U.S. Fish & Wildlife Service

Draft Recovery Plan for the Santa Ana Sucker

(Catostomus santaanae)

Photo courtesy of USFWS/Christine Medak and Kai Palenscar

Draft Recovery Plan for Santa Ana Sucker

(*Catostomus santaanae*)

Region 8
U.S. Fish and Wildlife Service
Sacramento, California

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Regional Director, Pacific Southwest Region, Region 8,
U.S. Fish and Wildlife Service

Date: XXXXXXXXXXXXXXXXXX

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Carlsbad, CA 92008
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Acknowledgements

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We also thank our partners who have played an active role in Santa Ana sucker conservation. Numerous agencies provided information through surveys and research, and helped to restore habitat and implement recovery actions. Their support over the years has contributed to a better understanding of this species, which has subsequently helped to develop a draft Recovery Plan. We appreciate these efforts and look forward to continued cooperation with our external partners as we continue to refine methodologies and implement actions that support recovery of the Santa Ana sucker.

EXECUTIVE SUMMARY

Current Species Status

The Santa Ana sucker (*Catostomus santaanae*) is one of only a few native fishes currently extant in southern California. It is listed as a threatened species under the Endangered Species Act of 1973, as amended (Act) (USFWS 2000); its range is restricted to the Los Angeles, San Gabriel, and Sana Ana River Basins. Critical habitat was designated for this species on December 14, 2010 (USFWS 2010).

Threats

The primary threat to Santa Ana sucker is ongoing, rangewide hydrological modifications which lead to degradation and loss of habitat. Additionally, isolation by impassable barriers or unsuitable habitat limits gene flow within the watershed, thus increasing the vulnerability of small occurrences to a range of stochastic (random) factors.

Recovery Strategy

Due to the rangewide, large-scale hydrological modifications, the most pressing threat to the species is the lack of suitable habitat necessary to increase population resiliency (ensure a large enough population to withstand stochastic events) and redundancy (a sufficient number of populations to ensure the species can withstand catastrophic events). Therefore, the highest priority for the recovery of Santa Ana sucker is implementation of management actions to restore and improve habitat conditions throughout the current range of the species. These actions include initiating studies that will lead to a thorough understanding of the implications of past and current hydrological modifications throughout the range of the species; controlling nonnative species; minimizing recreation pressures; improving water quality; employing adaptive management techniques to address the uncertainties of global climate change; and involving stakeholders and partners in all applicable conservation and management actions.

Given the substantial reduction in the range of the species, the currently occupied areas, particularly in the Santa Ana River watershed, will likely not be sufficient to provide the resiliency and redundancy necessary for recovery. Additionally, representation (maintaining the breadth of the genetic makeup to conserve the adaptive ability of the species) is a concern due to the small population size within each watershed. To reduce the risk of extirpation, while determining appropriate actions to manage threats within the current range, areas not currently accessible to the fish should be assessed for potential reintroduction. Increasing the extent of occupied habitat will improve the representation, resiliency, and redundancy of Santa Ana sucker, thereby improving the status of the species.

The long term viability of the Santa Ana sucker will require maintenance of genetic variability through protection and preservation of historical population and habitat distributions. Healthy viable populations within each of three defined Recovery Units (RU): Santa Ana River RU; Los Angeles River RU; San Gabriel River RU will be necessary to recover the species.

Recovery Goal and Objectives

The goal of this recovery plan is to control or reduce threats to Santa Ana sucker to the extent that it no longer requires protections afforded by the Act and therefore, warrants delisting.

Based on the recovery strategy and current threats to the species the following objectives are identified. Work with landowners and other stakeholders to:

1. Develop and implement a rangewide monitoring protocol to accurately and consistently document populations, occupied habitat, and threats.
2. Conduct research projects specifically designed to inform management actions and recovery.
3. Increase the abundance and develop a more even distribution of Santa Ana sucker within its current range by reducing threats to the species and its habitat.
4. Expand the range of the Santa Ana sucker by restoring habitat (if needed), and reestablishing occurrences within its historical range.

Delisting Criteria

Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range
A.1 Adequate amounts of suitable habitat are restored, protected, and managed within each recovery unit to support viable populations (see Recovery Criteria E.3) of all life stages of Santa Ana sucker and provide resiliency and redundancy to protect against catastrophic events throughout the current range of the species.

Factor C: Predation
C.1 Management is implemented to reduce competition and predation by nonnative species to levels determined to be necessary for the maintenance of viable Santa Ana sucker populations.

Factor E: Other natural or manmade factors affecting its continued existence
E.1 The current range of the species is expanded through modification or removal of existing barriers, restoration of suitable habitat, and/or reintroduction of the species to areas within its historical range in a configuration that ensures reasonable certainty the remaining genetic makeup of the species has been preserved and can withstand catastrophic events in the watershed.

E.2. Occupied areas of each RU are genetically connected, through natural processes or management, to ensure population viability and genetic exchange.

E.3 Stable or increasing population averaged over 15 years within the Santa Ana River, Los Angeles River, and San Gabriel River Recovery Units, as defined below in the Recovery Program.

E.4 A long-term monitoring and management plan is in place to evaluate the effectiveness of management actions to address ongoing threats and to identify new threats which may require implementation of adaptive management actions.

Estimated Date and Cost of Recovery:
Date: 2040
Cost: $4,205,000 + TBD

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I. BACKGROUND

We, the U.S. Fish and Wildlife Service (Service), listed the Santa Ana sucker (*Catostomus santaanae*) as threatened in southern California, in the Los Angeles, San Gabriel, and Sana Ana River Basins on April 12, 2000 (USFWS 2000), under the Endangered Species Act of 1973 (Act), as amended. Critical habitat was designated for this species on December 14, 2010 (USFWS 2010). A threats assessment and review of the biological status was conducted in a 5-year status review for the species in 2011 (USFWS 2011). Santa Ana sucker is assigned a Recovery Priority Number of 5C, which indicates the species faces a high degree of threat, has a low potential for recovery, and has taxonomic status as a species (USFWS 1983a; 1983b). The "C" indicates conflict with construction or other development projects or other forms of economic activity. Additionally, a recovery outline for Santa Ana sucker was approved on March 30, 2012 (USFWS 2012).

Santa Ana suckers are one of only a few native fishes currently extant in southern California and their distribution has been reduced in the three watersheds where they occur. The primary threat to Santa Ana sucker is habitat loss, degradation, and modification through hydrological modifications rangewide. Additionally, isolation by impassable barriers or unsuitable habitat limits gene flow within and between watersheds, thus increasing the vulnerability of small occurrences to a range of environmental and genetic stochastic factors.

Recovery plans focus on restoring the ecosystems on which a species is dependent or reducing threats to the species. Recovery plans constitute an important Service document that serves as a logical path to recovery of the species based on what we know about the species' biology and life history, and threats to the species. Recovery plans help to provide guidance to the Service, States, and other partners on methods of minimizing threats to listed species and measurable objectives against which to measure progress towards recovery. Recovery plans are advisory documents, not regulatory documents, and cannot substitute for the determinations and promulgation of regulations required under section 4(a)(1) of the Act. A decision to revise the status of, or remove a species from the Federal List of Endangered and Threatened Wildlife (50 CFR 17.11) is ultimately based on an analysis of the best scientific and commercial data available, regardless of whether that information differs from the recovery plan.

The following discussion summarizes characteristics of Santa Ana sucker biology, demography and distribution, population status, and threats that are relevant to recovery. Additional information is available in the critical habitat rule, 5-year review, and recovery outline for the species (USFWS 2010; USFWS 2011; USFWS 2012), and associated literature.

A. Species Description and Taxonomy

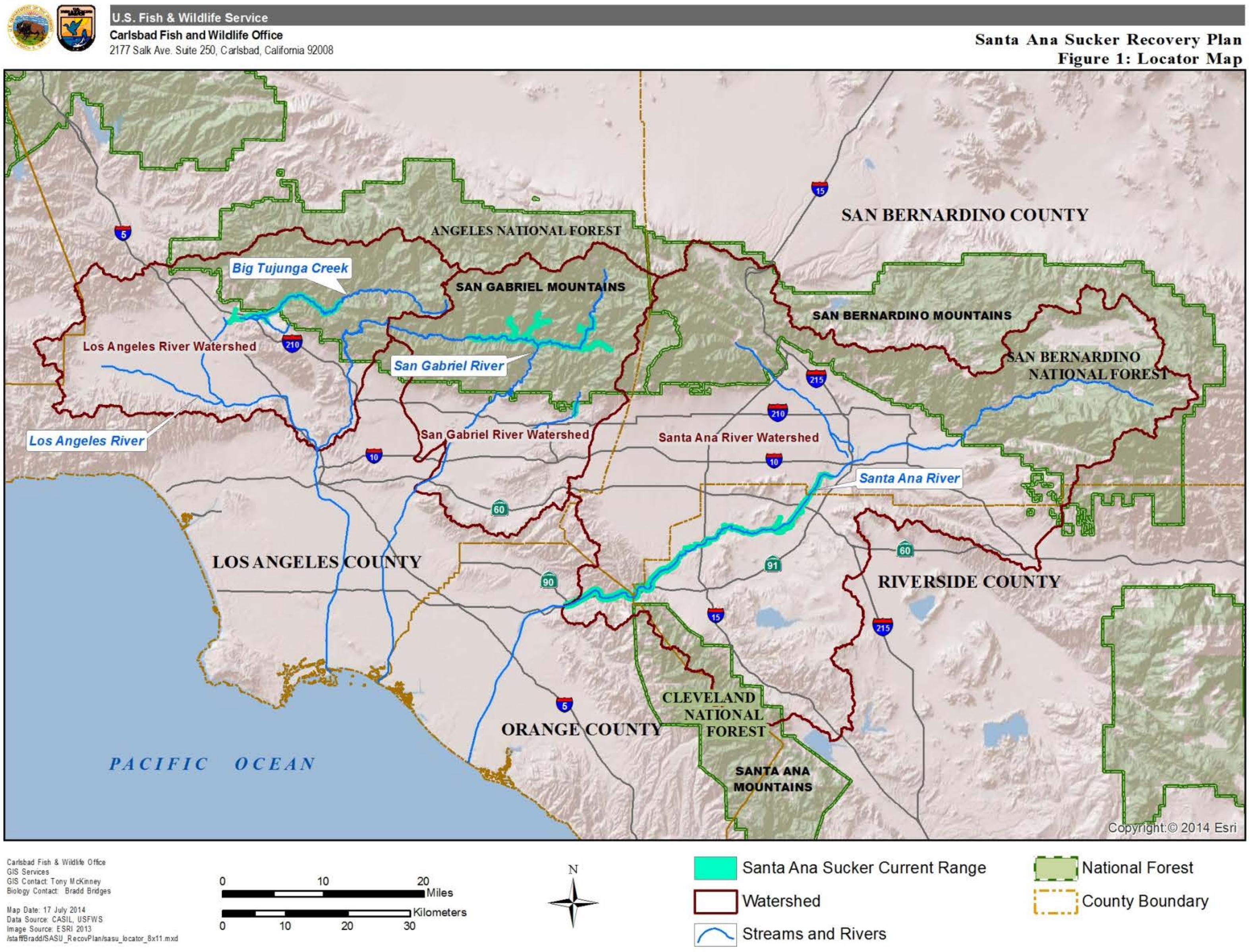
Santa Ana sucker is a small, short-lived member of the sucker family of fishes (Catostomidae), named so primarily because of the downward orientation and anatomy of their mouth parts, which allow them to suck up algae, small invertebrates, and other organic matter with their fleshy, protrusible (extendable) lips (Moyle 2002, p. 179). Santa Ana sucker was described in 1908 by Snyder as *Pantosteus santa-anae* from the Santa Ana River near Riverside, California (Snyder 1908, p. 33). Smith (1966, pp. 53–58) amended the specific name to eliminate the hyphen and relegated *Pantosteus* to a subgenus of *Catostomus*, which represented a new combination. Recent work has been conducted to investigate the phylogenetic relationships between suckers in western North America (Unmack *et al*. 2014), but there is still some uncertainty where *Catostomus santaanae* would be placed. Currently, the taxonomic classification of Santa Ana sucker is *Catostomus santaanae* and has not changed since it was listed.

Santa Ana suckers are generally less than 6.3 inches (in) (16 centimeters (cm)) in length; however, they have been collected at lengths up to 8 in (20.3 cm) (RCRCD 2010, p. 3). Males and females appear to grow at an equivalent rate (Greenfield *et al.* 1970, p. 174; Moyle 2002, p. 183). Their jaws have cartilaginous scraping edges inside the lips. Their color is silvery-white on the belly and dark gray on the sides and back, with irregular dorsal blotches on the sides and faint patterns of pigmentation arranged in lateral stripes. Membranes connecting the rays of the caudal (tail) fin are pigmented, but the anal and pelvic fins usually lack pigmentation (Moyle 2002, p. 182).

Spawning tubercles (raised growths on sexually mature fish), particularly at the beginning of the breeding season, are present on most parts of the body of breeding males and are heaviest on the anal fin, caudal fin, and lower half of the caudal peduncle (narrow region of body immediately in front of the caudal fin). Female suckers grow tubercles on the caudal fin and caudal peduncle (Moyle 2002, pp. 182–183).

B. Population Trends and Distribution

The Santa Ana sucker's historical range includes the rivers and larger streams in southern California emanating from the San Gabriel and San Bernardino Mountains in Ventura, Los Angeles, Orange, Riverside, and San Bernardino Counties, including the mainstems and tributaries from near the Pacific Ocean to the uplands of the Santa Ana River, Los Angeles River, and San Gabriel River watersheds (USFWS 2000, p. 19686) (Figure 1). Information about the occurrence of the Santa Ana sucker in many tributaries within its historical range is incomplete; however, it is likely that the species' historical distribution within the watersheds varied from year to year depending on habitat suitability and access (for example, physical barriers or water availability) to these different areas. Thus, the distribution of the species expanded and contracted with changes in local conditions. Continuity between the main river channel and its tributaries allowed the species to vacate and recolonize areas in response to habitat suitability. Because historical data are not available to determine the upper limit of the species within each tributary, we consider the historical range to extend throughout the watersheds where the in-stream gradient does not exceed 7 degrees.


U.S. Fish & Wildlife Service
Carlsbad Fish and Wildlife Office
2177 Salk Ave. Suite 250, Carlsbad, California 92008
Santa Ana Sucker Recovery Plan
Figure 1: Locator Map
SAN BERNARDINO COUNTY
ANGELES NATIONAL FOREST
Big Tujunga Creek
SAN GABRIEL MOUNTAINS
SAN BERNARDINO MOUNTAINS
SAN BERNARDINO NATIONAL FOREST
Los Angeles River Watershed
San Gabriel River
Los Angeles River
San Gabriel River Watershed
Santa Ana River Watershed
Santa Ana River
LOS ANGELES COUNTY
RIVERSIDE COUNTY
CLEVELAND NATIONAL FOREST
ORANGE COUNTY
SANTA ANA MOUNTAINS
PACIFIC OCEAN
Copyright: © 2014 Esri
Carlsbad Fish & Wildlife Office
GIS Services
GIS Contact: Tony McKinney
Biology Contact: Bradd Bridges
Map Date: 17 July 2014
Data Source: CASIL, USFWS
Image Source: ESRI 2013
0 10 20 Miles
0 10 20 30 Kilometers
N
Santa Ana Sucker Current Range
Watershed
Streams and Rivers
National Forest
County Boundary

The Santa Ana sucker is also found in the Santa Clara River (Santa Clara River watershed). However, we determined at the time of listing, because of its presumed introduced status, not to include the Santa Clara River population in the listed entity of Santa Ana sucker (USFWS 2000, p. 19687). The United States Geological Survey (USGS) is currently conducting an assessment of genetic distinctiveness for all occupied streams, including the Santa Clara River. However, we currently have no new information that clarifies the status of this species as native or nonnative to this river. Because they are not listed, the Santa Ana suckers in the Santa Clara River are outside the scope of this recovery plan. However, some research has been done on Santa Ana suckers in the Santa Clara River that is relevant to the species as a whole. Further, obtaining additional information on the status of these Santa Ana suckers may help inform recovery of the listed entity.

The listing rule states that approximately 80 percent of the Santa Ana sucker's historical range has been lost in the Los Angeles River watershed, 75 percent in the San Gabriel River watershed, and 70 percent in the Santa Ana River watershed (USFWS 2000, pp. 19687–19688). The upper limit of Santa Ana suckers in the Santa Ana, Los Angeles, and San Gabriel (West fork) Rivers is generally restricted by artificial barriers preventing their movement, such as artificial dams or grade control structures. Thus, the current range of the species in these watersheds is restricted or curtailed compared to what it was historically. If these artificial barriers did not exist, Santa Ana suckers would likely be able to, at least under certain stream-flow conditions, move into other portions (or reaches) of the rivers in which they occur, as well as associated tributaries, up to some upper limit. However, in streams or rivers that are not restricted by artificial barriers, such as the San Gabriel River (North and East forks), the upper limit of where fish are likely to occur is determined by the in-stream gradient and the inability to physically swim upstream when a certain gradient is exceeded. Results from a GIS analysis suggest that Santa Ana suckers do not occur above areas where the in-stream slope exceeds 7 degrees (USFWS 2009, p. 65065). Though the geographic range of the species has not changed since the time of listing, the spatial distribution of Santa Ana sucker has changed temporally, especially in the Santa Ana River watershed.

Comprehensive surveys and population estimates for the historically or currently occupied geographic area of Santa Ana sucker are lacking. Historical records are too scarce to generate population estimates and while recent surveys are more numerous (for example, Drake 1988, p. 52; Baskin et al. 2005, p. 1; Swift 2009, p. 3; Ecorp Consulting 2010b, p. 9; Saiki 2000, pp. 11–12; Chambers Group 2004, p. 3; Ecorp Consulting 2007, p. 9), a lack of consistent survey methodology between watersheds limits the ability to make meaningful comparisons of survey results over time or between different locations. The abundance of Santa Ana suckers has been reduced in all three watersheds, because of the decrease in available habitat relative to the historical range of the species (Moyle and Yoshiyama 1992, p. 204). A brief discussion of the current range of the Santa Ana sucker in the Santa Ana River, Los Angeles River, and San Gabriel River watersheds is included below.

1. Santa Ana River Watershed

Santa Ana sucker was historically documented throughout the upper and lower portions of the Santa Ana River watershed including the mainstem from near the current location of Seven Oaks Dam to approximately 14 miles (mi) (22.5 kilometers (km)) below Prado Dam and multiple tributaries including City Creek, Warm Creek, Lytle Creek, Rialto Channel, Evans Lake drain, Tequesquite Arroyo, Sunnyslope Creek, Anza Park drain, and Chino Creek.

In contrast to the species' range in the Los Angeles and San Gabriel Rivers, where the extant populations are in the upper portions of the watershed, the species is confined to the lowlands of the Santa Ana River watershed. Barriers to migration restrict the range of the Santa Ana sucker to approximately 34 mi (55 km) from South La Cadena Drive to near California State Route 90. The extent of habitat suitable for spawning in the mainstem varies from year to year but ranged from approximately 2.6 to 6.0 mi (4.2 to 9.6 km) above Prado Dam between 2006 and 2010 (USFWS 2011, p. 13). Substrate within the remainder of the mainstem above Prado Dam consists of greater than 90 percent silt and sand. We have no information to indicate that spawning is occurring below Prado Dam. The species is also known to occupy tributaries within this range, including Rialto Channel, Tequesquite Arroyo, Sunnyslope Creek, and Anza Park drain. Cumulatively, within the current range, these tributaries contain approximately 1.25 mi (2.0 km) of suitable habitat for the species, with the remainder channelized for flood control. Rialto Channel is the only tributary where the habitat is consistently good quality for both foraging and spawning (0.30 mi, 0.48 km).

Yearly monitoring has occurred since 2001 in the Santa Ana River (near the junction of the Santa Ana River with California Highway 60 and upstream to Riverside Avenue) (SMEA 2009, p. 1). Over this 10-year survey period, results indicate a decline in the annual average estimate of Santa Ana suckers (SMEA 2009, p. 2; SMEA 2010, pp. 2–3). In addition, regularly there have been low numbers of Santa Ana suckers at locations that historically had the highest abundances (SMEA 2010, pp. 1–2). Despite numerous survey efforts (for example, Haglund and Baskin 2004; RCRCD 2005, 2010; Baskin and Haglund 2008; Entrix, Inc. 2005; Ecorp 2009; Mills 2012), only six Santa Ana suckers have been captured below Prado Dam since 2001.

2. Los Angeles River Watershed

Santa Ana sucker was historically documented throughout the upper and lower areas of the Los Angeles River watershed including the mainstem Los Angeles River near Universal City and Los Feliz Boulevard and the tributaries Big Tujunga Creek and Arroyo Seco Creek. However, the species has been extirpated throughout most of this watershed. Between 1938 and 1960, 51 mi (82 km) of the Los Angeles River and numerous tributaries within the lower watershed were channelized and cement lined (Gumprecht 2001). Santa Ana sucker within this area was extirpated.

The species is currently confined to approximately 13 mi (21 km) of Big Tujunga Creek, in the upper portions of the Los Angeles River watershed between Hansen and Big Tujunga Dams, and to approximately 2.2 mi (3.5 km) of Haines Creek (a tributary to Big Tujunga Creek) that is consistently occupied. Within the current range, there are other tributaries (for example, Little Tujunga Creek) that may be periodically occupied depending on availability of water in the creek, as well as habitat conditions.

Habitat assessments conducted throughout Big Tujunga Creek indicate that the habitat suitability is variable throughout the system, but does contain areas of contiguous good and excellent habitat that are suitable for all life stages (Haglund and Baskin 2009). The density of Santa Ana suckers in Big Tujunga Creek is often low, likely due to the variability in habitat suitability (Ecorp Consulting 2010a, p. 5; Haglund and Baskin 2010, pp. 5–6). Some of this variability in habitat suitability may also be due to the periodic isolation of upper and lower reaches from a lack of perennial flow during dry summer months (Haglund and Baskin 2010, pp. 1–2).

3. San Gabriel River Watershed

Santa Ana sucker was historically documented throughout the upper and lower portions of the San Gabriel River watershed including the mainstem San Gabriel River near Fish Canyon, Fish and Fern Canyon, Rio Hondo, San Jose Creek, West Fork, Bear Creek, North Fork, East Fork, Cattle Canyon Creek, and San Dimas Wash. By the late 1960s, the species was no longer found in the lower portions of the watershed (Miller 1968). The lower San Gabriel River was channelized for flood control purposes and does not provide suitable habitat for Santa Ana sucker.

The species is now confined to approximately 26 mi (42 km) in the upper portions of the San Gabriel River watershed. It occurs above San Gabriel Dam in the West Fork (east of Cogswell Dam), Bear Creek, North Fork, East Fork, and Cattle Canyon Creek. Below San Gabriel Dam it occurs in approximately 1.5 mi (2.4 km) of San Dimas Wash, a tributary isolated from the San Gabriel River by approximately 10 mi (16 km) of cement lined channels and underground culverts. Distribution of Santa Ana sucker in West Fork and Cattle Canyon has decreased by several kilometers, compared to 1975 (O'Brien *et al*. 2011, p. 7). In addition, suckers were not observed in Big Mermaids Canyon, though they had been seen in 1991 surveys (Hagland and Baskin 1992).

Santa Ana suckers are more abundant and in better condition (length-weight relationship) in the San Gabriel River, compared to those in the Santa Ana River (Saiki *et al.* 2007, p. 98). The higher body condition may be attributed to more-suitable habitat characters such as intermediate water velocities, and commonality of pools and riffles with coarser bottom substrates, all of which may contribute to a better functioning system and more suitable habitat for Santa Ana suckers (Saiki *et al.* 2007, pp. 99–100). In the San Gabriel River, there are some distinct differences between the three forks of the river (north, west, and east), which seem to correlate with both fish abundance and life-stage occupancy (Tennant 2006, pp. 4–5, 9). The east fork, with faster flows and more abundant riffles supported more juveniles, where the west fork with deeper pools supported more of the adults (Tennant 2006, pp. 5–9). These differences in abundance and body condition are presumably related to better water quality, including lower temperature, lower specific conductance, and lower turbidity, and better habitat availability in the San Gabriel River system.

Santa Ana suckers appear to be more abundant in the East Fork of the river than the West or North Forks (Tennant 2006, p. 6); however, Santa Ana suckers are consistently observed in all three forks (Haglund and Baskin 1992, p. 31; Haglund and Baskin 2003, p. 72; Tennant 2004, p. 5; Tennant 2006, p. 5; Ecorp Consulting 2007, p. 9; Ecorp Consulting 2010b, p. 9). We consider the San Gabriel River population to be the most viable of the populations in the three watersheds.

C. Life History and Ecology

Spawning occurs between mid-March to early-July, with peak activity usually in April (Moyle 2002, p. 183). For a small species of the sucker family, fecundity (number of eggs or offspring produced by an individual) of Santa Ana suckers is high and increases linearly with body weight (Greenfield *et al.* 1970, p. 170). Spawning takes place over gravelly riffles where fertilized eggs adhere to the substrate and hatch within 360 hours. Larvae measure approximately 0.28 in (7 millimeters (mm)) at hatching (Greenfield *et al.* 1970, p. 169). Greenfield *et al.* (1970, p. 170) found no gravid female Santa Ana suckers smaller than 1.9 in (49 mm) or 0.07 ounce (2.05 grams). Santa Ana suckers in the Santa Clara River generally mature during their second summer and die at the end of their third summer at 3 to 4.3 in (75 to 110 mm) standard length (Greenfield *et al.* 1970, p. 172). However, some individuals have been observed to survive through a fourth summer growing to a size of 5.6 to 6.0 in (141 to 153 mm) standard length (Greenfield *et al.* 1970, p. 172), and those in the San Gabriel River may survive into their fifth summer (Drake 1988, p. 56). Maximum age appears to vary among the watersheds, for unknown reasons, possibly due to the suitability of habitat and overall fish condition. Further investigation of age structure is necessary to fully understand the age, growth, and size relationship of Santa Ana sucker across its range.

D. Habitat Characteristics/Ecosystem

Santa Ana suckers occur in the watersheds draining the San Gabriel and San Bernardino Mountains of southern California. Their historical distribution extended from upper watershed areas to the Pacific Ocean; hence, they are capable of occupying habitats as diverse as mountain streams and rivers in alluvial floodplains (relatively flat landform created by the deposition of sediment over a long period of time from one or many rivers) (Swift *et al.* 1993, pp. 119–121; Moyle 2002, p. 183).

The streams that the Santa Ana sucker inhabits are generally perennial streams with water ranging in depth from a few inches to several feet and with currents ranging from slight to swift (Smith 1966, p. 57). These streams are naturally subject to periodic, severe flooding (Moyle 2002, p. 183) and may experience extended periods of low flow as a result of drought conditions that are typical of southern California climate cycles (CRWQCB 1995, p. 1-4). However, there are also areas within the range of Santa Ana sucker that experience periods of no flow as a result of past and current hydrological modifications to the watershed (for example dams, diversions, or recharge basins) (CRWQCB 1995, p. 1-4). Adequate water quantity and quality are important for the persistence of the Santa Ana sucker throughout urbanized areas. Not only is the presence of water vital to the Santa Ana sucker, the volume and flow rate are important in shaping the watershed and facilitating delivery of coarse substrates to occupied areas. Periodic high-flow events (flood flows) are essential because they deliver new, coarse (gravel and cobble) substrate to currently occupied areas and reshape the channel to create the complex habitat needed to support all life history stages (for example, open sandy bars for juveniles and deep undercut banks and pools for adults). Additionally, perennial flows with suitable water quality and substrate are needed to support breeding, feeding, and sheltering.

Santa Ana sucker utilize different substrate types throughout each life stage. The presence of coarse substrates, including gravel, cobble, or a mixture of gravel or cobble with sand, and a combination of shallow riffle areas and deeper runs and pools, provide optimal stream conditions (Haglund *et al.* 2001, p. 60; Haglund and Baskin 2003, p. 55; Thompson *et al.* 2010, p. 329). This species also prefers habitat containing in-stream or bank-side riparian vegetation that provides shade and cover, especially for larvae and juveniles. However, vegetation is less important for adults because they utilize larger, deeper pools, while riffles are more frequently utilized by larvae and juveniles (Moyle and Yoshiyama 1992, p. 202; Moyle 2002, p. 183). Open stream reaches with shifting sandy substrates are typically less suitable for algae, an important food source (Saiki *et al.* 2007, p. 98) and hence, less suitable as habitat for Santa Ana suckers. Therefore, a stream system that contains the appropriate quantity of coarse substrates with some larger cobbles or boulders to provide the space for successful reproduction and juvenile development and growth of algae as a primary food source is important for a viable population of Santa Ana suckers.

Specific tolerances to water quality variables such as water temperature, dissolved oxygen, and turbidity have not been determined for Santa Ana sucker. However, they are most abundant in clear water at temperatures that are typically less than 72 ºF (22 ºC) (Moyle 2002, p. 183). Mortality has been observed where water temperatures become elevated. High mortalities have been recorded in recent years in conjunction with extremely high air and water temperatures in both the Santa Ana River (water temperature of 91.0°F (32.8°C) during summer 2010; SMEA 2010b, pp. 1–2) and Big Tujunga Creek (water temperatures above 80°F (26.7°C) during summer 2011; C. Galst 2011, pers. obs.; T. Hovey 2011, pers. comm.). The continued presence of Santa Ana suckers in the Santa Ana River demonstrates that they are able to tolerate elevated temperatures in the summer months and turbid conditions associated with high flows (Chadwick and Associates, Inc. 1992, p. 37; Saiki 2000, p. 25; Moyle 2002, p. 183).

Tributaries, particularly those located near the confluence of occupied areas of the river mainstem, may also provide important habitat for Santa Ana suckers. Surveys have repeatedly reported the presence of adults in breeding condition (tuberculated) and juveniles along the margins in tributaries of the Santa Ana River (Chadwick and Associates, Inc. 1992, p. 49; Chadwick Ecological Consultants, Inc. 1996, p. 16; Haglund *et al.* 2002, pp. 54–60; SMEA 2011, p. 1). This indicates that tributaries may provide shallow-water refuge for juveniles from larger predatory fish and may similarly act as refuge for juvenile and adult Santa Ana suckers during storm flows. Additionally, the species may be attracted to tributaries due to the relatively colder water temperatures typically found in these higher-order streams (Swift 2001, p. 26).

E. Critical Habitat

Critical habitat was originally designated for Santa Ana sucker on February 26, 2004 (USFWS 2004). On December 14, 2010, critical habitat for the species was revised, designating critical habitat in Los Angeles, Orange, Riverside, and San Bernardino Counties, California (USFWS 2010). The designated critical habitat includes approximately 9,331 ac (3,776 ha) of Federal, State, and private lands. Three units were designated (Unit 1: Santa Ana River, Unit 2: San Gabriel River, and Unit 3: Big Tujunga Creek (Los Angeles River)). Individual units are each intended to independently support a population of Santa Ana sucker in a functioning hydrologic system that provides suitable water quality, water supply, and coarse sediments. Primary constituent elements (PCEs) for the Santa Ana sucker are those physical and biological features that support life history functions essential to the conservation of the species and may require special management considerations or protection. These include primarily a functioning hydrological system that provides sources of water and course sediment necessary to maintain all life stages, including adults, juveniles, larvae, and eggs of Santa Ana sucker. A detailed description of the PCEs and the function of critical habitat for the species can be found within the 2010 final rule designating critical habitat (USFWS 2010).

F. Reasons for Listing and Current Threats

The following discussion is a brief summary of ongoing threats that continue to impact the Santa Ana sucker and its habitat. For additional information regarding the Santa Ana sucker, see the listing rule, revised critical habitat, 5-year review, and recovery outline (USFWS 2000; USFWS 2010; USFWS 2011; USFWS 2012). In determining whether to list, delist, or reclassify (change from endangered to threatened status, or threatened to endangered) a species under section 4(a) of the Act, we evaluate five factors: (A) the 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) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence.

The final listing rule (USFWS 2000, pp. 19686–19698) identified the following threats to Santa Ana sucker: habitat destruction, natural and human-induced changes in stream-flow, urban development and related land-use practices, intensive recreation, introduction of nonnative competitors and predators, and demographics associated with small population size.

The 5-year review for Santa Ana sucker (USFWS 2011) and the Santa Ana sucker recovery outline (USFWS 2012) identified the following threats to Santa Ana sucker: modification, fragmentation, and loss of habitat attributed to dams, changes in water allocations, and other hydrological modifications; water quality degradation; impacts to habitat due to recreation; wildfire; and potential effects of nonnative vegetation and predators, which are described below. The primary threat to Santa Ana sucker is rangewide modification, fragmentation, and loss of habitat through hydrological modifications. A detailed evaluation of all threats is included in the 2011 5-year review (USFWS 2011). Threats to Santa Ana sucker are summarized below under each of the five factors.

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

Currently, the threats to Santa Ana sucker's habitat are primarily attributed to urbanization and the repercussions of human population growth in Los Angeles, Orange, Riverside, and San Bernardino Counties. Modification, fragmentation, and loss of habitat have been the primary reasons for the decline in Santa Ana sucker throughout its range and continue to be significant threats to the recovery of the species in portions of its range. We categorize Factor A threats (all of which are attributable to urbanization) to Santa Ana sucker's habitat or range into the following categories: (1) Hydrological modifications, (2) water quality, (3) nonnative vegetation, (4) wildfire, (5) off-highway vehicle (OHV) use, and (6) mining activities.

Hydrological Modifications

Human activities, such as construction of dams, water diversions, flood control channels, roads, and other impervious surfaces, have altered the hydrology of the watersheds throughout Santa Ana sucker's range. These activities have impacted dispersal and modified habitat such that much of it is no longer suitable. The Santa Ana sucker remains in a very small portion of its historical range and although no additional construction of barriers to dispersal or further fragmentation of Santa Ana sucker habitat has occurred since its listing, habitat degradation continues due to ongoing operations of flood control and water conservation facilities and permanent modifications to the watersheds.

Not only is the presence of water vital to the Santa Ana sucker, the volume and flow rate are important in shaping the watershed and maintaining appropriate substrates in occupied areas. In the Santa Ana River, there are significant pressures put on the hydrologic process through water diversions and impediments, which may impact the suitability of available habitat for Santa Ana sucker. The water that provides the habitat for Santa Ana sucker throughout most of the year and all of the water during dry summer months primarily originates from discharges of treated wastewater (CRWQCB 2008, p. 1-11; USFWS 2008, pp. 2–3). In addition, current and future water diversions for human uses have appropriated most of the available water in the Santa Ana River watershed (CRWQB 2010, p. 2). The treatment plant discharges provide a constant source of water for Santa Ana suckers but may not be adequate to maintain the complex diversity of habitat variables (for example, sufficient sediment with appropriate grain size for spawning, pools, riffles, shallow stream margins, undercut banks, emergent aquatic vegetation, and riparian vegetation) necessary to support each life stage of the species. Water flow in Big Tujunga Creek and in the West Fork of the San Gabriel River are also regulated by dams but the extent that altered hydrology may threaten the Santa Ana sucker in the San Gabriel River or Big Tujunga Creek is not well understood. Unregulated flows are available to maintain habitat for the Santa Ana sucker in the East and North forks of the San Gabriel River and its associated tributaries. Several unregulated tributaries also flow into Big Tujunga Creek.

The delivery of coarse substrates (for example, cobble and gravel) to occupied habitat is reduced in all three watersheds by dams and regulated flows. The accumulation of sediment above dams may also be altering habitat for the Santa Ana sucker. As sediment accumulates above the dam, the actively flowing stream channel gradually converts to a still-water marsh. Marsh habitat favors nonnative animals, such as largemouth bass (*Micropterus salmoides*), that are predators on the Santa Ana sucker (USACE 2001, p. 4-28), and the fine substrate that settles out in still water does not support breeding and foraging habitat for Santa Ana sucker. In particular, Prado Dam may be altering habitat for Santa Ana sucker in the Santa Ana River. Based on surveys conducted annually since 2006, the river channel is predominantly sand substrate upstream for a minimum of 18.5 mi (29.8 km) above Prado Dam, which is 76 percent of the remaining perennial stream habitat for Santa Ana sucker above the dam. The amount of suitable habitat varied annually between 2006 and 2010, ranging from approximately 2.6 to 6.0 mi (4.2 km to 9.6 km) (USFWS 2011, p. 13).

Flood control infrastructure (for example, levees, culverts, bank protection) designed to protect urban development may require regular maintenance. Maintenance that requires frequent disturbance to the stream channel can degrade habitat for Santa Ana sucker by removing/displacing substrate, impacting aquatic and riparian vegetation, and increasing the distribution of nonnative vegetation. Remaining spawning habitat in the Santa Ana River is largely contained between flood control levees, where maintenance of the levees includes relocation of the river channel when it approaches the levees.

Hydrological modifications that limit the dispersal of Santa Ana suckers include flood control dams, drop structures, recreational dams, road crossings (for example, culverts) and levees. Large dams, such as Prado Dam, severely limit connectivity between Santa Ana suckers, only allowing limited unidirectional migration downstream. Recreational dams, such as low-flow barriers constructed out of rocks, vegetation, or other debris to create pools for recreation, create barriers during low-flow conditions but may be passable during higher-flow conditions. Culverts and other road crossings may prevent access into tributaries or limit connectivity within the main river channel. Levees can prevent access to portions of the floodplain that were historically occupied by the species.

Water Quality

Wastewater-dominated rivers, like the Santa Ana River, are subject to increased inputs of regulated and unregulated contaminants (Kolpin *et al*. 2002, pp. 1202–1211; Jenkins *et al*. 2009, p. 39), which degrade water quality and habitat suitability. Contaminants in water discharged from sewage treatment facilities may be amplified because of the limited availability of cleaner, natural water to flush out or dilute residual chemicals. Degraded water quality affects this species primarily in the Santa Ana River, but may occur in association with recreational use in the other watersheds. Other water quality impacts to Santa Ana suckers include (but are not limited to): elevated temperatures and changes in hydrological regime attributed to global climate change, low oxygen levels attributed to increased nutrients causing algal blooms, and increased ammonia levels that are toxic to fish. Each of these scenarios may result in degradation of water quality in occupied habitat and elevated stress of the fish, lower reproductive input, or death.

Nonnative Vegetation

Aquatic habitat may be modified by the presence of nonnative vegetation in a variety of ways. *Arundo donax* (giant reed) is a nonnative, aquatic, perennial reed-like grass (Poaceae). It is commonly found growing along lakes, streams, and other wetted areas, but once established it can survive long periods of drought. Compared to other riparian vegetation, it is known to use excessive amounts of water to supply exceptionally high growth rates (Bell 1997, p. 104). This species is considered a primary threat to riparian corridors because of its ease of establishment and ability to alter the hydrology of the system. *Arundo donax* tends to form large, continuous, clonal rhizome masses that stabilize river or stream banks, altering the flow regime of the system, and preventing natural dynamic processes such as stream meandering, and, deposition and scouring of sediments (Bell 1997, p. 106). The modification of in-stream habitat by *Arundo donax* can also reduce the suitability of habitat for Santa Ana sucker and increase the potential to support nonnative aquatic predators (see Factor C: Predation below).

A nonnative, invasive, filamentous red alga (*Compsopogon coeruleus*) was recently identified in the Santa Ana River in 2014 (Spoo-Chupka 2014). This red alga has likely been introduced into the Santa Ana River multiple times. The first record for this species in the Santa Ana River was from 2012, where it was found near Yorba Linda Boulevard, Yorba Linda, California (Sheath and Stancheva 2014.). The second and most recent observation in the Santa Ana River was made in February 2014 where it was found in the discharge pool of the Rapid Infiltration and Extraction Facility (RIX), City of Colton, California. The RIX discharge pool appears to be an introduction location, as the alga has not been found to occur upstream from this location. It attaches to hard substrates and exists as an aquatic epilith (growing on rocks) or epiphyte (growing on plants). In the upper Santa Ana River the red alga was more abundant in areas composed of cobble or gravel substrate and less abundant in areas dominated by sand (C. Medak and K. Palenscar 2014, pers. obs.).

One concern is that the presence of this nonnative red alga has reduced the available foraging and spawning habitat for the Santa Ana sucker because it grows very rapidly, up to 10 centimeters per day (Palenscar 2014a, pers. obs.), and creates dense carpets of filaments that cover the bottom via layering. Santa Ana sucker are not known to forage on or spawn within filamentous algae. When conducting a snorkel survey in the Santa Ana River in late February 2014, fewer Santa Ana sucker were observed in areas where the alga was abundant (Medak and Palenscar 2014, pers. obs.). This rapid invasion of a nonnative species has altered vital Santa Ana sucker habitat throughout most of its occupied range within the upper portion of the Santa Ana River as well as potentially altering ecosystem processes. There was approximately 0.5 mi (0.8 km) of suitable spawning habitat within the Santa Ana River in February 2014 (Medak and Palenscar 2014, pers. obs.).

Wildfire

Wildfire may impact riparian vegetation throughout occupied and unoccupied reaches of all three watersheds by eliminating vegetation that shades the water and moderates water temperature, or by producing silt-and-ash-laden runoff that can significantly increase turbidity of rivers. The loss of riparian vegetation may impact water transport, sediment transport, water quality, and flow regime. Large wildfires may threaten aquatic species by isolating populations and causing local extirpations. Wildfire has the potential to impact the Santa Ana sucker throughout its range, but impacts are expected to be localized and temporary. Therefore, we do not consider wildfire to be a substantial threat at this time.

Off-highway Vehicle Use

OHVs impact both riparian and in-stream habitat that is important for Santa Ana suckers. Users of OHVs may drive along the banks of rivers, which can degrade bank stability and lead to erosion, and damage riparian plant communities that provide shade over the river and increase bank stability. OHVs may also drive through the river and disturb sediments, create increased turbidity, potentially crush Santa Ana suckers, and otherwise disturb substrates that Santa Ana suckers require for feeding and rearing young. OHV use primarily occurs in the San Gabriel Canyon OHV area, at the confluence of the East and West Forks of the San Gabriel River and above Mission Avenue, in the Santa Ana River. The San Gabriel Canyon OHV area is currently being managed by the USFS to reduce impacts to the species and is monitored to determine the effectiveness of management actions (For example, Ecorp Consulting 2010b). OHV use in the Santa Ana River is unauthorized. Although OHV use is currently not considered a substantial threat, it has the potential to significantly impact Santa Ana sucker in absence of specific management actions and enforcement.

Mining Activities

Sand and gravel are used as construction aggregate for public works projects such as roads and highways and a multitude of other commercial uses (Kondolf 1997, p. 540). In-stream mining alters the channel geomorphology and bed elevation, and can require water diversion, clearing, and excavation (Kondolf 1997, p. 541). The practice of in-stream mining may induce channel incision and erosion, but more importantly for Santa Ana suckers, mining for gravel and sand removes necessary substrates from the watershed and discharges fine residual sediment back into the watershed. These activities have occurred in the Santa Ana River upstream of occupied habitat areas. Additionally, suction dredging to find precious minerals is generally a recreational activity that occurs most frequently on U.S. Forest Service (USFS) lands. These activities have been known to occur in the San Gabriel River and Los Angeles River watersheds; however, as of August 6, 2009, California Department of Fish and Wildlife (CDFW) imposed a moratorium on instream suction dredging until the State of California completes a court-ordered environmental review, and adopts a permitting program (CDFW website viewed October 14, 2010). Sluicing and high banking, techniques also used to find precious minerals, are likely occurring in the San Gabriel River and to a lesser extent in Big Tujunga Creek (Welch 2010, pers. comm.). While mining is not currently considered a substantial threat, changes in restrictions that increase the rangewide extend of mining activities could have a substantial impact on the species.

Factor B*: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*

The 2000 listing rule indicated that CDFW reported the illegal harvest of Santa Ana suckers with gill and throw nets in the Santa Ana River below Prado Dam (M. Maytorena, CDFW, 1997, pers. comm.). Since listing, we received information that Santa Ana suckers may be a food source for people living in encampments along the Santa Ana River and there may be a correlation of this illegal activity to the observed decline in Santa Ana suckers with proximity to these camps (RCRCD 2007, p. 13). However, the relative impact of illegal harvesting of the species is unknown. We have no information indicating that overutilization of Santa Ana sucker in the San Gabriel River or Los Angeles River watersheds has historically or is currently a substantial threat to Santa Ana sucker.

Factor C*: Disease or Predation*

We have no information indicating that disease is a substantial threat to the continued existence of Santa Ana suckers throughout its range.

Nonnative predators, such as bass and sunfish (Family Centrarchidae), tilapia (Family Cichlidae), carp (Family Cyprinidae), and catfish (Family Ictaluridae), have been reported in each of the watersheds currently occupied by Santa Ana sucker (Allen 2003, p. 6; Chambers Group 2004, p. 6-3; RCRCD 2006, p. 11; Morrissey 2009, p. 7; Ecorp Consulting 2010a, p. 7; Ecorp Consulting 2010b, p. 9). The American bullfrog (*Rana catesbeiana*), another potential predator, has also been observed in Big Tujunga (Haines Creek) (Ecorp Consulting Inc. 2013, pp. 29–31) and the Santa Ana River near the confluence with Rialto Channel (Palenscar 2014b, pers. obs.). The relative abundance of Santa Ana suckers appears to decrease with increasing numbers of exotic fish (Swift 2001, p. 29; Ecorp Consulting Inc. 2013, p. 19). An increase of nonnative predators would suggest increased predation pressures, which could further impact Santa Ana sucker; however, further study is needed to determine the quantity of Santa Ana suckers consumed by nonnative predators to better describe the magnitude of this threat.

Factor D*: Inadequacy of Existing Regulatory Mechanisms*

In the listing rule, regulatory mechanisms thought to have some potential to protect Santa Ana sucker included: (1) California Endangered Species Act (CESA) (where the Santa Ana sucker occurred in areas where State-listed species are located), (2) California Environmental Quality Act (CEQA), (3) National Environmental Policy Act (NEPA), (4) Clean Water Act (CWA), (5) the Act (where, prior to listing, Santa Ana sucker co-occurred with other federally listed species), and (6) land management or conservation measures by Federal, State, or local agencies or by private groups and organizations (USFWS 2000, pp. 19686–19698). The listing rule provides an analysis of the potential level of protection provided by these regulatory mechanisms.

The status of regulatory mechanisms and their adequacy for protection of Santa Ana sucker remains largely unchanged since listing. Several State and Federal mechanisms provide a conservation benefit to Santa Ana sucker. However, the Act is the primary Federal law that provides protection for this species since its listing as threatened in 2000. Critical habitat was revised in 2010 and was designated throughout the range of the Santa Ana sucker, including unoccupied areas essential for the conservation of the species. The Western Riverside County Multiple Species Habitat Conservation Plan (Western Riverside County MSHCP), under which Santa Ana sucker is a covered species, was permitted and is currently being implemented. The

MSHCP affords protection to the species and its habitat in a portion of its range above Prado Dam.

Other Federal and State regulatory mechanisms provide discretionary protections for the species based on current management direction, but do not guarantee protection for the species absent its status under the Act. We are not aware of any new regulatory mechanisms that have been enacted since the time of listing that would preclude the need for protection of the species under the Act. Therefore, in absence of the Act, other laws and regulations have limited ability to protect the species.

Factor E*: Other Natural or Manmade Factors Affecting Its Continued Existence*

The majority of the Santa Ana sucker's historical range was lost prior to listing, and the distribution of this species has continued to constrict in portions of the San Gabriel River and Santa Ana River watersheds. Small population size may be the result of several conditions, including their inability to recolonize previously occupied areas and lack of redundant tributaries or refuge habitat to prevent extirpation due to catastrophic events. Survey data indicate that fish density is likely decreasing in areas in the Santa Ana River (SMEA 2009, p. 1) and tends to be variable in Big Tujunga Creek (Ecorp Consulting 2010a, p. 5; Haglund and Baskin 2010) and San Gabriel River (O'Brien *et al*. 2011, p. 10)). Small populations of Santa Ana sucker are more vulnerable to extirpation during stochastic events, such as flood, fire, or sustained drought. Given the impact these events could have on any of the three watersheds where Santa Ana suckers exist, they represent a potential threat to the species as a whole

Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying are predicted by the year 2100 (Field *et al.* 1999, p. 1; Cayan *et al.* 2005, pp. 7–8; IPCC 2007, pp. 8–9). While Santa Ana suckers are capable of withstanding elevated water temperatures (Saiki *et al.* 2007, pp. 98–99), their lethal upper temperature limit is unknown. Fish are generally more stressed at the upper extremes of their temperature range and though they may be able to survive, elevated temperature is an example of a stressor that may affect them through decreased growth and reduced disease resistance (Barton *et al.* 2002, pp. 111–148). All life stages of Santa Ana suckers require cool water (Saiki *et al.* 2007, pp. 99–100). However, connectivity within the watersheds may be exacerbated by the predicted decreases in annual precipitation and fish may not have access to areas with cool, clean water because of the lack of water or barriers to dispersal. Increasing air temperatures and decreasing precipitation levels, predicted to occur as a result of global climate change, are likely to impact the availability of suitable cooler-water habitat. Therefore, though difficult to quantify, change in global climate may impact the Santa Ana sucker throughout its range.

Summary

The primary threat to Santa Ana sucker is rangewide habitat loss, degradation, and modification through hydrological modifications. The loss of available habitat (caused by dams, changes in water allocations, and other hydrological modifications) combined with other increasing threats (such as water quality degradation, impacts to habitat from recreation, and potential effects of nonnative vegetation and predators) have a cumulative effect on Santa Ana sucker and its habitat. Additionally, isolation by impassable barriers or unsuitable habitat limits gene flow, thus increasing the vulnerability of small populations to a range of environmental and genetic stochastic factors.

Threats are likely to continue with the increasing pressure for water conservation (storage) for human use through dams and water diversions, as well as continuing impacts of urbanization, recreation, degraded and fragmented habitat, degraded water quality, vulnerability of small populations, and, potentially, global climate change. However, the scope and severity of impacts to the Santa Ana sucker vary within the three watersheds.

The Santa Ana River watershed has been highly modified as a result of changes to the hydrology from urban development and barriers, such as Prado Dam and Seven Oaks Dam. The distribution of Santa Ana suckers is limited primarily to a few miles of the mainstem below South La Cadena Drive and a few small tributaries, where suitable spawning habitat exists. The system is largely channelized and the extent of suitable habitat is constrained by a reduction of water and sediment from upstream sources. Water quality is variable and may impact the sucker throughout its range. Nonnative species, including aquatic predators and the newly identified invasive alga, also pose serious threats and continue to degrade habitat in the Santa Ana River.

The range of Santa Ana sucker in the Los Angeles River watershed was reduced by about 80 percent at the time of listing and is now limited to an area confined between Hansen Dam and Big Tujunga Dam (USFWS 2000; O'Brien and Stephens 2009). Flows regulated by Big Tujunga Dam affect water and sediment transport in Big Tujunga Creek; however, unregulated flows are available from several tributaries. The adequacy of existing water and sediment sources to maintain habitat for Santa Ana sucker is not well understood. Many road crossings, recreational dams, and culverts limit fish passage and contribute to habitat degradation. Nonnative predators are abundant in Haines Creek and gain access to the system from the Tujunga ponds.

The San Gabriel River watershed provides much suitable habitat for the Santa Ana sucker with abundant cobble and good flows. Although the hydrology has been altered on the West fork of the San Gabriel River by Cogswell Dam, unregulated flows are available to maintain habitat for the Santa Ana sucker in the East and North forks and associated tributaries. Recreational activities (swimming, fishing, off-highway vehicle use) are extensive and contribute to the degradation of habitat. Recreational dams are abundant in the lower portions of the North, East, and West forks and require management to reduce potential impacts to Santa Ana sucker. Predators have been reported in the watershed and may gain access from Cogswell and San Gabriel reservoirs. Nonnative plants are present in the lower portions of the East and West forks and may contribute to habitat degradation.

G. Conservation Efforts

Since listing, surveys for Santa Ana sucker have been conducted in various portions of its range. Species-specific projects have also been conducted in each of the three watersheds where Santa Ana sucker occur. There have been studies exploring life history parameters, population dynamics and demographics, habitat assessments, environmental conditions, and possible restoration sites. These studies have been important for making decisions regarding the status of the species and the current conditions within each of the watersheds. Other activities have also occurred for the benefit of Santa Ana sucker such as removal of nonnative vegetation and nonnative predators. Examples of these activities and past research are listed in Table 1 below.

There are currently 18 individuals (or companies) permitted to conduct recovery activities for the Santa Ana sucker under section 10(a)(1)(A) of the Act. Most recovery permits cover presence/absence surveys that generally allow for capture, handling, and release of individuals encountered while conducting authorized surveys. Additionally, some permittees are authorized to conduct more invasive activities, such as collecting biological samples (fin clips), measuring/weighing individuals, or collecting specimens. Recovery of Santa Ana suckers is being achieved in part through on-the-ground recovery actions, implementation of management plans, and through active cooperation with partners through sections 7 and 10 of the Act.

H. Summary

Historical Santa Ana sucker habitat has been drastically degraded and fragmented from hydrological modifications, resulting in the species' reduced geographic range and vulnerability to stochastic events. Increased distance between suitable habitats has likely resulted in reduced genetic exchange between populations and reduced ability to colonize new or previously occupied habitat. Life history traits of the sucker (for example, early sexual maturity, protracted spawning period, high fecundity) are conducive to re-colonization; however, it appears (based on our evaluation of the results of studies investigating availability of suitable habitat (Thompson *et al*. 2010)) that reintroductions are likely needed to provide resilience and redundancy for the species to recover. Reintroduction to existing or restored habitat may be a viable option to increase distribution and abundance if suitable habitat is available. The sucker is dependent on habitat that has been, and continues to be, under developmental pressures. Protection and active management are needed to improve and restore suitable habitat in order to prevent further decline and to enable recovery of the species. Additionally, research, monitoring, and nonnative species removal are already underway and should be expanded throughout the species range. Key challenges will be developing a recovery strategy that can be implemented in a system where there are continuing human-use water needs and requirements for flood control operation to maintain human health and safety.

Table 1: Studies and activities funded and carried out for the conservation of the Santa Ana sucker.

Santa Ana River		
Year	**Title**	**Reference**
1992	Santa Ana River use-attainability analysis	Chadwick and Associates 1992
1996	Current status of the Santa Ana sucker in the Santa Ana River	Chadwick Ecological Consultants Inc. 1996
1999	Conservation program for the Santa Ana sucker in the Santa Ana River	Baskin and Haglund 1999
2000	Water quality and other environmental variables associated with variations in population densities of the Santa Ana sucker. In the Santa Ana and San Gabriel Rivers	Saiki 2000
2001	Santa Ana sucker survey/seining in the Santa Ana River	Baskin and Haglund 2001
2001	The Santa Ana sucker in the Santa Ana River: distribution, relative abundance, spawning areas, and impact of exotic predators	Swift 2001
2001-2009	Implementation of the Santa Ana sucker Conservation Program for the Santa Ana River	Haglund *et al*. 2001, 2002, 2003, 2007, 2010; Haglund and Baskin 2004
2002	Evaluation of Santa Ana sucker (*Catostomus santaanae*) habitat and water quality changes in the Santa Ana River as a result of temporary shutdowns at the Rapid Infiltration and Extraction Plant	Allen 2002
2003	Evaluation of Santa Ana Sucker (*Catostomus santaanae*) spawning success in the Santa Ana River and the potential effects on temporary shutdowns at RIX	Allen 2003
2004	Assessment of the influence of hydrology and sediment transport in the Santa Ana River on Santa Ana sucker habitat	Humphrey *et al.* 2004
2006-2009	Santa Ana sucker research and population augmentation project 2006-2008 Annual Report	RCRCD 2006, 2007, 2008, 2009
2007	Santa Ana Watershed Association 2007 annual report	SAWA 2007
2009	45-day survey report on pre-construction presence/absence surveys for the Santa Ana sucker (*Catostomus santaanae*) at three locations on the Santa Ana River	Ecorp Consulting 2009
2010	Feasibility of the Restoration of Sunnyslope Creek for Santa Ana suckers	SAWA 2010
2010	Influence of habitat dynamics on the distribution and abundance of the federally threatened Santa Ana sucker, *Catostomus santaanae*, in the Santa Ana River	Thomson *et al*. 2010

Year	Title	Reference
2011	Draft Seven Oaks Dam Gate Test	USACOE 2011
2011	The Riverside North Aquifer Storage and Recovery Project on the Santa Ana Sucker	AECOM 2011
2011	Sunnyslope nonnative electro-shocking report	RCRCD 2011
2012	Sunnyslope Creek native fish habitat restoration project monitoring report	OCWD 2012
2012-2014	Fish passage barrier identification and assessment throughout the range of Santa Ana sucker	Baskin 2014
2012-2014	USGS analysis of the population genetics of the Santa Ana sucker	Ongoing
2013-2014	Relative Abundance and habitat surveys by SAWA	SAWA 2014
2014	Ongoing monitoring initiated in Santa Ana River by the Service to assess effects of nonnative red alga on Santa Ana sucker	Ongoing

Big Tujunga River		
Year	**Title**	**Reference**
2001	Lower Big Tujunga stream pool location survey	Andresen 2001
2002	Fish survey of Big Tujunga Creek below Big Tujunga Dam No. 1 with special reference to Santa Ana sucker	Swift 2002
2004	Report - Los Angeles River Haines Creek Fish Survey for LACDPW	Baskin and Haglund 2004
2007-2008	Santa Ana sucker (*Catostomus santaanae*) habitat suitability survey 2007-2008 Big Tujunga Creek	EDAW and SMEA 2009
2008-2009	Santa Ana Watershed Association 2008-2009 annual report	SAWA 2009
2009	Data summary of the 2009 fish surveys in the Big Tujunga Creek Basin	O'Brien and Stephens 2009
2010	Report for the Santa Ana sucker (*Catostomus santaanae*) survey and relocation effort in the Big Tujunga	Ecorp Consulting 2010a
2010	Santa Ana sucker (*Catostomus santaanae*) and macroinvertebrate baseline survey 2009, Big Tujunga Creek	Haglund and Baskin 2010

San Gabriel River		
Year	**Title**	**Reference**
2001-2006	Surveys for the Santa Ana sucker (*Catostomus santaanae*) on the San Gabriel River	Tennant 2001, 2004, 2006
2002	Status of the Santa Ana sucker and Santa Ana speckled dace in the U.S. Forest Service San Gabriel River OHV area	Haglund and Baskin 2002
2003	Final Report Habitat and resource utilization by the Santa Ana sucker (*Catostomus santaanae*) and the Santa Ana speckled dace in the east fork of the San Gabriel River	Haglund and Baskin 2003
2004	Estimating leakage from Cogswell Dam (West Fork San Gabriel River)	Ally 2004a
2004	Survey of selected stream parameters in the East Fork San Gabriel River and its tributary Cattle Canyon, and in the North Fork San Gabriel	Ally 2004b
2004	Results of electrofishing surveys done in the San Gabriel River (West, North, and East Forks) and tributaries Bear Creek and Cattle Canyon during June and July 2003	Ally 2004c
2004	Results of electrofishing surveys done in four streams of the San Gabriel River drainage in June 2004	Ally 2004d
2007	Fish population and habitat surveys San Gabriel Canyon OHV area	Ecorp Consulting 2007
2008	Update for the Santa Ana sucker located in San Dimas Canyon East Fork	Chambers Group 2008
2010	Santa Ana sucker population and habitat monitoring surveys in the U.S. Forest Service San Gabriel Canyon OHV area	Ecorp Consulting 2010b
2011	Status of fishes in the upper San Gabriel River basin	O'Brien *et al*. 2011
2012	45 day report for the Santa Ana sucker capture and relocation activities below the San Dimas Dam	Chambers Group 2012a
2011-2012	Santa Ana sucker surveys in USFS OHV area, San Gabriel River, Angeles National Forest	Chambers Group 2011, 2012b

II. RECOVERY PROGRAM

This section describes the Santa Ana sucker recovery program by outlining a strategy, identifying where recovery will occur (recovery units), defining the recovery goal and objectives, and delineating criteria to remove the Santa Ana sucker from the list of threatened and endangered species (delist the species).

RECOVERY PRIORITY NUMBER

The recovery priority number for Santa Ana sucker is 5C. This number indicates the species faces a high degree of threat, has a low potential for recovery, and has taxonomic status as a species. The high degree of threat is due to potential loss of water supply, pollution, the highly urbanized nature of the Santa Ana River, significant pressure placed on the species by recreational use and flood control restrictions, predation by introduced predators, and susceptibility of small populations to random catastrophic events. The low potential for recovery is due to the significant amount of effort needed to secure the required water supply, restore habitat, and secure funding for research and water quality standard revisions needed to protect Santa Ana sucker from pollution. The "C" indicates conflict with construction or other development projects or other forms of economic activity, specifically water conservation and flood control projects and associated infrastructure (for example, dams, diversions, and drop structures).

A. Recovery Strategy

Due to the rangewide large-scale hydrological modifications, the most pressing threat to the species is the lack of suitable habitat necessary to increase population resiliency (ensure a large enough population to withstand stochastic events) and redundancy (a sufficient number of populations to ensure the species can withstand catastrophic events). Therefore, the highest priority for the recovery of Santa Ana sucker is implementation of management actions to restore and improve habitat conditions throughout the current range of the species. These actions include initiating studies that will lead to a thorough understanding of the implications of past and current hydrological modifications throughout the range of the species; controlling nonnative species; minimizing recreation pressures; improving water quality; employing adaptive management techniques to address the uncertainties of global climate change; and involving stakeholders and partners in all applicable conservation and management actions.

Given the substantial reduction in the range of the species and the threats associated with small population size (see Factor E, Small Population Size), the currently occupied areas (particularly in the Santa Ana River watershed) will likely not be sufficient to provide the resiliency and redundancy necessary for recovery of the species. Additionally, representation (maintaining the breadth of the genetic makeup to conserve the adaptive ability of the species) is a concern due to the small population size within each watershed. To reduce the risk of extirpation, while determining appropriate actions to manage threats within the current range, areas not currently accessible to the fish should be assessed for potential reintroduction. Increasing the extent of occupied habitat will improve the representation, resiliency, and redundancy of Santa Ana sucker, thereby improving the status of the species.

Recovery Units

The establishment of Recovery Units (RU) is an effective tool for species that are divisible into geographically or otherwise identifiable units that are essential to the recovery of the species. Recovery Units are areas that are individually necessary for long-term sustainability of the species and serve to facilitate species recovery. Recovery goals, and criteria to reach those goals, are set for each RU and when accomplished should be considered as indicators that the species could be delisted. Recovery actions will be prioritized differently between recovery units depending on the magnitude and intensity of threats. For example, hydrological modifications from dams impact the species and its habitat in all three watersheds. However, in the Santa Ana and Los Angeles River watersheds the construction and operation of large dams have impacted the habitat suitability to a greater extent than in the San Gabriel River watershed. In contrast, the construction of recreational dams is more prevalent in the San Gabriel and Los Angeles River watersheds, compared to the Santa Ana River watershed. Therefore, each action is assigned a priority relative to its need within each recovery unit.

All of the Recovery Units are necessary for the recovery of the Santa Ana sucker and provide redundancy in order to maintain its historical population and habitat distributions, as well as protection of the genetic variability. We believe that to achieve recovery of the Santa Ana sucker the species must possess healthy, viable populations within each of the three RUs: (1) Santa Ana River RU; (2) Los Angeles River RU; (3) San Gabriel River RU (See Figure 1 for site map of Santa Ana River, Los Angeles River, and San Gabriel River watersheds which are equivalent to the RUs). Within each of the three RUs we have also defined several reaches of the mainstem and its associated tributaries, which lack connectivity due to barriers to fish passage.

Santa Ana River Watershed Recovery Unit (SARW-RU)

The SARW-RU includes the Santa Ana River, tributaries, and areas being considered for possible reintroduction (*).

SARW-RU REACHES:

- La Cadena Reach: Santa Ana River above South La Cadena Drive and its connecting tributaries* (for example, Santa Ana River above Seven Oaks Dam*, Mill Creek*, Lytle Creek*, Cajon Wash*, City Creek*, Plunge Creek*, Warm Creek*, Mountain Home Creek*, Bear Creek*, Alder Creek*) (Figure 2).
- Prado Reach: Santa Ana River between Prado Dam and the drop-structure at South La Cadena Drive and its connecting tributaries (for example, Sunnyslope Creek, Tequesquite Arroyo, Hole Creek, Anza Drain, Rialto Channel, Temescal Creek*, Chino Creek*, San Antonio Creek*, Cucamonga Creek*, Day Creek*, and other potential restorable tributaries) (Figure 3).
- Imperial Reach: Santa Ana River from California State Route 90 to Prado Dam and its connecting tributaries (for example, Aliso Creek*). (Figure 3).

Los Angeles River Watershed Recovery Unit (LARW-RU)

The LARW-RU includes Big Tujunga Creek, Little Tujunga Creek, Haines Creek, and areas being considered for possible reintroduction (*)

LARW-RU REACHES:

- Big Tujunga Reach: Big Tujunga Creek above Big Tujunga Dam and its connecting tributaries (for example, Fall Creek*, Mill Creek*) (Figure 4).
- Hansen Reach: Big Tujunga Creek between Big Tujunga Dam and Hansen Dam and its connecting tributaries (for example, Little Tujunga Creek, Haines Creek, Gold Creek, Delta Canyon Creek, Stone Canyon Creek, Vogel Canyon Creek, Clear Creek) (Figure 4).
- Los Angeles Reach: Los Angeles River down to the Los Angeles/arroyo Seco confluence and its connecting tributaries (for example, Arroyo Seco Creek*, Pacoima Canyon Creek*) (Figure 4).

San Gabriel River Watershed Recovery Unit (SGRW-RU)

The SGRW-RU includes the East, North, and West forks of the San Gabriel River, Bear Creek, Cattle Canyon Creek, San Dimas Wash, and areas being considered for possible reintroduction (*).

SGRW-RU REACHES

- Cogswell Reach: West Fork of the San Gabriel River above Cogswell Dam* (Figure 5).
- San Gabriel Reach: The San Gabriel River, north of San Gabriel Dam, from Cogwsell Dam to the easternmost section of Cattle Canyon Creek. This reach includes the East (including area above the "Bridge to Nowhere"*), North, and West forks of San Gabriel River and its connecting tributaries (for example, Bear Creek, Big Mermaids Creek, Cattle Canyon Creek) (Figure 5).
- Whittier Reach: San Gabriel River from above Whittier Narrows Dam to Morris Dam and its connecting tributaries (for example, San Dimas Wash, Fish Creek*, Dalton Creek*, Santa Anita Creek*, Monrovia Creek*) (Figure 5).

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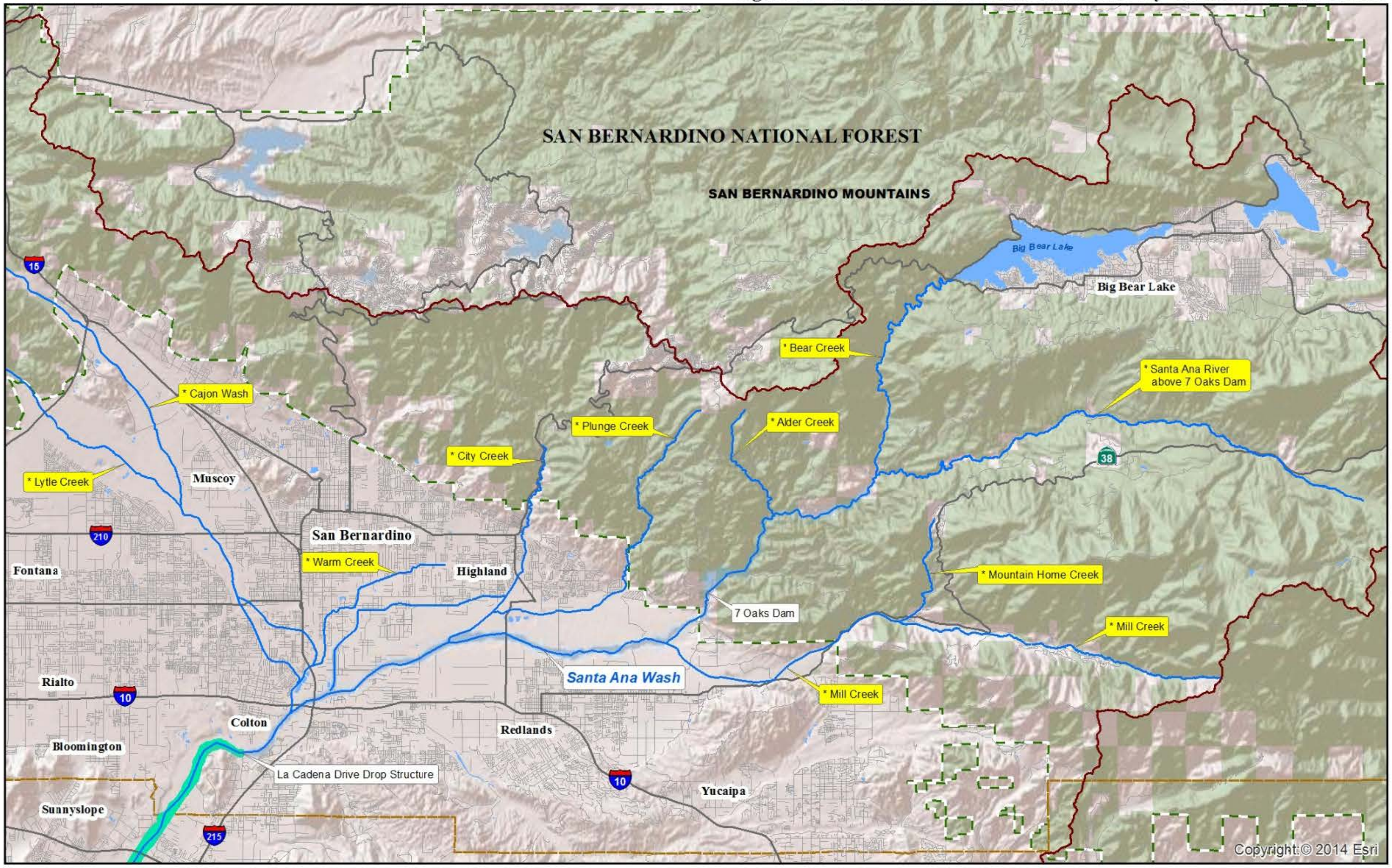
Santa Ana Sucker Recovery Plan
Figure 2: Santa Ana River Watershed Recovery Unit: La Cadena Reach



Carlsbad Fish & Wildlife Office
GIS Services
GIS Contact: Tony McKinney
Biology Contact: Bradd Bridges

Map Date: 19 August 2014
Data Source: CASIL, USFWS
Image Source: ESRI 2013
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N

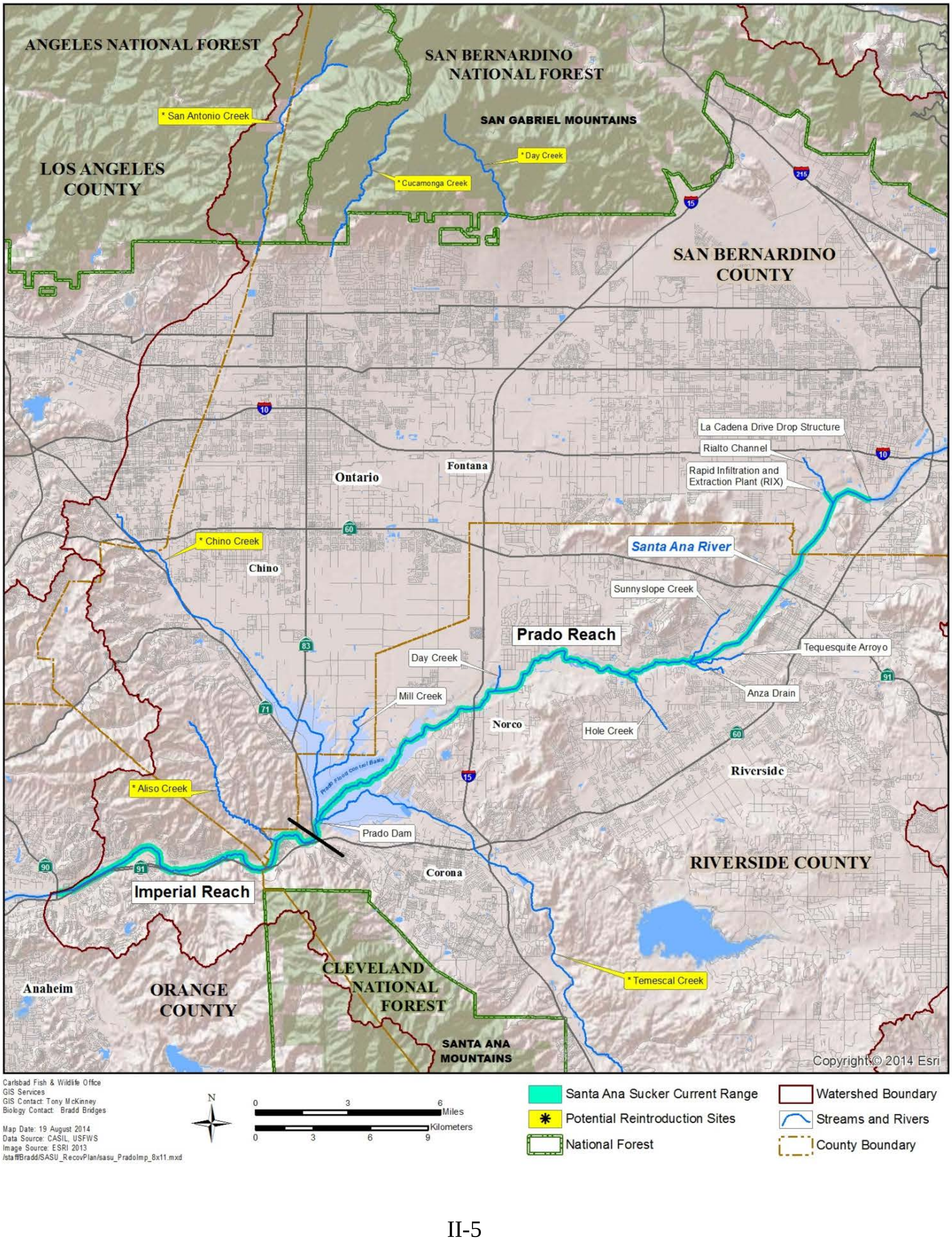
0 4.5 9 Miles

0 7 14 Kilometers

Santa Ana Sucker Current Range
Potential Reintroduction Sites
Streams and Rivers
Watershed Boundary
National Forest
County Boundary

Santa Ana Sucker Recovery Plan

Figure 3: Santa Ana River Watershed Recovery Unit: Imperial and Prado Reaches



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Map Date: 19 August 2014
Data Source: CASIL, USFWS
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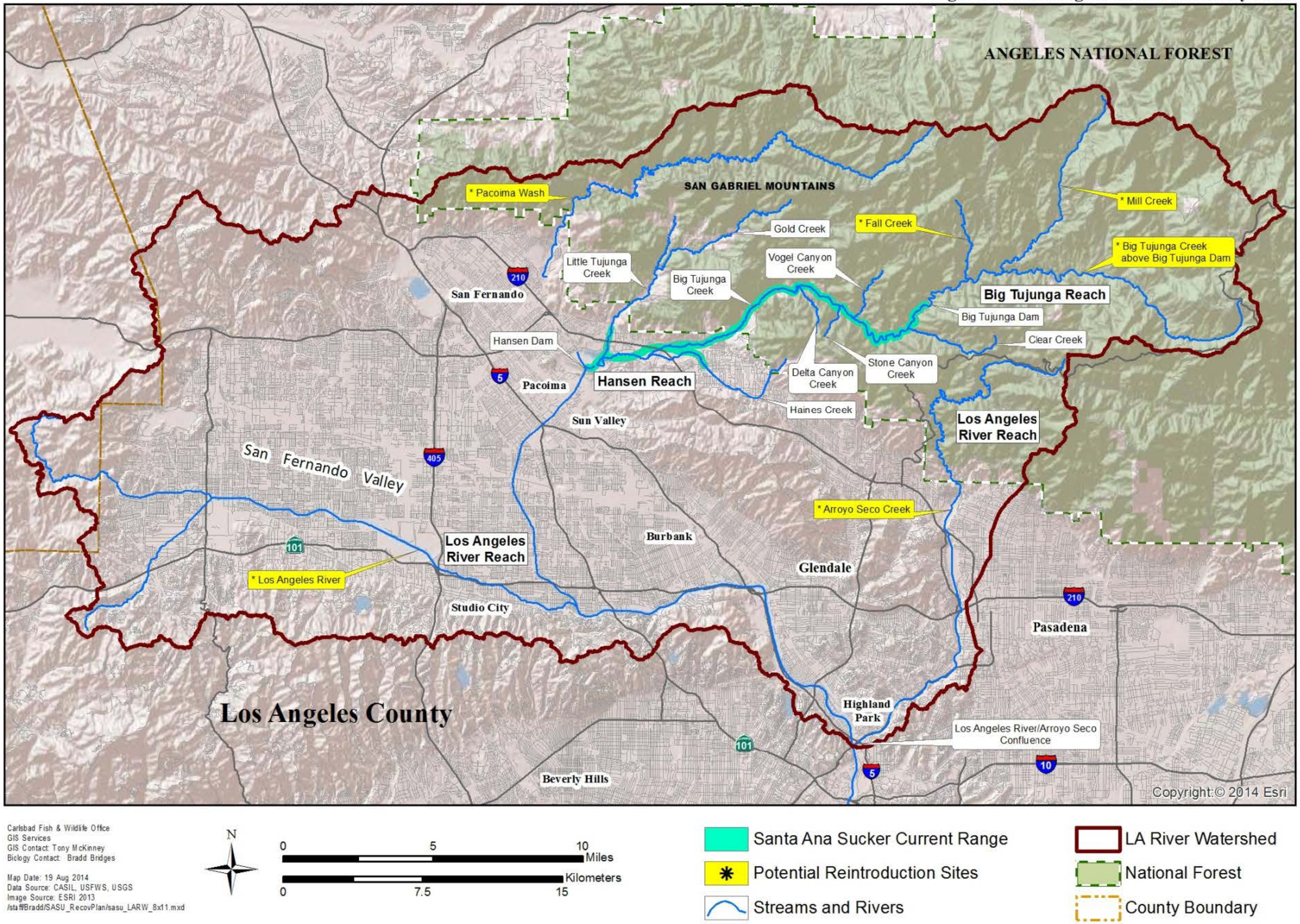
Santa Ana Sucker Recovery Plan
Figure 4: Los Angeles River Recovery Unit



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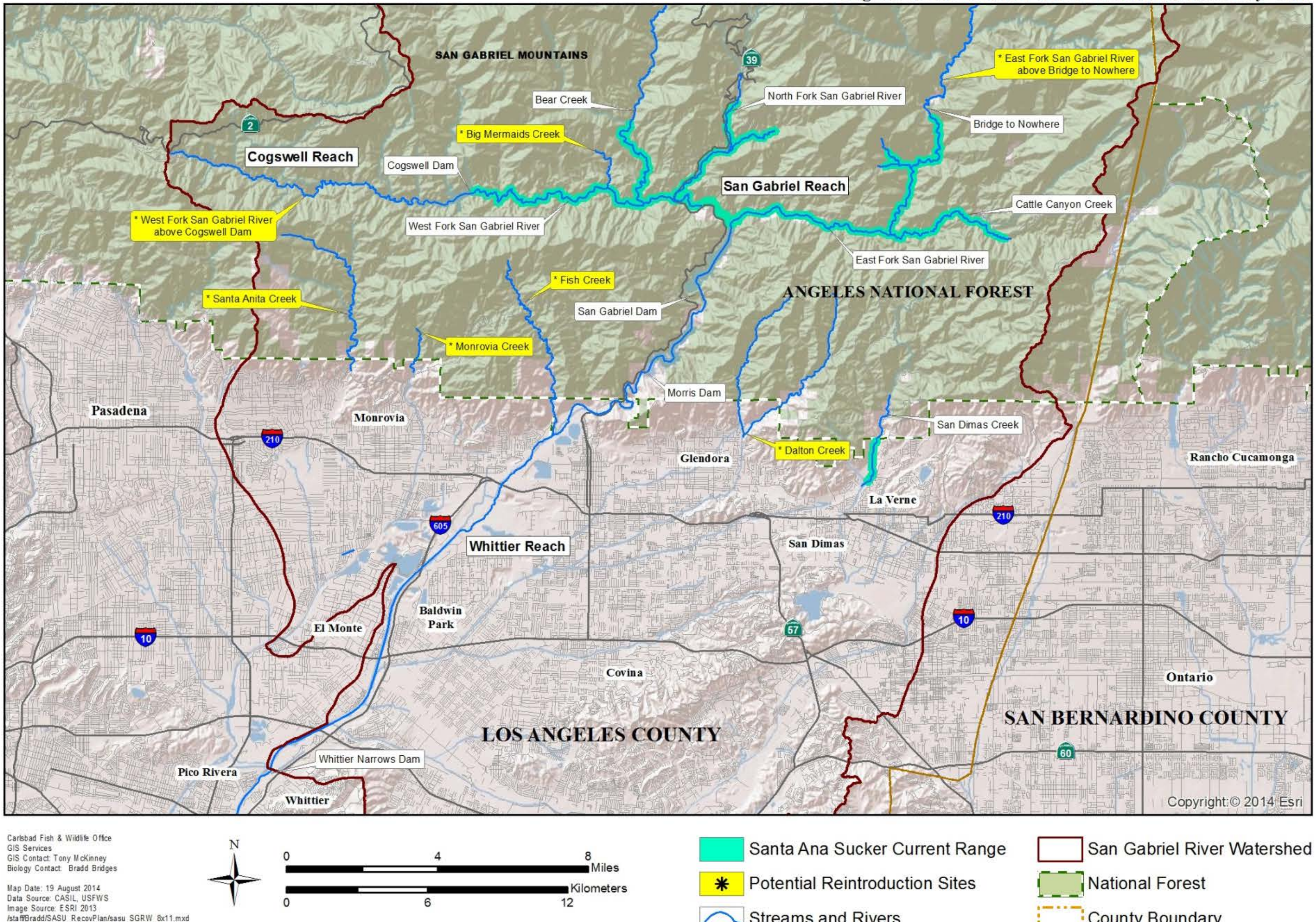
Santa Ana Sucker Recovery Plan

Figure 5: San Gabriel River Watershed Recovery Unit



B. Recovery Goal

The goal of this recovery plan is to control or reduce threats to Santa Ana sucker to the extent that it no longer requires protections afforded by the Act and, therefore, warrants delisting.

C. Recovery Objectives

Based on the recovery strategy and current threats to the species the following objectives are identified. Work with landowners and other stakeholders to:

1. Develop and implement a rangewide monitoring protocol to accurately and consistently document populations, occupied habitat, and threats.

2. Conduct research projects specifically designed to inform management actions and recovery.

3. Increase the abundance and develop a more even distribution of Santa Ana sucker within its current range by reducing threats to the species and its habitat.

4. Expand the range of the Santa Ana sucker by restoring habitat (if needed), and reestablishing occurrences within its historical range.

D. Recovery Criteria

An endangered species is defined in the Act as a species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. When we evaluate whether or not a species warrants downlisting or delisting, we consider whether the species meets either of these definitions. A recovered species is one that no longer meets the Act's definitions of threatened or endangered due to amelioration of threats. Determining whether a species should be downlisted or delisted requires consideration of the same five categories of threats which were considered when the species was listed and which are specified in section 4(a)(1) of the Act.

Recovery criteria are conditions that, when met, indicate that a species may warrant downlisting or delisting. Thus, recovery criteria are mileposts that measure progress toward recovery. Because the appropriateness of delisting is assessed by evaluating the five categories of threats identified in the Act, the recovery criteria below pertain to and are organized by these categories. These recovery criteria are our best assessment at this time of what needs to be completed so that the species may be removed from the list entirely. Because we cannot envision the exact course that recovery may take and because our understanding of the vulnerability of a species to threats is very likely to change as more is learned about the species and its threats, it is possible that a status review may indicate that delisting is warranted before all recovery criteria are met. Conversely, it is possible that the recovery criteria could be met and a status review may indicate that delisting is not warranted; for example, a new threat may emerge that is not addressed by the recovery criteria below.

Delisting Criteria

Recovery occurs when threats outlined in the **Reasons for Listing and Continued Threats** sections have been sufficiently ameliorated based on the criteria enumerated below. Recovery for Santa Ana sucker is not defined in terms of absolute numbers of fish, but by the number of protected and managed occurrences (existing and reestablished) that are sustained via natural processes and demography as well as ongoing management. The recovery criteria presented below represent our best estimate for measuring when the recovery objectives have been met. Unless stated explicitly, criteria are applicable to all recovery units and delisting will be considered for Santa Ana sucker when the following conditions have been met in each of the recovery units, including the Santa Ana River, Los Angeles River, and San Gabriel River RUs:

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

A.1 Adequate amounts of suitable habitat are restored, protected, and managed within each recovery unit to support viable populations (see Recovery Criteria E.3) of all life stages of Santa Ana sucker and provide resiliency and redundancy to protect against catastrophic events throughout the current range of the species.

Factor C: Predation

C.1 Management is implemented to reduce competition and predation by nonnative species to levels determined to be necessary for the maintenance of viable Santa Ana sucker populations.

Factor E: Other natural or manmade factors affecting its continued existence

E.1 The current range of the species is expanded through modification or removal of existing barriers, restoration of suitable habitat, and/or reintroduction of the species to areas within its historical range in a configuration that ensures reasonable certainty the remaining genetic makeup of the species has been preserved and can withstand catastrophic events in the watershed.

E.2. Appropriate gene flow is maintained between occupied areas of each RU, through natural processes or management, to ensure population viability and genetic exchange.

E.3 Stable or increasing population averaged over 15 years within each RU and occupancy in each of the following areas:

Santa Ana River Watershed Recovery Unit –

- Santa Ana River in the Prado Reach and Imperial Reach;

- Four tributaries in the Prado Reach and/or Imperial Reach (for example Tequesquite Arroyo, Anza Drain, Hole Creek, Evans Drain, Sunnyslope Creek, Day Creek, Aliso Creek); and
- Three tributaries in the La Cadena Reach (for example City Creek, Lytle Creek, Cajon Wash, Alder Creek, Plunge Creek, Santa Ana River above Seven Oaks Dam).

Los Angeles River Watershed Recovery Unit –

- Big Tujunga Creek in the Hansen Reach;
- Two tributaries in the Hansen Reach (for example, Haines Creek, Little Tujunga Creek); and
- One tributary in either the Big Tujunga Reach or Los Angeles Reach (for example, Fall Creek, Mill Creek, Arroyo Seco Creek).

San Gabriel River Watershed Recovery Unit –

- The East, West, and North forks of San Gabriel River in the San Gabriel Reach;
- Three tributaries in the San Gabriel Reach (for example, Bear Creek, Big Mermaids Creek, Cattle Canyon Creek); and
- Either the Cogswell Reach, the East Fork above the "Bridge to Nowhere", or one tributary in the Whittier Reach (for example, San Dimas Wash, Fish Canyon Creek).

E.4 A long-term monitoring and management plan is in place to evaluate the effectiveness of management actions to address ongoing threats and to identify new threats which may require implementation of adaptive management actions.

III. RECOVERY ACTION NARRATIVE AND IMPLEMENTATION SCHEDULE

The actions identified below are those that, in our opinion, are necessary to bring about the recovery of Santa Ana sucker and ensure its long-term conservation. However, these actions are subject to modification as dictated by new findings, changes in species status, and the completion of other recovery actions. We anticipate this recovery plan will be evaluated periodically to determine if the objectives are being achieved, and will be updated as necessary to incorporate new information.

Each action has been assigned a priority according to our determination of what is most important for the recovery of these species based on the life history, ecology, and threats (see the Background section of this document) and the following definitions of the priorities:

Priority 1: An action that is taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2: An action that is taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to provide for full recovery of the species.

There are several factors that are pertinent to consider when assigning priority numbers to these actions. First, Santa Ana suckers within Santa Ana and Los Angeles River watersheds are more at risk than in the San Gabriel River watershed, because the extent of suitable habitat is lower due to the construction and operation of large dams, making populations in these two watersheds at higher risk of local extirpation. There are also fewer unaltered tributaries available in the Santa Ana and Los Angeles River watersheds, compared to the San Gabriel River. In contrast, the hydrology in a large portion of the current range in the San Gabriel River remains unaltered (east and north forks and associated tributaries).

Priorities for each action will therefore vary within each watershed, depending on the magnitude and scope of the threats. The timing of actions may also be affected by the availability of funding, landowner permission, and the extent of information required to address the threat. Some threats may require specific research in order to inform management actions (for example, the timing and extent of flows needed to maintain suitable habitat conditions) while others can be addressed based on the current information available (for example, control of unauthorized OHV activity in occupied habitat). Recovery actions will be implemented in coordination with the landowners and other stakeholders within each watershed. Therefore, implementation tables were created separately for each watershed to determine priority actions necessary for recovery. While some threats are similar across the range of the species, separate tables will enable managers to focus on implementation of actions that are most pertinent for recovery of the Santa Ana sucker in their watershed.

The Recovery Action Narrative provides details of the actions necessary to achieve Santa Ana sucker recovery. The priorities within each Recovery Unit are specified in Tables 2, 3, and 4 following this section.

The numeric recovery priority system follows that of all Service recovery plans. Actions may be assigned Priority 1 where they are needed to prevent extinction or stabilize and secure populations or ecological functions undergoing irreversible degradation. Actions are labeled Priority 2 if they are needed to prevent the significant decline of the species or habitat. Priority 3 actions include other actions necessary for the full recovery of the species. Because situations change over time, priority numbers must be considered in the context of past and potential future actions at all sites. Therefore, the priority numbers assigned are intended to guide, not to constrain, the allocation of limited conservation resources.

A. Recovery Action Narrative

1. Develop and implement a rangewide monitoring protocol to accurately and consistently document populations, occupied habitat, and threats.

A standard protocol for monitoring Santa Ana sucker is needed to evaluate the efficacy of Recovery Actions and progress towards meeting Recovery Criteria. It will also allow for comparison of the relative status of the species in each watershed.

1.1 Develop a rangewide monitoring protocol. The protocol should include the following components (**Priority 2**):

- Metrics related to the status of the Santa Ana sucker population (for example, abundance, age structure, and distribution).
- Metrics related to the suitability of habitat for each life stage (for example, water quality, water quantity, substrate, and food sources).
- Metrics related to the status of threats (for example, hydrological modifications and barriers to dispersal, water quality, nonnative vegetation, and OHV use).
- Standardized data sheets.

1.2 Review and update the monitoring protocol to reflect new information as it becomes available. For example, research that leads to a better understanding of life history strategies, such as patterns of migration, growth, reproduction, and recruitment, may result in changes to metrics used to define suitable habitat for each life stage. (**Priority 3**)

2. Conduct biological research to inform management actions and recovery for the Santa Ana sucker.

There are numerous gaps in our understanding of Santa Ana sucker biology and ecology. Research is needed to identify optimum habitat conditions and to identify how to best minimize impacts caused by reduced water quality, altered hydrology, nonnative species, and small population size.

2.1 **Water Quality –** Determine the sensitivity of Santa Ana sucker to water quality variables that may be altered by hydrological modification or regulated discharges. Variables may include water temperature, thermal fluctuations, dissolved oxygen, turbidity, nitrates/nitrites, total dissolved solids, perchlorate, chlorine, sulfides, ammonia, various metals, and other organic compounds

2.1.1 Evaluate sensitivity to environmental conditions in the Santa Ana River RU (**Priority 2**).

2.1.2 Evaluate sensitivity to environmental conditions in the Los Angeles River RU **(Priority 2).**

2.2 **Hydrology –** In areas with modified hydrology, determine hydrological processes necessary to maintain breeding, feeding, and sheltering habitat for the species. Research should also focus on the timing and magnitude of flows that will maintain the complex diversity of habitat variables necessary to support each life stage (for example, sufficient sediment with appropriate grain size for spawning, pools, riffles, shallow stream margins, undercut banks, emergent aquatic vegetation, and riparian vegetation). The historical flow regime should be evaluated to determine the hydrological conditions that led to the creation of suitable habitat for the species and should be restored to the extent possible.

2.2.1 Evaluate hydrological processes in the Santa Ana River RU (**Priority 1**).

2.2.2 Evaluate hydrological processes in the Los Angeles River RU (**Priority 1**).

2.2.3 Evaluate hydrological processes in the San Gabriel River RU (for example West fork) (**Priority 3**).

2.3 **Sediment Transport –** In areas with modified hydrology, evaluate sediment sources and transport to determine if sufficient sediment is available to maintain appropriate gradient and substrate composition for the species.

2.3.1 Evaluate sediment transport in the Santa Ana River RU (**Priority 1**).

2.3.2 Evaluate sediment transport in the Los Angeles River RU (**Priority 3**).

2.3.3 Evaluate sediment transport in the San Gabriel River RU (**Priority 3**).

2.4 **Suitable Habitat –** Determine the habitat conditions (for example, gradient, water quality, water velocity, and substrate) that are conducive to supporting the Santa Ana sucker.

2.4.1 Determine optimal habitat conditions for spawning. Research should focus on how Santa Ana sucker reproduction is affected by gradient, substrate composition, water velocity, water quality, and any other relevant aspect of its habitat. This may include studies related to spawning cues, spawning behavior, egg adhesion, and viability of eggs, in relation to changing environmental conditions (**Priority 2**).

2.4.2 Determine optimal conditions for feeding. Research should include identification of food resources and habitat conditions necessary to sustain food resources (for example, water flow, water quality, and substrate) and feeding. Research should address food resources necessary to sustain all life stages (**Priority 2**).

2.5 **Nonnative Species –** Determine how habitat suitability can be improved through reduction of nonnative aquatic species and nonnative riparian vegetation.

2.5.1 Identify management actions that will ameliorate potential impacts of nonnative predators on Santa Ana sucker. Identify which life stages and under what circumstances Santa Ana suckers are most susceptible to predation (for example monitor stomach contents of predators).

2.5.1.1 Identify actions to ameliorate impacts of predation in the Santa Ana River RU (**Priority 2**).

2.5.1.2 Identify actions to ameliorate impacts of predation in the Los Angeles River RU (**Priority 2**).

2.5.1.3 Identify actions to ameliorate impacts of predation in the San Gabriel River RU (**Priority 3**).

2.5.2 Determine if habitat conditions for Santa Ana sucker can be improved through the removal/management of nonnative riparian vegetation (for example, *Arundo donax* and *Tamarix ramosissima*) (**Priority 3**).

2.5.3 Investigate the extent of impacts of invasive red algae (*Compsopogon coeruleus*) to Sana Ana sucker habitat within the Santa Ana River Recovery Unit. If impacts are found to be significant, investigate management actions to remove or treat this nonnative to reduce impacts to the sucker where it occurs (**Priority 1**).

2.6 **Genetics –** Ensure the natural genetic diversity across the range of the species is preserved.

2.6.1 Determine the genetic variation within and between watersheds where Santa Ana sucker occur (**Priority 2**).

2.6.2 Determine the status of Santa Ana sucker in the Santa Clara River. Additional information is needed from genetic studies to verify whether the species was artificially introduced into that watershed or if it occurs there naturally and should be considered part of the listed entity (**Priority 3**).

2.7 **Captive Propagation –** Captive propagation may be necessary to assist in the recovery of the species (for example, Santa Ana River Recovery Unit) due to the limited extent of suitable spawning habitat.

2.7.1 Use data available from monitoring activities and studies of Santa Ana sucker genetics, demography, life history, and ecology to determine if captive propagation would be needed to obtain the number of fish of appropriate genetic makeup needed to reestablish occurrences or a refuge population (**Priority 1**).

2.7.2 Determine the methodology necessary for captive propagation of Santa Ana suckers and rearing of all life stages (**Priority 1**).

2.7.3 If captive propagation is needed, assemble the necessary information to comply with the Fish and Wildlife Service's captive propagation policy, including development of a captive propagation plan that includes the following information (**Priority 1**):

- Location of facility.
- Number and origin of fish required for propagation.
- Methodology used for care and propagation.
- Number of reproductive crosses needed.
- Target number of fish to be produced.

3. Increase the abundance and distribution of the Santa Ana sucker within its current range by reducing threats to the species and its habitat.

Work with partners to plan and implement management for the Santa Ana sucker in each Recovery Unit. Management should include the implementation of Recovery Actions aimed at reducing threats to the species and its habitat. The abundance and distribution of Santa Ana suckers have been reduced in all watersheds as a result of modification or destruction of suitable habitat. Protection, restoration, and management of habitat within the current range of the species are critical to maintaining a stable population within each watershed. Many actions listed below will help to address multiple threats.

3.1 Ameliorate hydrological modifications due to flood control and water conservation operations. Based on the results of hydrology, sediment transport, and life history studies, secure sufficient water flows and sediment to maintain habitat for all life stages of the Santa Ana sucker. Natural hydrological functions should be mimicked to the extent possible and habitat managed to simulate natural processes as necessary in areas with regulated discharge to maintain suitable habitat for the species.

3.1.1 Prepare and implement a management plan to determine where flows are inadequate to sustain Santa Ana sucker habitat, and restore habitat through a combination of the following:

- Reduce water diversions to provide water flows sufficient to maintain habitat for Santa Ana sucker.

- Provide supplemental water flow from potable water supplies to restore or create habitat.

- Work with partners to improve habitat conditions through modification of dam/diversion operations. Changes in operations (amount and timing of releases) may contribute to restoration of a more natural system of water and sediment transport, which would improve habitat quality for the Santa Ana sucker.

- Manage sediment supply and distribution (for example, use sluice gates or other mechanisms to allow sediment transport through detention facilities) to sustain and improve habitat.

- Restore natural gradient in streams where flood control structures have altered the natural gradient.

- Manage vegetation and channel configuration to emulate conditions caused by flood-related disturbances.

3.1.1.1 Prepare and implement management plan to address flood control and water conservation operations in the Santa Ana River RU **(Priority 1).**

3.1.1.2 Prepare and implement management plan to address flood control and water conservation operations in the Los Angeles River RU **(Priority 2).**

3.1.1.3 Prepare and implement management plan to address flood control and water conservation operations in the San Gabriel River RU **(Priority 3).**

3.1.2 Reduce disturbance associated with flood control infrastructure maintenance. Work with our partners to determine if operation or design of flood control facilities could be altered to reduce the frequency of disturbance to the Santa Ana sucker and its habitat.

- Evaluate and change flood control facility maintenance practices to reduce the frequency of disturbance required.

- Redesign levees/embankments to eliminate the need for frequent repairs associated with annual storm flows.

- Enlarge or redesign culverts to provide more efficient sediment transport.

3.1.2.1 Reduce disturbance associated with flood control maintenance in the Santa Ana River RU **(Priority 2).**

3.1.2.2 Reduce disturbance associated with flood control maintenance in the Los Angeles River RU **(Priority 3).**

3.1.2.3 Reduce disturbance associated with flood control maintenance in the San Gabriel River RU **(Priority 3).**

3.2 Ameliorate hydrological modifications that create fish passage barriers. Reduce barriers to fish passage within currently occupied habitat to restore connectivity between populations and access to suitable habitat. Barriers to fish movement also have the potential to directly impact habitat for the Santa Ana sucker by changing the stream gradient, and altering hydrology. Determine which barriers to remove or modify to improve connectivity and reduce impacts to fish dispersal and sediment transport; implement removal or modification of identified barriers.

- **Recreational Dams.** Identify and remove recreational dams that are barriers to dispersal or otherwise impact Santa Ana sucker, post signs prohibiting the construction of recreational dams, and create educational brochures for distribution on public lands.

- **Road Crossings.** Create low flow channels or fish ladders within cement aprons under bridge crossings. Install bridges or culverts of a size and configuration that will allow fish passage over a wide range of flow levels.

- **Access into tributaries.** Reestablishing connection of tributaries to the mainstem will provide additional habitat and refuge for the Santa Ana sucker, especially juvenile suckers (for example, in Sunnyslope Creek). Remove cement barriers or cement lining in channels to increase access and habitat suitability (for example, in Day Creek and Evans Drain). Reestablish tributary flow rates sufficient to keep channel clear of vegetation and suitable for Santa Ana sucker.

- **Access to the floodplain.** Acquire (if necessary) and resort hydro-morphologic process to lands within the floodplain, such as abandoned golf courses and other areas where artificial fill has been placed.

3.2.1 Address specific fish passage barriers in the Santa Ana River RU **(Priority 2).**

3.2.2 Address specific fish passage barriers in the Los Angeles River RU **(Priority 3).**

3.2.3 Address specific fish passage barriers in the San Gabriel River RU **(Priority 3).**

3.3 Ameliorate reduced water quality. Based on the results of water quality studies (Recovery Action 2.1), ensure the water quality of flows altered by hydrological modification and regulated discharges are improved, as necessary, to provide water quality suitable for the Santa Ana sucker.

- Maintain water quality standards as defined by the Regional Water Quality Control Board to support Santa Ana sucker.

- Identify and implement dam operations that maintain suitable water quality for Santa Ana sucker.

- Integrate appropriate water quality standards into long-term monitoring program

3.3.1 Provide water quality suitable for the Santa Ana sucker in the Santa Ana River RU (**Priority 2**).

3.3.2 Provide water quality suitable for the Santa Ana sucker in the Los Angeles River RU (**Priority 3**).

3.3.3 Provide water quality suitable for the Santa Ana sucker in the San Gabriel River RU (**Priority 3**).

3.4 Ameliorate competition and predation by nonnative species to levels determined to be necessary for the maintenance of viable Santa Ana sucker populations

3.4.1 Manage nonnative predators, as necessary (based on the results of research conducted under Recovery Action 2.5.1) to reduce impacts caused by these species. Potential strategies include:

- Work with partners to alter dam operations to help suppress nonnative species by periodically increasing flow releases when there is an abundance of nonnative species.

- Reduce the extent of habitat available to support nonnative predators (for example, remove recreational dams and nonnative riparian vegetation).

- Reduce the introduction of nonnative predators into habitat for Santa Ana sucker (for example, install fish screens to prevent escape of nonnative predators from ponds and artificial wetlands)

3.4.1.1 Manage predators in the Santa Ana River RU (**Priority 2**).

3.4.1.2 Manage predators in the Los Angeles River RU (for example, Haines Creek) (**Priority 2**).

3.4.1.3 Manage predators in the San Gabriel River RU (**Priority 3**).

3.4.2 Manage nonnative vegetation, as necessary (based on the results of research conducted under Recovery Actions 2.5.2 and 2.5.3) to reduce impacts to Santa Ana sucker habitat caused by nonnative vegetation (for example, *Arundo donax*, *Tamarix ramosissima*, and *Compsopogon coeruleus*).

- Remove nonnative riparian vegetation in areas that will improve habitat conditions for Santa Ana sucker.

- Coordinate with existing nonnative riparian vegetation removal programs to target areas that will improve habitat conditions for Santa Ana sucker.

- Control the extent of the invasive algae by drying, chemical treatment, managing flows, or altering water quality.

3.4.2.1 Manage nonnative vegetation in the Santa Ana River RU (**Priority 1**).

3.4.2.2 Manage nonnative vegetation in the Los Angeles River RU (**Priority 3**).

3.4.2.3 Manage nonnative vegetation in the San Gabriel River RU (**Priority 3**).

3.5 Ameliorate impacts to habitat from recreational activities (for example, OHV use, swimming/bathing, fishing, and mining). Strategies should consider the timing, frequency, location, and magnitude of activities that can be implemented in occupied habitat for the Santa Ana sucker without causing a decline in productivity within the watershed. Develop and implement strategies to reduce impacts through outreach and regulated access:

- Limit the number of activity permits issued and implement timing restrictions.
- Reduce the number of access points.
- Increase the number of trash facilities and the frequency of trash collection.
- Install signs informing the public of authorized activities.
- Patrol and issue tickets for unauthorized activities.
- Develop educational programs and brochures.

3.5.1 Manage recreation in the Santa Ana River RU (for example OHV activity) **(Priority 2).**

3.5.2 Manage recreation in the Los Angeles River RU (for example, swimming, mining, OHV activity) **(Priority 2).**

3.5.3 Manage recreation in the San Gabriel River RU (for example, swimming, mining, OHV activity) **(Priority 2).**

4. Increase the range of the Santa Ana sucker by restoring habitat (as needed), and reestablishing occurrences within its historical range.

The abundance and distribution of the Santa Ana sucker has been reduced by modification and destruction of suitable habitat. Reestablishment of Santa Ana sucker in areas currently outside of the range of the species is needed for recovery. In order to reestablish occurrences, areas within the historical range of the species will need to be restored, protected, and managed to provide habitat suitable for all life stages of Santa Ana sucker. Expansion of the range can occur passively through removal of barriers to dispersal or it can occur through active reintroduction of the Santa Ana sucker to habitat within its historical range.

The extent of additional occupied habitat that will be needed for the recovery of the species within each watershed is related to the extent of threats within the current range and the potential to manage those threats. An expanded range, including refuge populations, provides resiliency where threats within the current range cannot be reduced effectively or to an extent needed to maintain a stable population. We will prioritize locations for potential reintroduction, based on the ability to reduce threats in the current range in a timely and effective manner.

The planning and implementation of projects involving the expansion of the range of the species will involve cooperation with stakeholders, including, but not limited to private landowners, local resource management agencies, and State, and Federal agencies. Expansion of the species range will generally occur as follows:

4.1 **Assess habitat within the historical range** that can be restored and made suitable for passive range expansion or reintroduction of Santa Ana sucker. The highest priority should be given to areas within the historical range that contain the known habitat requirements (described in the **Habitat and Ecosystem** section above) or can be restored with reasonable effort to provide these characteristics.

4.1.1 Assess areas within the Santa Ana River RU for potential range expansion. Areas to be considered for possible reintroduction include: Aliso Creek, Temescal Creek, Chino Creek, San Antonio Creek, Cucamonga Creek, Day Creek, Alder Creek, Santa Ana River above Seven Oaks dam, Mill Creek, Lytle Creek, Cajon Wash, City Creek, Plunge Creek, Warm Creek, Mountain Home Creek, Bear Creek, and other potential tributaries (**Priority 1**).

4.1.2 Assess areas within the Los Angeles River RU for potential range expansion. Areas to be considered for possible reintroduction include: Fall Creek, Mill Creek and Arroyo Seco Creek, and Pacoima Wash (**Priority 3**).

4.1.3 Assess areas within the San Gabriel RU for potential range expansion. Areas to be considered for possible reintroduction include: upstream from Cogswell Dam, East For San Gabriel River above the Bridge to Nowhere, Fish Creek, Dalton Creek, Santa Anita Creek, and Monrovia Creek (**Priority 3**).

4.2 **Plan and implement habitat restoration and reintroductions** using data obtained from habitat assessments of potential range expansion areas. Restoration and reintroduction plans should include the following information to assist in evaluating how the actions may benefit the Santa Ana sucker:

- A description of existing habitat conditions (for example, water quality, hydrology, stream gradient, substrate, cover, and other habitat variables determined to be important for supporting the species).

- A description of potential threats to the species (for example, altered hydrology, nonnative species, recreation, poor water quality).

- The methodology for restoration of suitable habitat (if necessary).

- Number, age class(s), and origin of fish to be relocated (if necessary). The origin of fish should be based on the results of genetic analysis (Recovery Task 2.6.1) to ensure the proposed relocation does not alter the natural genetic diversity across the range of the species.

- Methods for transport and release of fish (if necessary).

- Timing of project implementation.

- Pre- and post-project monitoring strategy to assess effectiveness of the habitat restoration or reintroductions. Monitoring should be conducted for a sufficient period to determine if the project resulted in persistent occurrences of healthy fish (for example, abundance, distribution, age classes).

- Long-term management activities required to maintain the species within the expanded range and to address ongoing threats as described in Objective 3 above. Adaptive management strategies should be incorporated as needed to address new threats as they are identified. For isolated occurrences, management should consider future introductions that may be necessary to ensure minimal genetic drift, genetic bottlenecks, and other risks associated with low genetic variability.

4.2.1 Prepare and implement range expansion plan(s) for the Santa Ana River RU (**Priority 1**).

4.2.2 Prepare and implement range expansion plan(s) for the Los Angeles River RU (**Priority 3**).

4.2.3 Prepare and implement range expansion plan(s) for the San Gabriel River RU (**Priority 3**).

B. Implementation Schedule

The following implementation schedule outlines actions and estimated costs for this draft recovery plan. This schedule prioritizes actions, provides an estimated timetable for performance of actions, indicates the responsible parties, and estimates costs of performing actions. Cost estimates are provided for the entire recovery period (estimated to be 25 years) as well as detailed for the first 5 years of the recovery period. These actions, when accomplished, should further the recovery and conservation of the listed species.

Key to additional terms and acronyms used in the Implementation Schedule:

Definition of action durations:

Number: The predicted duration of the action in years.

Ongoing: An action that is currently being implemented and will continue throughout the recovery period.

Continual: An action that is not currently being implemented but will be implemented continuously throughout the recovery period once begun.

Unknown: Either action duration or associated costs are not known at this time.

Responsible Parties:

Responsible parties are those partnering agencies who may voluntarily participate in any aspect of implementation of particular tasks listed within this draft recovery plan. Responsible parties may willingly participate in project planning, funding, staff time, or any other means of implementation. The identification of responsible parties for specific tasks (Tables 2-4) is not intended to limit involvement by other parties or to require the involvement of the party identified. Key land managers, land owners, or other stakeholders that have been identified in the implementation schedule:

- California Department of Fish and Wildlife (CDFW)
- City of Riverside (Riverside)
- County of Los Angeles Department of Public Works (LACDPW)
- Los Angeles County Department of Parks and Recreation (LACDPR)
- Inland Empire Resource Conservation District (IERCD)
- Orange County Flood Control District (OCFCD)
- Orange County Water District (OCWD)
- Private landowners (Private)
- Regional Water Quality Control Board (RWQCB)
- Riverside-Corona Resource Conservation District (RCRCD)
- Riverside County Flood Control and Water Conservation District (RCFCWCD)
- Santa Ana Watershed Association (SAWA)
- San Bernardino County Flood Control District (SBCFCD)
- Santa Ana Watershed Protection Authority (SAWPA)
- Southern California Edison (SCE)
- U.S. Army Corps of Engineers, Los Angeles District (USACE)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Geological Survey (USGS)
- U.S. Forest Service (USFS)

Please note, additional Responsible Parties may be added in the final Recovery Plan subsequent to coordination and collaboration with our partners on specific recovery actions.

Table 2: Implementation Schedule – Actions to be completed across all recovery units (Santa Ana River, Los Angeles River, and San Gabriel River Recovery Units).

Santa Ana River, Los Angeles River, and San Gabriel River Recovery Units											
Action number	Priority	Description	Responsible Parties[1]	Duration (years)	Fiscal Year Cost Estimates (thousands of dollars)						Total cost of action for recovery
					FY1	FY2	FY3	FY4	FY5	Total	
1.1	2	Develop a rangewide monitoring protocol.	USFWS	1	50					50	50
1.2	3	Review and update the monitoring protocol to reflect new information as it becomes available.	USFWS	Continual	TBD						TBD
2.4.1	2	Determine optimal habitat conditions for spawning.	USFWS CDFW	2		100	100			200	200
2.4.2	2	Determine optimal conditions for feeding.	USFWS CDFW	2		100	100			200	200
2.5.2	3	Determine if habitat conditions for Santa Ana sucker can be improved through the removal/management of nonnative riparian vegetation.	RCRCD SAWA USFS	2	50	50				100	100
2.6.1	2	Determine the genetic variation within and between watersheds where Santa Ana sucker occur.	USGS	1	50					50	50
2.6.2	3	Determine the status of Santa Ana sucker in the Santa Clara River.	USFWS CDFW USGS	1	50					50	50

[1] The identification of responsible parties for specific tasks (Tables 2–5) is not intended to limit involvement by other parties or to require the involvement of the party identified.

Table 3: Implementation Schedule – Santa Ana River Recovery Unit.

Santa Ana River Recovery Unit												
Action number	**Priority**	**Description**	**Responsible Parties**	**Duration (years)**	**Fiscal Year Cost Estimates (thousands of dollars)**						**Total cost of action for recovery**
					FY1	**FY2**	**FY3**	**FY4**	**FY5**	**Total**	
2.1.1	2	Evaluate sensitivity to environmental conditions in the Santa Ana River RU.	USFWS USGS RWQCB	2	100	100				200	200
2.2.1	1	Evaluate hydrological processes in the Santa Ana River RU.	USGS USACE	2	75	75				150	150
2.3.1	1	Evaluate sediment transport in the Santa Ana River RU.	USGS USACE	1			75			75	75
2.5.1.1	2	Identify actions to ameliorate impacts of predation in the Santa Ana River RU.	OCWD USACE	2	50	50				100	100
2.5.3	1	Investigate the extent of impacts of invasive red algae (*Compsopogon coeruleus*) to Santa Ana sucker habitat within the Santa Ana River RU. Investigate management actions to remove or treat this nonnative to reduce impacts to the sucker where it occurs.	USFWS RWQCB USACE CDFW	Unknown	60	60				120	120
2.7.1	1	Use data available from monitoring activities and studies of Santa Ana sucker genetics, demography, life history, and ecology to determine if captive propagation is required to obtain the number of fish of appropriate genetic makeup needed to reestablish occurrences or develop a refuge population.	USFWS	Unknown	TBD						TBD

Action number	Priority	Description	Responsible Parties	Duration (years)	Fiscal Year Cost Estimates (thousands of dollars)						Total cost of action for recovery
					FY1	FY2	FY3	FY4	FY5	Total	
2.7.2	1	Determine the methodology necessary for captive propagation of Santa Ana suckers and rearing of all life stages.	RCRCD	2	75	75				150	150
2.7.3	1	If captive propagation is required, assemble the necessary information to comply with the captive propagation policy, including development of a captive propagation plan.	USFWS CDFW USGS	1			50			50	50
3.1.1.1	1	Prepare and implement management plan to address flood control and water conservation operations in the Santa Ana River RU.	USACE OCFCD RCFCWCD SBCFCD SCE SAWPA	Unknown	TBD						TBD
3.1.2.1	2	Reduce disturbance associated with flood control maintenance in the Santa Ana River RU.	USACE OCFCD RCFCWCD SBCFCD	Unknown	TBD						TBD
3.2.1	2	Address specific fish passage barriers in the Santa Ana River RU.	TBD	Unknown	TBD						TBD
3.3.1	2	Provide water quality suitable for the Santa Ana sucker in the Santa Ana River RU.	RWQCB USACE	Continual	TBD						TBD
3.4.1.1	2	Manage predators in the Santa Ana River RU.	OCWD Riverside USFS CDFW USFWS	Continual	50	25	25	25	25	150	275
3.4.2.1	1	Manage nonnative vegetation in the Santa Ana River RU.	IERCD RCRCD SAWA OCFCD OCWD	Continual	50	25	25	25	25	150	275

Action number	Priority	Description	Responsible Parties	Duration (years)	Fiscal Year Cost Estimates (thousands of dollars)						Total cost of action for recovery
					FY1	FY2	FY3	FY4	FY5	Total	
3.5.1	2	Manage recreation in the Santa Ana River RU.	OCWD OCFCD USACE Private	Continual	40	20	20	20	20	120	220
4.1.1	1	Assess areas within the Santa Ana River RU for potential range expansion..	USFWS CDFW USFS	2	50	50				100	100
4.2.1	1	Prepare and implement range expansion plan(s) for the Santa Ana River RU.	USFWS USACE USFS USGS	Continual	TBD						TBD

Table 4: Implementation Schedule – Los Angeles River Recovery Unit.

Los Angeles River Recovery Unit

Action number	Priority	Description	Responsible Parties	Duration (years)	Fiscal Year Cost Estimates (thousands of dollars)						Total cost of action for recovery
					FY1	FY2	FY3	FY4	FY5	Total	
2.1.2	2	Evaluate sensitivity to environmental conditions in the Los Angeles River RU.	LACDPW RWQCB	2	100	100				200	200
2.2.2	1	Evaluate hydrological processes in the Los Angeles River RU.	USGS LACDPW USFS	2	50	50				100	100
2.3.2	3	Evaluate sediment transport in the Los Angeles River RU.	USGS LACDPW USFS	1			75			75	75
2.5.1.2	2	Identify actions to ameliorate impacts of predation in the Los Angeles River RU.	LACDPW USFS	2	50	50				100	100
3.1.1.2	2	Prepare and implement management plan to address flood control and water conservation operations in the Los Angeles River RU.	LACDPW USFS	Unknown	TBD						TBD
3.1.2.2	3	Reduce disturbance associated with flood control maintenance in the Los Angeles River RU.	LACDPW	Unknown	TBD						TBD
3.2.2	3	Address specific fish passage barriers in the Los Angeles River RU.	USFS	Unknown	TBD						TBD
3.3.2	3	Provide water quality suitable for the Santa Ana sucker in the Los Angeles River RU.	LACDPW RWQCB USFS	Continual	TBD						TBD
3.4.1.2	2	Manage predators in the Los Angeles River RU (for example, Haines Creek).	LACDPW USFS	Continual	50	25	25	25	25	150	250

Action number	Priority	Description	Responsible Parties	Duration (years)	Fiscal Year Cost Estimates (thousands of dollars)						Total cost of action for recovery
					FY1	FY2	FY3	FY4	FY5	Total	
3.4.2.2	3	Manage nonnative vegetation in the Los Angeles River RU.	LACDPW USFS	Continual	50	25	25	25	25	150	250
3.5.2	2	Manage recreation in the Los Angeles River RU.	USFS LACDPR	Continual	40	20	20	20	20	120	220
4.1.2	3	Assess areas within the Los Angeles River RU for potential range expansion.	USFWS CDFW USFS	2	50	50				100	100
4.2.2	3	Prepare and implement range expansion plan(s) for the Los Angeles River RU.	USFS USFWS CDFW LACDPW	Continual	TBD						TBD

Table 5: Implementation Schedule – San Gabriel River Recovery Unit.

San Gabriel River Recovery Unit											
Action number	Priority	Description	Responsible Parties	Duration (years)	Fiscal Year Cost Estimates (thousands of dollars)						Total cost of action for recovery
					FY1	FY2	FY3	FY4	FY5	Total	
2.2.3	3	Evaluate hydrological processes in the San Gabriel River RU (for example, West fork).	USGS LACDPW USFS	2	50	50				100	100
2.3.3	3	Evaluate sediment transport in the San Gabriel River RU.	USGS LACDPW USFS	1			75			75	75
2.5.1.3	3	Identify actions to ameliorate impacts of predation in the San Gabriel River RU.	USFS LACDPW	2	50	50				100	100
3.1.1.3	3	Prepare and implement management plan to address flood control and water conservation operations in the San Gabriel River RU.	LACDPW USFS	Unknown	TBD						TBD
3.1.2.3	3	Reduce disturbance associated with flood control maintenance in the San Gabriel River RU.	LACDPW USFS	Unknown	TBD						TBD
3.2.3	3	Address specific fish passage barriers in the San Gabriel River RU.	USFS Private LACDPW	Unknown	TBD						TBD
3.3.3	3	Provide water quality suitable for the Santa Ana sucker in the San Gabriel River RU.	LACDPW USFS RWQCB	Continual	TBD						TBD
3.4.1.3	3	Manage predators in the San Gabriel River RU.	LACDPW USFS	Unknown	TBD						TBD

Action number	Priority	Description	Responsible Parties	Duration (years)	Fiscal Year Cost Estimates (thousands of dollars)						Total cost of action for recovery
					FY1	FY2	FY3	FY4	FY5	Total	
3.4.2.3	3	Manage nonnative vegetation in the San Gabriel River RU.	USFS	Unknown	TBD						TBD
3.5.3	2	Manage recreation in the San Gabriel River RU.	USFS	Continual	40	20	20	20	20	120	220
4.1.3	3	Assess areas within the San Gabriel River RU for potential range expansion.	USFWS CDFW USFS	1	25	25				50	50
4.2.3	3	Prepare and implement range expansion plan(s) for the San Gabriel River RU.	USFWS CDFW USFS	Continual	TBD						TBD

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