owens tui chub occurred at Hot Creek Headwaters, Little Hot Creek Pond, Upper Owens Gorge, White Mountain Research Station, Sotcher Lake, Cabin Bar Ranch, and Mule Spring. Recent surveys found that the Owens tui chub has been extirpated from Cabin Bar Ranch. Sotcher Lake is outside the historical range of the Owens tui chub and is not within the Owen Basin hydrologic unit. No introductions have occurred at Fish Slough, Round Valley, Warm Springs, Blackrock, or Southern Owens. There are no plans to establish new populations of Owens tui chubs at any of these sites. Since the approval of the Recovery Plan in 1998, one population of the Owens tui chub has been established and one has been lost. Reproducing and self-sustaining populations do not exist within the six Conservation Areas. Therefore, criterion 1 has not been achieved.

2. Threats must be controlled.

   This criterion addresses Factors A, C and E. Threats to the Owens tui chub under Factors A, C and E are described in the Recovery Plan and are still present. Since release of the Recovery Plan, the threat to the Owens tui chub from overutilization of ground water in the

Figure 3. Conservation Areas identified for Owens tui chub downlisting and delisting in the 1998 Owens Basin Wetland and Aquatic Species Recovery Plan, Inyo and Mono Counties, California.



valleys adjacent to the Owens Valley (Long, Chalfant, and Hammil Valleys), which reduces spring flow and habitat for the Owens tui chub, has been identified. Because threats to the Owens tui chub under Factors A, C and E continue to occur and no efforts have been implemented to control these threats, criterion 2 has not been achieved.

3. Each Conservation Area must have an approved management plan and implementing agreement with the landowner and the Service.

   This criterion addresses Factors C and E.

   None of the six existing populations of Owens tui chubs has approved management plans or implementing agreements between the Service and the landowners, and therefore this criterion has not been achieved.

4. Successful establishment of populations includes presence of juveniles and three additional age classes of Owens tui chubs.

   This criterion addresses Factors C and E.

   Surveys of population demographics for the Owens tui chub since approval of the Recovery Plan have been implemented for only one of the six populations. Therefore, data are not available to assess whether criterion 4 has been achieved.

5. Ensure that hybrid tui chubs do not occur in the Conservation Areas.

   This criterion addresses Factor E.

   Genetic analysis of 23 populations has been completed and has identified eight introgressed populations of Owen tui chubs (Chen and May 2003). These populations were at Hot Creek (including Little Hot Creek), Mammoth Creek, Twin Lakes near Mammoth, June Lake, and the Upper Gorge Tailbay in Mono County, and A1 Drain, C2 Ditch, and McNally Canal in Inyo County. Because none of these hybrid populations have been eliminated and efforts to prevent future introductions of hybrids and non-native Lahontan tui chubs to non-introgressed populations have not been implemented, criterion 5 has not been achieved.

6. The biomass of the Owens tui chub must exceed the biomass of deleterious, non-native fish species at each site.

   This criterion addresses Factor C.

   This criterion has been addressed where current populations of Owens tui chubs occur. However, populations must occur in the six Conservation Areas before the species may be considered for downlisting . Currently, populations occur in the Little Hot Creek and Hot Creek Conservation Areas. Therefore, criterion 6 has not been achieved.

The Owens tui chub can be considered for delisting when all of the following goals have been achieved:

1. Reproducing and self-sustaining populations of the Owens tui chub must exist throughout seven Conservation Areas for 5 consecutive years. Two of the Conservation Areas must be in the Long Valley and five in the Owens Valley. The Conservation Areas are Little Hot Creek, Hot Creek, Fish Slough, Round Valley, Warm Springs, Blackrock, and Southern Owens.

   This criterion addresses Factors A and E.

   Criterion 1 for downlisting has not been achieved yet (see downlisting above); therefore, this criterion for delisting has not been achieved.

2. Threats must be controlled.

   This criterion addresses Factors A, C and E. Threats to the Owens tui chub under Factors A, C and E are described in the Recovery Plan. Since release of the Recovery Plan, the threat to the Owens tui chub from overutilization of ground water, which reduces spring flow and habitat for the Owens tui chub, has been identified.

   Criterion 2 for downlisting has not been achieved yet (see downlisting above); therefore, this criterion for delisting has not been achieved.

3. Each Conservation Area must have an approved management plan and implementing agreement with the landowner and the Service.

   This criterion addresses Factors C and E.

   Criterion 3 for downlisting has not been achieved yet (see downlisting above); therefore, this criterion for delisting has not been achieved.

4. Successful establishment of populations includes presence of juvenile and three additional age classes of Owens tui chubs.

   This criterion addresses Factors C and E.

   Data are not available to assess whether Criterion 4 for downlisting has been achieved (see downlisting above); therefore, this criterion for delisting has not been achieved.

5. Ensure that hybrid tui chubs do not occur in the Conservation Areas.

   This criterion addresses Factor E.

   Criterion 5 for downlisting has not been achieved yet (see downlisting above); therefore, this criterion for delisting has not been achieved.

6. The biomass of the Owens tui chub must exceed the biomass of deleterious non-native fish species at each site.

   This criterion addresses Factor C.

   Criterion 6 for downlisting has not been achieved yet (see downlisting above); therefore, this criterion for delisting has not been achieved.

In summary, for the Owens tui chub to meet the downlisting or delisting criteria in the Recovery Plan, the following recovery tasks must be successfully implemented:

- establish multiple, self-sustaining populations of Owens tui chubs throughout much of the historical range of the species in identified Conservation Areas;
- ensure these populations are self-sustaining;
- ensure that each population contains juvenile and three additional age classes and that the biomass of Owens tui chubs exceed the biomass of deleterious, non-native aquatic predatory species, which would demonstrate successful recruitment and minimal predation on smaller Owens tui chubs by non-native aquatic species;
- reduce competition with non-native aquatic species;
- increase the ability to conserve and protect aquatic habitats;
- implement measures to prevent hybridization with introduced Lahontan tui chubs;
- to the extent possible, reduce the probability of the loss of Owens tui chub populations from stochastic events; and
- complete an approved management plan and implementing agreement that address water quantity and groundwater management with the land managers.

These Recovery Plan criteria do not address threats from disease; catastrophic events that may affect the Owens Basin; demographic, genetic, or environmental stochasticity; or climate change to the Owens tui chub. The Recovery Plan identifies no recovery criteria for the Toikona lineage, as the occurrence of this lineage was unknown when the Recovery Plan was approved.

IV. SYNTHESIS

When the Owens tui chub was first described in 1973, most of the habitat for the species had been altered or destroyed. At the time of listing in 1985, the Owens tui chub was on the edge of extinction; only the Hot Creek Headwaters, Upper Owens Gorge, and Cabin Bar Ranch populations existed, which made up about 1 percent of the species' original range (Service 1985). These three populations were isolated from each other, and the habitat between them had been destroyed or altered to such a degree that there was no possibility of genetic interchange between them.

Since its listing in 1985, new populations of Owens tui chubs have been established, bringing the current number to six. Four of these populations are in small, man-made or man-altered waters and one is outside the historical range of the species at an artificial lake (Sotcher Lake). All are isolated from each other.

The threats to the Owens tui chub that resulted in listing continue to threaten the species with extinction. They include the potential for further destruction and alteration of a greatly reduced habitat, predation by non-native aquatic species, inadequacy of existing laws and regulations to conserve and protect the remaining habitat for the species, and hybridization with introduced Lahontan tui chubs. Additional threats that were not described in the listing rule include demographic, genetic, and environmental stochasticity, catastrophic events, and climate change.

The success of the existing populations and establishing new populations, as recommended in the Recovery Plan for downlisting and delisting, is not likely for the long term unless the major threats are eliminated or reduced for these populations and new populations are established. The LADWP is the major land manager in the Owens Basin. With the CDFG and Service, they are developing a habitat conservation plan for the Owens tui chub that includes better management of populations on their lands and the creation of new aquatic habitats suitable for establishing new populations of the Owens tui chub. The LADWP's commitment to these actions makes the potential for recovery of this species high. Until LADWP implements these actions in the habitat conservation plan, the threats to the Owens tui chub remain. Therefore, we recommend that the endangered status of the Owens tui chub remain unchanged.

V. RESULTS

Recommended Listing Action:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (indicate reason for delisting according to 50 CFR 424.11):
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
__✓__ No Change

New Recovery Priority Number and Brief Rationale: We recommend that the recovery priority number be changed to 3. This number indicates that the taxon is a subspecies that faces a high degree of threat and has a high potential for recovery. The threats that were present when the Owens tui chub was listed are still present with new threats identified. Although the number of populations of Owens tui chubs has increased from three at the time of listing to six, there are now two distinct genetic lineages to consider. The major land manager in the Owens Valley (LADWP) is cooperating in the development and implementation of plans to establish and manage new populations of both lineages of Owens tui chub.

Listing and Reclassification Priority Number and Brief Rationale: No change needed

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

Develop management plans and implementation agreements for all existing and new populations. Implement population monitoring and adaptive management.

Establish and secure additional populations of the Toikona lineage of Owens tui chubs. Increasing the number of populations and the size of each population of the Toikona lineage will conserve the genetic distinctiveness of this evolutionary lineage, maintain the genetic variation, and prevent the loss of alleles. Recommended sites include but are not limited to the Cartago Springs Wildlife Management Area and the private duck club pond near Dirty Socks.

Establish new populations of the Owens lineage. Recommended locations include but are not limited to the Owens Valley Native Fish Sanctuary.

Improve habitat for existing populations at Little Hot Creek Pond, Owens Gorge, and Mule Spring. This improvement includes but is not limited to management/removal of non-native aquatic floral and faunal species. For the Upper Owens Gorge population, increase the availability of lacustrine habitat and provide for adequate water quality and quantity throughout the year.

Remove non-native aquatic species.

Conduct additional research to gain a better understanding of the origin, genetics, and ecophysiology of the Toikona lineage of the Owens tui chub. This information will help determine the best ways to conserve the unique attributes of this lineage.

Develop and implement an education and outreach program for residents of, and visitors to, the Owens and Mono Basins. The program would focus on the importance of conserving the native fish species including the Owens tui chub and the deleterious effects of non-native predatory fish species. It would involve residents and visitors, adults and children, in ways they can help conserve the Owens tui chub.

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

Owens tui chub (*Siphateles bicolor snyderi)*

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
✓ No change needed

Review Conducted By: Judy Hohman

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve Diane L. Noda Date 5/28/09