Petition to List the Santa Ana Speckled Dace (*Rhinichthys osculus* subspecies) as Endangered or Threatened under the Endangered Species Act

CENTER for BIOLOGICAL DIVERSITY

Because life is good.

May 11, 2020

Notice of Petition

Submitted to the U.S. Fish and Wildlife Service on May 11, 2020:

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Petitioner Center for Biological Diversity formally requests that the U.S. Fish and Wildlife Service ("USFWS") list the Santa Ana speckled dace (*Rhinichthys osculus* subspecies) as an endangered or threatened Distinct Population Segment under the federal Endangered Species Act ("ESA"), 16 U.S.C. §§1531-1544. Alternatively, Petitioner requests that the USFWS determine that the Santa Ana speckled dace is a valid species, which should be listed as endangered or threatened under the ESA.

The Center requests that critical habitat for the Santa Ana speckled dace be designated concurrent with listing.

This petition is filed under §553(e) of the Administrative Procedure Act ("APA" - 5 U.S.C. §§ 551-559), §1533(b)(3) of the ESA, and 50 C.F.R. §424.14(b). This petition sets in motion a specific administrative process as defined by §1533(b)(3) and 50 C.F.R. §424.14(b), placing mandatory response requirements on the USFWS. Because the Santa Ana speckled dace is exclusively a fresh water fish, the USFWS has jurisdiction over this petition.

The Center for Biological Diversity is a nonprofit environmental organization dedicated to the protection of native species and their habitats. The Center submits this petition on its own behalf and on behalf of its members and staff with an interest in protecting the Santa Ana speckled dace and its habitat.

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Executive Summary

The Santa Ana speckled dace is a small cyprinid fish native to the Santa Ana, San Jacinto, San Gabriel, and Los Angeles river systems of southern California.

It has long been thought that Santa Ana speckled dace merit description as a subspecies of speckled dace, due to their geographic separation from other speckled dace populations and distinctive morphology. Recent genetic analyses have confirmed that Santa Ana speckled dace are distinct from other dace populations and perhaps merit full species designation. For the purposes of the Endangered Species Act, the Santa Ana speckled dace is Distinct Population Segment which qualifies as a “species” and should be protected as endangered or threatened under the Act.

Speckled dace occupy a variety of aquatic habitats, but optimal habitat is in perennial streams fed by cool springs and with overhanging riparian vegetation. Optimal spawning habitat is in shallow areas of gravel or gravelly riffle edges with tributary inlets.

Santa Ana speckled dace now occupy only remnants of their historical range and are restricted mainly to headwater tributaries, many of them within National Forests. These include: Big Tujunga Creek and Haines Creek tributaries in the Los Angeles River drainage; the East, West and North Forks of the San Gabriel River, as well as tributaries Cattle Canyon, Devil's Canyon, Bear Creek, and Fish Canyon; the mainstem, North Fork and Middle Fork of Lytle Creek, Cajon Creek, West Fork City Creek, and Plunge Creek in the Santa Ana River basin; North Fork San Jacinto River, and Indian Creek in the San Jacinto River headwaters. Most of these populations have lost connectivity and are isolated from other populations.

Santa Ana speckled dace have been extirpated from: most of the Los Angeles River basin, including tributaries Little Tujunga Creek, Pacoima Creek, and Santa Anita Canyon Creek; most of the Santa Ana River basin, including the middle reaches of the Santa Ana River, and tributaries Mill Creek, East Twin Creek, Santiago Creek, Silverado Canyon, Harding Canyon, and San Antonio Creek; and most of the San Jacinto River basin, including the mainstem San Jacinto River, South Fork San Jacinto River, and tributaries Herkey Creek and Strawberry Creek.

The decline of the Santa Ana speckled dace is part of a greater overall decline of freshwater fishes in Southern California. Dams, water diversions, and urbanization combined with drought have been the primary threats to dace and other Southern California freshwater fish. Dams and water diversions deplete stream flows, sometimes dewater streams, alter natural flow regimes, and isolate dace populations. Reservoirs and dams favor introduced predators and competitors of dace. Urbanization and suburbanization has degraded all of the watersheds containing dace. Extensive river channelization and impoundment has occurred in the middle and lower reaches of all rivers for flood control. Dace habitat has also been destroyed or modified by roads, agricultural activities, pollution, livestock grazing, mining, and recreation.

Santa Ana speckled dace are highly vulnerable to extinction within the next 50 years because their small, fragmented, populations are restricted to areas that are increasingly prone to catastrophic fire, flooding and debris flows, intensive water diversion and consumption, pollution, invasive species, expanding urbanization and suburban development, and recreation. Climate change will exacerbate many of the impacts of these threats to dace.

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Introduction

North American freshwater ecosystems and the many species they support are some of the most threatened ecosystems on the planet. Based on current trends, Ricciardi and Rasmussen (1999) model a future extinction rate of four percent per decade for North American freshwater fauna, stating, "North American freshwater biodiversity is diminishing as rapidly as that of some of the most stressed terrestrial ecosystems on the planet." The projected extinction rate for U.S. freshwater animals is five times that of terrestrial animals, and is comparable to the extinction rate for tropical rainforests (Herrig and Shute 2002). From 1898 to 2006, 57 North American freshwater fish taxa became extinct, and three distinct populations were extirpated from the continent; and since 1989, the numbers of extinct North American fishes have increased by 25% (Burkhead 2012). The modern extinction rate for North American freshwater fishes is conservatively estimated to be 877 times greater than the background extinction rate for freshwater fishes (Burkhead 2012). Reasonable estimates project that future increases in extinctions will range from 53 to 86 species of North American freshwater fish lost by 2050 (Burkhead 2012).

The situation for freshwater fish in California is even more dire. An assessment of conservation status by Moyle et al. (2011) found that 107 of California's 129 native freshwater fish taxa (83%) risk extinction in the next century; a 16% increase since 1995 and a 21% increase since 1989. Moyle et al. (2015) found that 62 of California's 124 native inland fishes (defined as those breeding in fresh water) are of special concern, while 38 others are listed or extinct, meaning that 81% of California's highly distinctive inland fish fauna are in decline, headed toward extinction, or already extinct. California is in the forefront of the world trend towards extinctions in fresh water, with nearly half of the 2,000 or so California aquatic species threatened with extinction (Howard et al. 2015).

The decline of the Santa Ana speckled dace is part of an overall pattern of decline of freshwater fishes in Southern California, due to the impacts of dams, increasing water use, and urbanization, combined with drought and climate change. As early as 1995, Moyle et al. (1995) declared Santa Ana speckled dace numbers so diminished that they were in danger of extinction. The American Fisheries Society rated the Santa Ana speckled dace as threatened (Jelks et al. 2008). The U.S. Forest Service stated that the Santa Ana speckled dace population in the Los Angeles basin is "very low and on the verge of extinction" (USFS 2010). Moyle et al. (2015) rated the status of Santa Ana speckled dace as of "critical concern" and in danger of extinction in the next 50 years. The California Natural Diversity Database ranks the Santa Ana speckled dace as "critically imperiled" (CDFW 2019).

NATURAL HISTORY

Description

Moyle et al. (2015) provide a description of speckled dace:

> Speckled dace are small cyprinids, usually measuring 8-11 cm SL (Moyle 2002). Although physically variable, they are characterized by a wide caudal peduncle, small scales (47-89 along lateral line) and pointed snout with a small, subterminal, mouth. Larvae have deep bodies, small eyes, overhanging snout and are characterized by 35-41 myomeres and distinctive coloration (Feeney and Swift 2008). Distinctive coloration in larvae includes large spots located on the sides of the bottom portion of the caudal peduncle and a wedge-shaped patch of

spots on top of the head. Larvae have functioning eyes, mouth, and gas bladder by the time the notochord flexes at about 7-9 mm TL. A noticeable band of pigment running just below the lateral midline is visible at about 9 mm. The terminal mouth of larvae becomes subterminal at about 9.7 mm. The pectoral fins remain unpigmented until the later stages of larval development. Later stages also develop a distinctive spot on the base of the caudal fin. Scales appear when dace reach 13 mm FL (Jhingran 1948). Once fully developed, the dorsal fin usually has 8 rays and originates well behind the origin of the pelvic fins (Moyle 2002). The anal fin has 6-8 rays. Pharyngeal teeth (1,4-4,1 or 2,4-4,2) are significantly curved with a minor grinding surface. The maxilla usually has a small barbel at each end. The snout is connected to the upper lip (premaxilla) by a small bridge of skin (frenum). Most fish larger than 3 cm have distinctive dark speckles on the upper and sides of the body, a dark lateral band that extends to the snout, and a spot on the caudal peduncle. The rest of the body is dusky yellow to olive, with the belly a paler color. Breeding adults of both sexes have fins tipped by orange or red, while males also have red snouts and lips and tiny tubercles on the head and pectoral fins.

Taxonomy

The genus *Rhinichthys* is widely distributed and abundant in North America and has eight recognized species. However, most species are highly variable and may encompass complexes of unrecognized species or subspecies (Moyle 2002). Early taxonomists described different forms as separate species but later lumped them together when the variable nature of each species was discovered. For example, Jordan and Evermann (1896) described 12 separate species, which were later collapsed into a single species (Hubbs et al. 1974), with ichthyologists citing morphological plasticity.

However, subspecies, many of which were formerly recognized as full species, continue to be recognized on the basis of their location and isolation, provided formal scientific names exist for them. Although widely distributed, evidence continues to mount that isolated speckled dace populations throughout the west have long independent evolutionary histories, with distinctive adaptations to local environments (Moyle et al. 2015, Moyle unpublished data).

Much of the resistance to breaking *Rhinichthys osculus* into separate species stems from lack of definitive morphological characters (Smith et al. 2017). While character driven identification is the primary means to identify species, it is no longer the only way to identify species and has not been for decades now (Baumsteiger and Moyle 2018). Cryptic evolutionary lineages exist that can only be identified through genetic/genomic approaches as Baumsteiger and Moyle (2018) found for speckled dace and Baumsteiger et al. (2017) found for another group of cyprinids (CA Roach/Hitch Lavinia/Hesperoleucus).

Relationships among various lineages have been awaiting resolution using modern molecular and morphometric techniques. In Oregon, speckled dace collected from five river basins exhibited high levels of divergence (0.82) among locations, and high genetic diversity (0.2, nucleotide diversity) within basins (Pfrender et al. 2004). Similarly, Oakey et al. (2004) found that speckled dace collected throughout the western United States were significantly different among sub-basins, consistent with the idea that local populations are characterized by long isolation from other populations. Based on the findings of their phylogenetic studies, Pfrender et al. (2004) proposed that populations within different basins should be considered to be Evolutionarily Significant Units for the purposes of management. Mounting evidence demonstrates that multiple speckled dace populations throughout Death Valley, California constitute either valid subspecies or distinct population segments (Sada et al. 1995; Furiness 2012; Baumsteiger and Moyle 2018).

The Santa Ana speckled dace has long been thought to merit subspecies or full species designation due to its distinctive morphology (Cornelius 1969; Hubbs et al. 1979) and genetic distinction from other dace in California (Oakey et al. 2004; Smith and Dowling 2008), although the subspecies has not yet been formally described. Santa Ana speckled dace are more closely related to speckled dace in the Colorado River basin than dace in northern California, as a result of a split in clades approximately 3.6 million years ago (Oakey et al. 2004; Smith and Dowling 2008). Oakey et al. (2004) determined that Santa Ana speckled dace from the Santa Ana and San Gabriel rivers formed a monophyletic lineage. Santa Ana speckled dace in the Santa Ana and San Gabriel rivers were found to be only distantly related to those in the Owens or Amargosa rivers (Smith and Dowling 2008). Smith and Dowling (2008) indicated that Santa Ana speckled dace have been isolated long enough (through the Pleistocene) to develop distinctive morphological characters. The long phylogenetic branch lengths associated with Santa Ana speckled dace suggests they have undergone rapid molecular evolution (Moyle et al. 2015).

Nerkowski (2013, 2015) characterized and identified polymorphic microsatellite markers for *R. osculus* in which twenty-three were identified through Illumina pair-end sequencing. Seven of these loci were then used to examine the patterns of genetic variation and population structure that occurred within and among the watersheds in the Southern California. Nerkowski (2015) also examined the regional relationships among Southern California, Central California and Owen's River Valley speckled dace populations. Analysis of the microsatellite data revealed significant population structure exists within the Southern California region. This structure is best explained by watershed as well as isolation by distance. Highly significant geographic structure also exists among the geographic regions of Southern California, Central Coast, and Owen's River Valley regions that are congruent with the regional differentiation elucidated by mtDNA sequence data. In both cases, the degree of population differentiation was correlated with isolation by distance. Within the Southern California Santa Ana speckled dace populations Nerkowski (2015) examined four models to explain the geographic structure: watershed, mountain range, tributary, and isolation by distance. While all were significant, the tributary model exhibited the higher level of population structure and a significant correlation was exhibited between geographic distance and population structure, suggesting isolation by distance may be playing a role. The results of the Nerkowski (2015) microsatellite analysis are congruent with an earlier broad scale analysis of mtDNA sequence data that suggests the Central California and the Owens Valley populations diverged from each other prior to the divergence of the Santa Ana speckled dace populations from the Colorado Basin populations, and that the Central Coast populations were not established as a result of a migration event from the Southern California populations, as was previously hypothesized.

VanMeter (2017) characterized the molecular structure of the mtDNA control region of *R. osculus*, evaluated the phylogeny of R. osculus in Southern California in relation to other speckled dace in California, and described the population genetics of R. osculus in Southern California. VanMeter (2017) sequenced an 1143 base-pair region of the mitochondrial DNA genome, which included the complete control region. Analysis of the sequence data revealed that the molecular structure of the speckled dace control region was similar to the molecular structure described for other vertebrate taxa. VanMeter (2017) collected 74 specimens of R. osculus from five different watersheds in three geographic regions of California: Southern California, the Central California Coast, and the Eastern Desert of the Owens River valley.

Phylogenetic analysis of sequence data revealed that the Santa Ana speckled dace is a genetically distinct population from R. osculus inhabiting the Central Coast or Eastern Desert regions, which both differ from the Santa Ana speckled dace by a genetic distance of more than 7 percent. VanMeter (2017) found that the Santa Ana speckled dace inhabiting the watersheds of Southern California form a reciprocally monophyletic clade with respect to the Central Coast dace and the Eastern Desert dace, which are sister clades to one another. Population genetic analysis by VanMeter (2017) demonstrated that a high degree of geographic population structure exists for the speckled dace in California, with 96% of molecular variance attributable to regional differences through isolation by distance. A high degree of population structure also exists among populations within the Southern California region. VanMeter (2017) found that 45% of molecular variance in the Santa Ana speckled dace is attributable to differences among tributaries. VanMeter (2017) concluded that the distribution of speckled dace in Southern California best fits a model of population structure by individual tributary, with episodes of localized population bottlenecks followed by sudden population expansion, most likely linked to climatic variation. VanMeter (2017) proposed the Santa Ana speckled dace constitutes an Evolutionarily Significant Unit (ESU) that qualifies it as a separate subspecies, on the basis that it is geographically separated from other populations, genetically distinct from other dace populations due to restricted gene flow, and possesses unique phenotypic characteristics.

Greaver (2019) provided nuclear DNA sequence data to determine the taxonomic status of Santa Ana speckled dace and to elucidate their evolutionary history and their monophyletic relationship among three California regions: southern, central coast, and Owens Valley. Greaver (2019) further defined their evolutionary trajectory by comparing Santa Ana speckled dace sequence data to that of speckled dace from the Colorado River of Arizona. To examine this, three EPIC intron markers were sequenced on 54 samples representing all four regions. Based on the mtDNA and microsatellite data alone, Greaver (2019) found strong support that the southern California populations of *R. osculus* are a reproductively isolated taxon at the species level. Greaver (2019) confirms this by showing the Santa Ana speckled dace to be reciprocally monophyletic for nuclear DNA markers, in conjunction with the mitochondrial DNA marker analyses.

The genetic evidence suggests that Santa Ana speckled dace should be considered a Distinct Population Segment, awaiting formal description as a separate species.

Range

Historically, the Santa Ana speckled dace was distributed throughout the upland portions of the Santa Ana, San Jacinto, San Gabriel, and Los Angeles river systems of southern California, though it was always rare in the lowlands (Swift et al. 1993). Today, the Santa Ana speckled dace occupies only remnants of its historical range, restricted to the headwaters of the Santa Ana and San Gabriel rivers, Big Tujunga and Haines creeks in the Los Angeles River drainage, and a few headwaters tributaries of the San Jacinto River (Moyle et al. 1995; Moyle et al. 2015). See Figure 1 for a range map delineating historical range and extant range.

Santa Ana speckled dace have suffered a significant range reduction (see Figures 1 and 2, range maps by U.C. Davis Center for Watershed Sciences, and Center for Biological Diversity, respectively). Santa Ana speckled dace have been extirpated from: most of the Los Angeles River basin, including tributaries Little Tujunga Creek, Pacoima Creek, and Santa Anita Canyon Creek; most of the Santa Ana River basin, including the middle reaches of the Santa Ana River, and tributaries Mill Creek, East Twin Creek, Santiago Creek, Silverado Canyon, Harding Canyon, and San Antonio Creek; and most of the San Jacinto River basin, including the mainstem San Jacinto River, South Fork San Jacinto River, and tributaries Herkey Creek and Strawberry Creek.

Santa Ana speckled dace have suffered an estimated range reduction of 75%, based on a range map generated by the Center for Biological Diversity using information on historic and current range contained in this petition (see Figure 2). The acreage of the historic watersheds with is 1,414,913 acres, while the extant watersheds only amount to 356,604 acres.

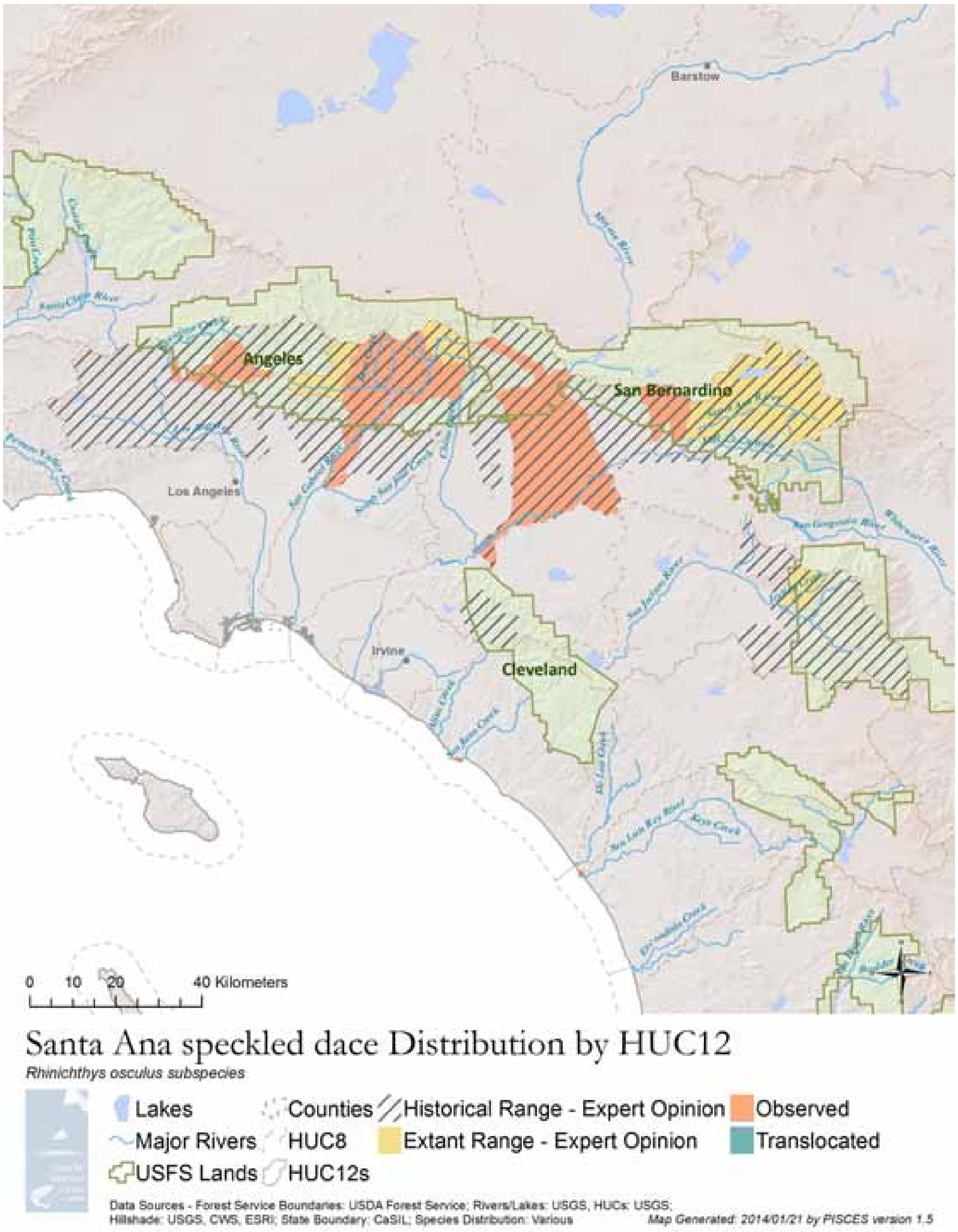

Figure 1. Santa Ana speckled dace range map by U.C. Davis Center for Watershed Sciences (2014)

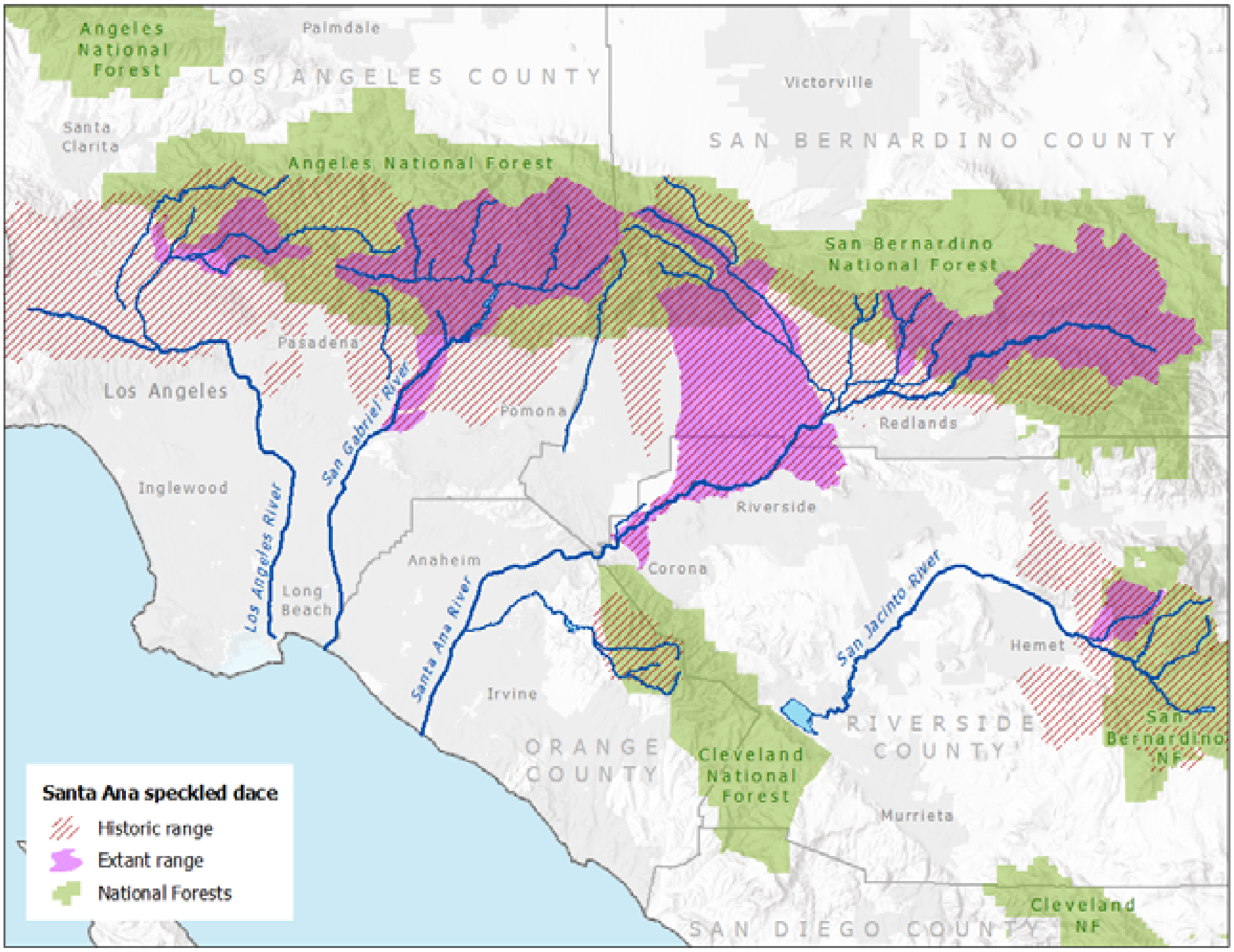

Figure 2. Santa Ana speckled dace range map by Center for Biological Diversity (2020)

Life History

Little information has been published on the life history of Santa Ana speckled dace, so the species account is largely based on information from other dace populations (Moyle et al. 2015).

Feeding

Speckled dace generally forage on small benthic invertebrates, especially taxa common in riffles, including hydropsychid caddisflies, baetid mayflies, and chironomid and simuliid midges, but will also occasionally feed on filamentous algae (Li and Moyle 1976; Baltz and Moyle 1982; Hiss 1984; Moyle et al. 1991). Their subterminal mouth, pharyngeal tooth structure, and short intestine are characteristic of small invertebrate feeders. Not surprisingly, diet varies with prey availability and speckled dace, in general, prey opportunistically on the most abundant small invertebrates in their habitat, which may change with season. Speckled dace have been observed feeding by picking and grazing on cobbles in riffles and pool tail-out habitats in the East Fork San Gabriel River (Moyle et al. 2015). Preference of forage items may also be influenced by presence of other fishes that share similar habitats, such as sculpin or juvenile steelhead (Johnson 1985).

Reproduction and Growth

Speckled dace generally reach maturity by their second summer, with females producing 190-800 eggs, depending on size and location (Moyle 2002). Presumably, Santa Ana speckled dace are at the low end of this range, given their relatively small size. Speckled dace spawning is generally associated with rising water temperatures and/or high flow events (John 1963; Mueller 1984), suggesting that Santa Ana speckled dace most likely spawn in March-May. Jhingran (1948) suggested that peak spawning is brought on by increasing water temperatures. Flooding may also induce spawning in intermittent streams (John 1963).

O'Brien (2013) described Santa Ana speckled dace spawning activity on May 8, 2012 in Bear Creek, a tributary to the West Fork San Gabriel River:

> On 8 May 2012, while conducting snorkel surveys in Bear Creek, tributary to the West Fork San Gabriel River (34° 16' N, 117° 53' W), Los Angeles County, California, I observed a small group of Santa Ana speckled dace congregated at the head of a lateral scour pool. Approximately 12 males, as characterized by their red snouts, were pursuing several females around the base of a small boulder in 0.5 m of water. The males repeatedly swam over, under and adjacent to the females while occasionally coming into contact with one another and forming a small tightly spaced group. This activity appeared to be communal and not territorial, although occasionally a male would give a brief chase to another male. Although gamete release was not noted, the females had distended bellies, and were observed coming into contact with a crevice near the base of the boulder and presumably releasing ova.
>
> This behavior was observed for approximately 45 minutes beginning at 1430 and was confined to an area of 1 m^2 at the head of the pool where water velocity was greatest. The substrate at the site was primarily gravel and boulder with a near absence of fines or algae, and no aquatic vegetation. Ambient temperature was 29° C, and surface water characteristics at the site were as follows: temperature 19° C; dissolved oxygen 8.3 mg/L; pH 8.5; specific conductance 0.3 μS/cm; turbidity 1.5 NTU. The water was clear with a velocity of 0.8 m/s and a flow of 0.3 m^3/s (CMS). Rainbow trout (*Oncorhynchus mykiss*), the only other fish species detected in Bear Creek, were also present in the pool and were more abundant than dace.
>
> I returned to the site after seven days and, although dace and trout were still present in the pool, mating or spawning activity was not observed. Flow had decreased to 0.2 CMS and dace were dispersed throughout the pool. Ova were attached to the base of the upstream face of the boulder where the mating behavior was centered during the week prior. The boulder was exposed to sunlight, and canopy closure was estimated at 50% for the entire pool.

O'Brien (2013) noted that a late-season rain event occurred in late April, which likely increased the flow in Bear Creek and may have triggered the observed mating behavior.

Spawning of speckled dace in lakes occurs primarily over shallow areas of gravel within the lake body itself or upstream in the edges of riffles of inlet streams. Groups of males will clear an area of algae and detritus and then surround a female when she enters the area. Females release eggs underneath rocks or near the gravel surface, while males release sperm (John 1963). Eggs settle into interstices and adhere to gravels. At temperatures of 18-19ºC, eggs hatch in 6 days but larvae remain in the gravel for another 7-8 days (John 1963). Fry in streams congregate in warm shallow areas, often in channels with rocks and emergent vegetation.

Length frequency analyses have determined age and growth patterns for speckled dace. By the end of their first summer, dace grow to 20-30 mm SL (Moyle 2002), growing an average of 10-15 mm per year in each subsequent year. Females tend to grow faster than males. However, growth rates can decrease under extreme environmental conditions, high population densities, or limited food supply (Sada 1990). Slight changes in growth rates are also positively correlated with changes in temperature, as seen in the Colorado River (Robinson and Childs 2001). Life expectancy is approximately three years where maximum sizes do not exceed 80 mm FL, which is typical of Santa Ana speckled dace. However, in the upper San Gabriel River drainage dace over 110 mm SL are fairly common (per Moyle et al. 2015). Elsewhere, dace may reach 110 mm FL and live up to six years (Moyle 2002). Smith and Dowling (2008) noted that Santa Ana speckled dace are small and have one-year generations, compared to speckled dace in the Colorado River drainage, which attain larger body sizes over 2-4 year generations.

Movement and Activity

Movement of dace depends on habitat conditions. Flooding is known to contribute to the downstream dispersal of the species (Riverside County Integrated Project 2000). Natural dispersal is usually up or downstream as conditions and suitable habitat permit, and is typically facilitated by flooding events (USFS 2010). Although speckled dace are usually found in loose groups in appropriate habitats, such as rocky riffles, they avoid large shoals except while breeding. They can be active both day and night. In areas where bird predators are scarce Santa Ana speckled dace can be found mostly during the day; with the removal of cover or an increase in predation their habits will become more nocturnal (Moyle 2002). Their activity is also mediated by stream temperature; they will remain active all year if stream temperatures do not become too low (Moyle 2002).

Habitat Requirements and Use

Their variability in body shape has allowed speckled dace to exploit a wide variety of habitats. Santa Ana speckled dace inhabit a number of stream and channel types, small springs, brooks, and pools in intermittent streams and large rivers, but in general are known to inhabit mid-gradient streams dominated by gravel and cobble substrates (USFS 2010). Surveys of trout streams in the Los Angeles basin found dace occupying shallow riffles dominated by gravel and cobble. In Cajon Wash, San Bernardino County, speckled dace do well with a large-sand substrate (USFS 2010). They can be found in the lower gradient reaches of streams after years of abundant perennial flow until those reaches dry up or become dominated by silty substrate (USFS 2010).

Santa Ana speckled dace are found mainly in perennial streams fed by cool springs that maintain summer water temperatures below 20ºC (Moyle et al. 1995), although speckled dace in other regions of the west tolerate temperatures of 26-28°C and the USFS has found Santa Ana speckled dace regularly in streams reaching 22°C (USFS 2010). It has been suggested that Santa Ana speckled dace require vegetative cover but in the San Bernardino National Forest they are most abundant in reaches of low to moderate vegetative cover (USFS 2010).

Deinstadt et al. (1990) characterized speckled dace habitat in the West Fork of the San Gabriel River, where they were most common where other native fish (rainbow trout and Santa Ana sucker) were common. Deinstadt et al. (1990) found them in riffles, pools, and runs, although they were most commonly associated with shallow, gravel-cobble dominated riffles. Deinstadt et al. (1990) described the West Fork as a small permanent stream (typical summer flow of 4 cfs, 5-8 m wide, depths mostly 15-30 cm) that flows through a steep, rocky canyon with chaparral-covered walls, with overhanging riparian plants, mainly alders and sedges, providing cover for fish.

Haglund and Baskin (2002) described habitat preferences for various life stages of Santa Ana speckled dace in the West Fork of the San Gabriel River: adults showed a preference for gravel substrate and a lesser preference for cobble substrate, a preference for flowing habitats (riffle, run, glide), and variability in depth preference; juveniles showed a preference for sand and gravel, pool and riffle habitat; fry were found exclusively in edgewater habitat over silt at depths of less than 17 cm where there was no measurable flow. Haglund and Baskin (2003) evaluated habitat and resource utilization by Santa Ana speckled dace at Heaton Flats on the East Fork of the San Gabriel River. They found that both adult and juvenile dace mostly occupy riffle habitat but when deeper water habitats were slightly more available dace show some preference for the deeper water habitats. Both adults and juveniles show a strong preference for mixed gravel/cobble substrates, with a secondary preference for sand/gravel and sand/cobble substrates. Adults and juveniles show a preference for water that is deeper than most of the available habitat, preferring water deeper than 25 cm. Both adults and juveniles show a strong preference for lowest bottom velocities; because the fish swim and rest along the bottom, they are clearly seeking low velocities which will reduce their energy expenditure to stay in place. Forest Service observations of habitat preferences of Santa Ana speckled dace during extensive surveys across the San Bernardino National Forest (USFS 2010) have been consistent with the description of Haglund and Baskin (2002, 2003).

Feeney and Swift (2008) characterized preferred Santa Ana speckled dace habitat as pools in low-gradient streams (0.5-2.5% slope) with sand to boulder substrates in slow-moving waters, noting that they were also found along stream edges by fast-moving water. O'Brien et al. (2011) observed Santa Ana speckled dace in the San Gabriel River drainage in a wide variety of habitats, including riffles, runs, and pools.

The presence of high silt runoff or man-made aqueduct channeling makes habitat unsuitable for dace (Moyle et al. 1995). Biologists report that speckled dace are very sensitive to reductions in water quality (USFS 2010). Dams and developed areas with urban runoff may seriously impact habitat capability to support dace (USFS 2010).

STATUS

Historic and Current Distribution and Abundance

The ability of speckled dace to colonize new areas and adapt to different environments has resulted in their wide distribution. Speckled dace are the only native fish found in all major drainages in western North America. In California, their native range includes drainages in: Death Valley (Amargosa River); Owens Valley; eastern Sierra Nevada (Walker River north to Eagle Lake); Surprise Valley; Klamath-Trinity basin; Pit River basin (including the Goose Lake watershed); Sacramento River basin as far south as the Mokelumne River; San Lorenzo, Pajaro and Salinas River basins; San Luis Obispo, Pismo and Arroyo Grande Creek basins; Morro Bay; and the San Gabriel and Los Angeles basins (Swift et al. 1993).

Santa Ana speckled dace historically inhabited streams in the upland areas of the Santa Ana, San Jacinto, San Gabriel, and Los Angeles river systems (Moyle et al. 1995). They have since disappeared from many parts of their range, including much of the Santa Ana River and many of its tributaries, and most of the Los Angeles and San Jacinto river basins (Swift et al. 1993; Moyle et al. 1995; Feeney and Swift 2008; O'Brien and Stephens 2009; Moyle et al. 2015).

Attempts to establish additional populations of Santa Ana speckled dace have been made through introductions into the Santa Clara and Cuyama rivers and into River Springs, Mono County. The introduction into the Santa Clara River is thought to have failed and the status of the other populations is uncertain (Moyle et al. 2015). The San Bernardino National Forest is considering Santa Ana speckled dace reintroductions in Waterman Canyon, Mountain Home Creek, Fredalba Creek, Etiwanda Creek, Alder Creek, Day Creek, and Cucamonga Creek (USFS 2020).

Population status by basin is presented below, based primarily on information from Swift et al. (1993), Moyle et al. (1995), Abbas (pers. comm. 2008), O'Brien (unpublished observations), USFS (2010), and Moyle et al. (2015). Historical information is based on collections of dace from the 1960s at California State University, Fullerton (now in the Natural History Museum of Los Angeles County), from the 1970s (also at LACMNH), from the 1980s (at LACMNH, University of California Los Angeles, and the U.S. Forest Service), and other publications, such as those from Swift and Moyle.

Petitioners sent a Freedom of Information Act Request to the San Bernardino National Forest, Angeles National Forest, and Cleveland National Forest in January 2020, requesting any survey information and/or data generated since 2009 in connection to occurrences of Santa Ana speckled dace, and any fish or stream surveys conducted in these National Forests in streams with known speckled dace populations. Other than the information contained in the 2010 Conservation Strategy (USFS 2010), the Forest Service responded that surveys for Santa Ana speckled dace occurred in: Big Tujunga Creek from 2009-2018 (BonTerra Consulting 2013; BonTerra Psomas 2016; Psomas 2019); East Fork San Gabriel River in 2010 (Weaver and Mehalick 2010) and 2017 (SRMA 2017); West Fork San Gabriel River in 2009 (ECORP 2009), 2011 (Chambers Group 2012), and 2013-2014 (ECORP 2013, 2014); East Twin Creek in 2014 (USFS 2020); and Strawberry Creek in 2014 (USFS 2020).

Los Angeles River Basin

Santa Ana speckled dace were once abundant throughout the Los Angeles River system (USFS 2010) but have been extirpated from most of the Los Angeles River basin, and only persist in Big Tujunga Creek and its tributary Haines Creek (Moyle et al. 2015).

Big Tujunga Creek

Big Tujunga Creek consists of two forks, both beginning in the San Gabriel Mountains above the Big Tujunga Dam. The upper portion of Big Tujunga Creek flows from east to west, and several tributaries from the north and south join it as it flows toward Big Tujunga Reservoir. Below the reservoir, the creek is called Big Tujunga Wash.

Santa Ana speckled dace once inhabited Big Tujunga Creek for 10-20 km below Big Tujunga Dam, but stream flows and temperatures varied so greatly that many fish populations, both native and invasive, could not maintain themselves. Habitat above Tujunga Dam and reservoir appears to be suitable for dace and may have also had dace in the past (USFS 2010).

Wells and Diana (1975) noted a complete lack of speckled dace in the Los Angeles drainage and only “infrequent” occurrences of dace in Big Tujunga Creek. Dace were thought to have been extirpated from Big Tujunga Creek due to drought conditions and establishment of non-native red shiners (Moyle et al. 1995). Surveys of the creek from 1991-1992 failed to find any dace (Swift et al., 1993). However, surveys from 2002-2005 found a few (in the 10s) speckled dace in Big Tujunga Creek. Dace were present in low numbers in lower Tujunga Wash outside the National Forest prior to the Station Fire in 2009 (USFS 2010).

Surveys by CDFW indicated that Big Tujunga dace populations rebounded after the 2009 Station Fire and were common within the Tujunga Wash (O’Brien and Stephens 2009). Surveys for Santa Ana suckers from 2009-2017 in Big Tujunga Creek below Big Tujunga Dam incidentally recorded occurrence and abundance of Santa Ana speckled dace in 22 short (25m) reaches of Big Tujunga Creek below Big Tujunga Dam, downstream 9.66 km to the Delta Flats area (BonTerra Consulting 2013; BonTerra Psomas 2016). A median count of 112 dace were seen over the 10 years of surveys: 0 dace in 2009; 263 dace at 10 locations in 2010; 3,215 dace at 16 locations in 2011; 1,879 dace at 14 locations in 2012; 146 dace at 12 locations in 2013; 217 dace at 11 locations in 2014; 78 dace at 8 locations in 2015; 25 dace at 7 locations in 2016; 29 dace at 8 locations in 2017; and 32 dace at 6 locations in 2018, indicating dace numbers have declined dramatically in these reaches since 2012 (Psomas 2019).

Santa Ana speckled dace are still present in Haines Creek downstream of the Angeles National Forest, in a small reach downstream of the forest boundary near Interstate 210 and in the wash below Haines Creek (USFS 2010). Speckled dace are absent further upstream; Haines Creek within the Angeles National Forest is intermittent, steep, and not suitable for dace (USFS 2010).

Little Tujunga Creek

Santa Ana speckled dace are thought to be extirpated from Little Tujunga Creek (Moyle et al. 1995).

Pacoima Creek

Wells and Diana (1975) found no occurrences of speckled dace in Pacoima Canyon Creek. Santa Ana speckled dace are thought to be extirpated from Pacoima Creek (Moyle et al. 1995).

Santa Anita Canyon Creek

Wells and Diana (1975) found no occurrences of speckled dace in Santa Anita Canyon Creek. High turbidity below the Big Santa Anita Reservoir seems to be responsible for the extirpation of fish species from this section of stream.

San Gabriel River Basin

Santa Ana speckled dace were once abundant throughout the San Gabriel River system (USFS 2010). The West, North, and East Forks of the San Gabriel River constitute the best remaining Santa Ana speckled dace habitat (Moyle et al. 1995).

East Fork San Gabriel River

The East Fork of the San Gabriel River is a 13 kilometer stretch of the river that flows west into the San Gabriel Reservoir. This stream is comprised mainly of a swift moving channel fed by intermittent gulches and canyons. Dace were found in the 1970s as far up as the first kilometer of Fish Canyon, the largest tributary to this fork, in stable numbers (Wells and Diana 1975). CDFG presence/absence electrofishing surveys in June 1997 documented 215 speckled dace (SL 43-90 mm) in three reaches of the East Fork San Gabriel River (Hernandez 1997). Multiple-pass electrofishing surveys performed by CDFW in the middle portion of the East Fork (Heaton Flat and Shoemaker Canyon) between 1997 and 2010 indicated an average estimated density of Santa Ana speckled dace of 2,143 fish/mile in 1997; 4,113 fish/mile in 2000; and 4,640 fish/mile in 2010 (Weaver and Mehalick 2010). A comprehensive survey of the upper San Gabriel River from 2007-2008 found that dace occupy 4.5 km of the East Fork (O'Brien et al. 2011). 39 Santa Ana speckled dace (45-77 mm in length) were found during fish shocking surveys in February and March 2017 in the East Fork San Gabriel River in the vicinity of the Camp 19 Bridge (SRMA 2017).

Cattle Canyon

Cattle Canyon is a tributary to the East Fork San Gabriel River. A small residual population of Santa Ana speckled dace occurs in Cattle Canyon in the Angeles National Forest (Swift et al. 1993). Mining had increased in Cattle Canyon by the 1990s so at times the dace population in this creek has been small or nonexistent (Moyle et al. 1995). CDFG presence/absence electrofishing surveys in June 1997 documented 351 speckled dace (SL 42-81 mm) in three reaches of Cattle Creek (Hernandez 1997). 2005 surveys documented the presence of "100s" of speckled dace in Cattle Creek (G. Abbas, pers. comm. 2008, per Moyle et al. 2015).

North Fork San Gabriel River

The North Fork of the San Gabriel is a 7.5 kilometer stream that flows out of the San Gabriel National Forest to meet the West Fork. A small population of Santa Ana speckled dace was detected in the lower portion of this stream in the 1970s (Wells and Diana 1975), however the intermittency of the flow in the headwaters makes many of the upper creeks uninhabitable for dace. Surveys of the North Fork in 2005 found dace during one of the two days of sampling

(Moyle et al. 2015). A comprehensive survey of the upper San Gabriel River from 2007-2008 found that dace occupy 4.5 km of the North Fork (O'Brien et al. 2011).

West Fork San Gabriel River

The West Fork consists of about 24 kilometers of stream above the San Gabriel Reservoir, broken by the Cogswell Reservoir where Devil's Canyon joins the river. Above the reservoir there are approximately 1-2 kilometers of dace habitat in both Devil's Canyon and the West Fork San Gabriel. Below the dam, there are 11 kilometers of viable dace habitat.

Dace populations in the West Fork in 1990 likely numbered less than 2,000 fish (Deinstadt et al. 1990). Dace were present the West Fork San Gabriel in "fair numbers" in 1993; Multiple-pass electrofishing surveys performed in the West Fork in 1993 found 29 dace in a 68 m section of stream (Moyle et al. 1995).

Surveys in 2006 found dace in only one of three locations sampled in West Fork San Gabriel (G. Abbas, pers. comm. 2008). A massive relocation project of moving native fish was conducted in 2005 and 2006 as part of the San Gabriel Sediment Removal Project, and 3,978 Santa Ana speckled dace were relocated upstream into the West Fork San Gabriel River. A subsequent comprehensive survey of the upper San Gabriel River from 2007-2008 found that dace occupied 20 km of the West Fork (O'Brien et al. 2011). However by 2009, catch rates of speckled dace in the West Fork of the San Gabriel River were very low (ECORP 2009) in comparison with 2007 surveys (ECORP 2007), with 197 dace captured in 2007 and only 50 dace in the same reaches in 2009. Likely causes were fluctuations of the San Gabriel Reservoir water level, which allowed predation by largemouth bass and invasion of green sunfish into the survey reaches (ECORP 2009). Only one (1) speckled dace was captured during November 2011 resurveys in these same stream reaches (Chambers Group 2012). Santa Ana speckled dace capture data in the West Fork show patterns of continual decline over time (Chambers Group 2012). No speckled dace were observed or captured in the OHV area during the 2013 surveys (ECORP 2013). This could be a result of the different survey methods that were used (seining and visual encounter surveys in 2013 versus previous electrofishing). In 2014, 96 speckled dace were observed in the OHV area during surveys, and an additional 28 speckled dace were observed downstream outside of the study area (ECORP 2014). Since all the speckled dace observed during the 2014 survey were adults and no dace were present in 2013, it is presumed that these fish either migrated down into the OHV area or were washed down with a recent storm event (ECORP 2014).

Devil's Canyon

Devil's Canyon is a tributary of the West Fork of the San Gabriel River inside the San Gabriel Wilderness Area. There is a remnant Santa Ana speckled dace population in the creek's lowest 1 kilometer where it flows into Cogswell Reservoir. Sampling by CDFG in 1993 indicated that dace were abundant in the 1 kilometer of stream immediately above the reservoir. Dace were also abundant here in 2005 (Moyle et al. 2015).

Chileno Canyon

Chileno Canyon is a lower tributary of the West Fork of the San Gabriel River. No Santa Ana speckled dace were present in this creek in the 1970s (Wells and Diana 1975).

Bear Creek

Bear Creek is the lowest tributary to the West Fork of the San Gabriel River. Santa Ana speckled dace were found in healthy numbers in the 1970s in the lower 6 kilometers of the main wash of Bear Creek however, they were not present in the west fork of the creek (Wells and Diana 1975). A small residual population of Santa Ana speckled dace was documented in Bear Creek in the early 1990s, in the Angeles National Forest (Swift et al. 1993).

Fish Canyon

A small residual population of Santa Ana speckled dace persists in the Angeles National Forest in Fish Canyon, a lower tributary to the San Gabriel River (Swift et al. 1993). Fish Canyon is isolated from the rest of the National Forest tributaries that support native fish (USFS 2010). It connects to the San Gabriel River in the valley floor several miles below Morris Dam and 1 mile south of the forest boundary. Only 6-7 fish were seen in 1988 despite a thorough search of the tributary, and this population was thought to be extinct by 1995 (Moyle et al. 1995). The best dace habitat in the lower canyon has been encroached upon by a rock quarry operation, but the quarry operator has made an effort to restore speckled dace habitat in the mining area (USFS 2010). Consultants with ECORP Mining report that the dace population is maintaining itself in the restoration area (USFS 2010). A few individual dace were collected from the rock quarry site in Fish Canyon in 2007 by ECORP (Moyle et al. 2015). Some surveys during the 2000s established their presence in this location, while others did not (Moyle et al. 2015). California Department of Fish and Wildlife surveys in 2006 and 2008 found that dace occupied a 0.8 km section of Fish Canyon within the Angeles National Forest above the quarry and that this population was reportedly “healthy” (O’Brien 2006, 2008; USFS 2010).

Santa Ana River Basin

Santa Ana speckled dace were once abundant in the upper mainstem and most of the tributaries of the Santa Ana River including Lytle, Cajon, City, Mill, Plunge, and East Twin Creeks. They have been extirpated from the middle reaches of the Santa Ana River, and from Mill, East Twin, Santiago and San Antonio Creeks. Recent surveys suggest that their distribution in the basin is now largely limited to small areas in headwater tributary streams, including Lytle, Cajon, City, and Plunge Creeks (USFS 2010; Moyle et al. 2015).

Santa Ana River

Speckled dace have been extirpated from the middle reaches of the Santa Ana River (Moyle et al. 2015) and are assumed to be extirpated from most of the Santa Ana River basin (Moyle et al.1995; Moyle 2002). Even though habitat conditions in the watered segments of the Santa Ana River seem suitable for Santa Ana speckled dace, no dace were found during focused fish surveys in the 1990s. In 1992, 1998, and 1999, the USFS and Southern California Edison conducted electrofishing surveys in reaches downstream of the Santa Ana River and Bear Creek diversion dams, and in Bear, Alder, and Hemlock Creeks. During these surveys no dace were found even though suitable dace habitat was sampled (FERC 2002). Dace were last seen near Rialto in 2001 (G. Abbas, pers. comm., 2008, per Moyle et al. 2015). Only a few specimens (usually <4) were documented in the mainstem in 2000 (Swift 2001) and 2005 (G. Abbas, pers. comm. 2008, per Moyle et al. 2015).

Lytle Creek

Speckled dace populations persist in mainstem Lytle Creek, North Fork Lytle Creek, Middle Fork Lytle Creek, and tributary Cajon Wash.

Mainstem Lytle Creek

The stronghold area for Santa Ana speckled dace in Lytle Creek has been the mainstem reach from Miller's Narrows downstream to Turk Point, approximately 1.4 river miles (USFS 2010; Moyle et al. 2015). The Forest Service has qualitatively monitored this reach since at least 1999. In 1999 and 2000, the USFS and Southern California Edison conducted electrofishing surveys in reaches upstream and downstream of the Lytle Creek diversion, in spring channels adjacent to the creek, and in the Middle Fork (USFS 2000; FERC 2002). Rainbow trout and Santa Ana speckled dace were the only fish collected. In May 1999, 642 Santa Ana speckled dace were collected from the lower mainstem of Lytle Creek between the diversion dam and the powerhouse. In May and June 2000, fish sampling was expanded into the Middle Fork and in spring channels above the diversion. Below the diversion, approximately 100 trout and Santa Ana speckled dace were captured. Above the diversion, no dace were captured. However, in adjacent spring channels, 42 Santa Ana speckled dace were collected.

Santa Ana speckled dace in the mainstem have had significant population fluctuations in response to drought induced low flows, major flooding (periods of declining population densities), and a couple years of sustained moderate flows (period of rapid population density increases) (Moyle et al. 2015). There is perennial water above Miller's Narrows in the mainstem up to the confluence with the Middle Fork, but dace were absent here between at least 1999 and 2005 (Moyle et al. 2015). Santa Ana speckled dace have been found in the bypass reach of the Lytle Creek Hydropower Project and are negatively impacted when changes in flows have resulted in the stranding and concentration of dace in the bypass reach as the streambed goes dry (FERC 2002). In June 2012 biologists had to collect and rescue juvenile Santa Ana speckled dace in Lytle Creek when creek flow had dried up leaving dace stranded in drying pools; rescued dace were moved further up the creek and released where there was adequate water flow year round.

In 2005 and 2006, sustained year-round flows from Turk point down to the Fontana Union Water Company diversion (1.8 river miles) resulted in an expansion of the speckled dace population throughout this reach, with juveniles rearing in the settling pond at the diversion intake structure; adults were also noted in the raceways of the intake structure (Moyle et al. 2015). It is assumed that in years when there are flows below Turk Point, that reach of the mainstem is occupied by Santa Ana speckled dace (Abbas 2008, per Moyle et al. 2015). In 2007 Southern California Edison reported capture of Santa Ana speckled dace in their diversion works above Miller's Narrows suggesting that some fish from a 2005 North Fork reintroduction had survived and migrated downstream (3.2 river miles) to this location (Moyle et al. 2015). All of the mainstem Lytle Creek above Turk Point was subsequently considered occupied by Santa Ana speckled dace (Moyle et al. 2015).

North Fork Lytle Creek

Dace were abundant in the North Fork of Lytle Creek in 1967 when they were collected by Cornelius (in the LACMNH collection), but the dace population has been very small since 1975, and no dace were found in 1992 (T.R. Haglund, pers. comm. cited in Moyle et al. 1995). In 2005, the USFS, CDFW, and Fontana Union Water Company reintroduced approximately 1,000

Santa Ana speckled dace from the lower mainstem of Lytle Creek to the Applewhite Picnic Area on the North Fork of Lytle Creek (Moyle et al. 2015). In 2007, the USFS and CDFW conducted another translocation of about 1,300 Santa Ana speckled dace from the lower mainstem of Lytle Creek to the North Fork at Applewhite Picnic area (Moyle et al. 2015).

Middle Fork Lytle Creek

The Middle Fork of Lytle Creek has perennial waters over a 3.2 km reach (Moyle et al. 2015). There is a reach of the South Fork beginning near the national forest boundary with the community of Scotland mapped as intermittent for approximately 0.6 river miles, however this reach has rarely gone dry and also supports a popular trout fishery (Moyle et al. 2015). In 2007, the USFS and CDFW conducted a reintroduction of approximately 500 Santa Ana speckled dace from the lower mainstem of Lytle Creek to the Middle Fork just a few hundred meters upstream of the Scotland boundary (Moyle et al. 2015). Surveys by the USFS confirmed the persistence of these fish as of 2008, but no assessment of their movement from the introduction point was conducted (Moyle et al. 2015). There is high quality habitat available from the forest boundary with Scotland upstream at least 4.1 river km (Moyle et al. 2015). There are no significant fish passage barriers known within this reach, so the full 4.1 km reach above Scotland is considered Santa Ana speckled dace habitat (Moyle et al. 2015).

Cajon Creek

Cajon Creek is a tributary of Lytle Creek. Santa Ana speckled dace appeared to be abundant in Cajon Creek in the 1990s, predominantly congregated in a 2 km reach upstream and downstream of Interstate 15 (Moyle et al. 1995). Their presence was also documented by surveys in 2005 (G. Abbas, pers. comm. 2008, per Moyle et al. 2015). There have been several recent fires in the area, and hazardous waste spills from trucks and trains using the transportation corridor threaten aquatic habitat in this watershed (Moyle et al. 2015). The USFS, CDFW, and BNSF Railroad moved dace into headwater tributaries of Cajon Creek to protect them from highway or railway spills (Moyle et al. 2015), and to reintroduce dace above fish passage barriers that have been created by the railroads (USFS 2010). Dace were moved from 2007-2008 into unoccupied reaches of Swarthout Canyon and upper Cajon Creek in the vicinity of the Crowder Creek tributary. The upper Cajon Creek transplant took well and young of the year were abundant in the newly occupied reach in summer 2008, when the population was augmented with another transplant (USFS 2010). In Swarthout Canyon, the transplant in 2007 did not appear to be successful except for a handful of fish. In 2008 another transplant was attempted in the two forks of spring water that keep the mouth of the Swarthout tributary perennial (total potential habitat reach of about 0.17 river miles), but suboptimal habitat conditions make reoccupation by dace unlikely without regular monitoring and supplementation. 2009 visual surveys documented only one young of year dace in the Swarthout tributary and both adults and young of year in the upper Cajon Wash reintroduction site.

City Creek

East Fork City Creek

Dace were observed in the East Fork of City Creek in September 2003, immediately after the Bridge Fire (G. Abbas, pers. comm. 2008). However fewer dace were seen in the East Fork after the Old Fire in October 2003, and none after subsequent flooding in December 2008 (Moyle et al. 2015). No dace were observed in the East Fork during annual surveys from 2004-2007 (Moyle et al. 2015).

West Fork City Creek

Dace were present in the West Fork of City Creek in 1982. Young-of-year and 2-year old dace were documented in the West Fork in 2008 and reconfirmed in 2009 (Moyle et al. 2015).

Mill Creek

Santa Ana speckled dace were found in Mill Creek in the 1980s, but not in 1990 and were thought to be extirpated (Moyle et al. 1995). A dace population was found in Mill Creek just downstream of the San Bernardino National Forest boundary in August 1997, but the species was not observed after a flash flood event in September 1997. A few dace were observed in Mill Creek in 2007 in a small pool created by a human-made grade control structure (G. Abbas, pers. comm. 2008, per Moyle et al. 2015). However, dace were not seen in 2008 and are now assumed to be extirpated from Mill Creek (G. Abbas, pers. comm. 2008, per Moyle et al. 2015).

Plunge Creek

Speckled dace were observed in Plunge Creek in 2001 (9 individuals) and 2005 (G. Abbas, pers. comm. 2008, per Moyle et al. 2015). Dace were collected in 2004 to protect them from potential flooding and were returned to the stream after the threat of flooding passed (G. Abbas pers. comm. 2008, per Moyle et al. 2015).

East Twin Creek

Santa Ana speckled dace were once abundant in East Twin Creek until the devastating wildfire and subsequent flood in 2003 and 2004 (USFS 2010). Multiple surveys from 2005-2009 did not detected dace and they are presumed to be extirpated (USFS 2010). Presence/absence surveys were done in 2014, though the USFS did not provide any survey results (USFS 2020). They are still presumed to be extirpated.

Santiago Creek

There was formerly a small dace population in Santiago Creek, within the Cleveland National Forest (Stephenson and Calcarone 1999; USFS 2010). Camm Swift found dace in Santiago Creek at the mouth of Black Star Canyon in July of 2000 (USFS 2010). “Exhaustive” surveys by the USFS in 2005, 2006, and 2007 could not find speckled dace within the mainstem Santiago Creek (J. O’Brien 2006-2009; USFS 2010). The Santiago population is now considered extirpated following a severe drought in 2002-2003 and massive post-fire flooding in 2008 (USFS 2010).

A small population of Santa Ana speckled dace persisted in the Silverado Canyon tributary of Santiago Creek, at Shrewsberry Springs, through 1987. No dace were found in the same or nearby areas in 1990 (Moyle et al. 1995), or in 2005 and 2007 (J. O’Brien 2007). The Silverado Canyon population may be extirpated (Moyle et al. 1995).

O’Brien found Santa Ana speckled dace in Harding Canyon, another tributary to Santiago Creek, prior to the 2007 Santiago Fire. Following the fire and subsequent flooding, O’Brien could not find dace in Harding Canyon, and they are assumed to be extirpated (USFS 2010).

Lone Pine Canyon

Small speckled dace populations were documented historically in Lone Pine Canyon.

San Antonio Creek

Santa Ana speckled dace were found in San Antonio Creek in the Angeles National Forest near the lower fire station in 1999 (USFS 2010). O'Brien conducted a comprehensive survey of San Antonio Creek in 2008 and did not find any dace and believed they are extirpated, though there is still suitable habitat there (USFS 2010).

San Jacinto River Basin

The San Jacinto River formerly supported quality habitat for speckled dace, particularly in the North Fork, South Fork, and tributaries Herkey Creek, and Strawberry Creek (Moyle et al. 1995). Dace have been extirpated from most of the San Jacinto River basin (Moyle et al. 2015).

San Jacinto River

Santa Ana speckled dace were formerly abundant in the San Jacinto River (USFS 2010). Santa Ana speckled dace were recorded in 15-30 km of the San Jacinto River, but not since the mid-1980s (T. Haglund, in Moyle et al. 1995). Dr. Thomas Haglund had difficulty finding any native fish in the San Jacinto River in the mid-1980s. Large portions of the river and the lower portion of its tributaries are now dry in the summer (Moyle et al. 1995). Surveys in 2005 failed to find speckled dace in the mainstem, or in the North and South Forks (G. Abbas, pers. comm. 2008, per Moyle et al. 2015).

North Fork San Jacinto River

Santa Ana speckled dace are known to occur in the North Fork San Jacinto River within the San Bernardino National Forest (SBNF 2020).

Indian Creek

Indian Creek is a headwater tributary of the San Jacinto River. A small population of Santa Ana speckled dace is still present in Indian Creek on the Soboba Indian Reservation. The Soboba Tribe reportedly agreed to cooperate with the USFS and CDFW to cooperatively manage to maintain dace on the reservation and reintroduce dace into the upper watershed within the National Forest (USFS 2010). Some Indian Creek dace were removed and held in captivity following the Esperanza Fire in 2006 to prevent total loss of the population from flooding. Dace survived the fire and were reconfirmed as present in Indian Creek in 2007 and 2008 (G. Abbas, pers. comm. 2008, per Moyle et al. 2015). This dace population has been able to sustain itself following the fire due to the lack of large flood events and is considered to be recovering (Moyle et al. 2015). The headwaters of Indian Creek are on the San Bernardino National Forest, but the steep gradient appears to prohibit dace from using this upper stream reach (USFS 2010).

Strawberry Creek

A small Santa Ana speckled dace population was found in Strawberry Creek in 1992 by the U.S. Forest Service (C. Swift pers. comm. in Moyle et al. 1995). Santa Ana speckled dace were formerly abundant in Strawberry Creek, until a devastating wildfire and subsequent flooding in

2003 and 2004 (USFS 2010). Several surveys following the 2003 Old Fire and Christmas Flood did not find dace in Strawberry Creek. Surveys failed to detect dace in 2005 or 2006 (G. Abbas, pers. comm. 2008). Speckled dace are presumed to be extirpated from Strawberry Creek (Moyle et al. 2015). Multiple USFS surveys from 2005-2009 have not detected dace in Strawberry Creek (USFS 2010). The USFS and CDFW surveyed Strawberry Creek for presence/absence of speckled dace in 2014, but did not provide any further information (USFS 2020).

Poppet Creek

A population of Santa Ana speckled dace is known from Poppet Creek, a tributary of the San Jacinto River (Pisces 2014).

Santa Clara River

Attempts to establish additional populations of Santa Ana speckled dace through introductions into the Santa Clara River are thought to have failed (Moyle et al. 2015).

Summary

The overall status of Santa Ana speckled dace is tenuous, based on its range reduction and limited distribution. See Table 1 regarding extant and extirpated populations.

Santa Ana speckled dace have been extirpated from most of the Los Angeles River basin, including Little Tujunga Creek, Pacoima Creek, and Santa Anita Canyon Creek. The species is extant in Big Tujunga Creek and tributary Haines Creek.

The stronghold for Santa Ana speckled dace is in the San Gabriel River basin. They are extant in the East, North, and West Forks of the San Gabriel River, as well as tributaries Cattle Canyon, Devil's Canyon, Bear Creek, and Fish Canyon. The species has been extirpated from Chileno Canyon.

Santa Ana speckled dace have been extirpated from much of the Santa Ana River basin, including the mainstem Santa Ana River, East Fork City Creek, Mill Creek, East Twin Creek, Santiago Creek, Silverado Canyon, Harding Canyon, and San Antonio Creek. Their distribution in the basin is now largely limited to small areas in headwater tributary streams, primarily the mainstem, North Fork and Middle Fork of Lytle Creek, along with the Cajon Creek tributary. Populations also remain in West Fork City Creek and Plunge Creek.

Santa Ana speckled dace have been extirpated from most of the San Jacinto River basin, including the mainstem and South Fork of the San Jacinto River, as well as Strawberry Creek. The species is extant in the North Fork San Jacinto River and the Indian Creek and Poppet Creek tributaries.

A population of Santa Ana speckled dace reintroduced to the Santa Clara River is thought to be extirpated.

Population Trends

Population estimates for Santa Ana speckled dace have not been generated (Moyle et al. 2015), and population trends are unknown for many streams and tributaries. However, the overall abundance is likely a small fraction of what it was in the past and numerous populations have been extirpated (Moyle et al. 2015). The populations that remain are mostly small and isolated from one another (Moyle et al. 2015). A few populations are known to be stable: East Fork San Gabriel River, Fish Canyon, and mainstem Lytle Creek. The Big Tujunga Creek and West Fork San Gabriel River populations are known to be declining. See Table 1 regarding the few known population trends.

Table 1. Summary of Santa Ana Speckled Dace Status by Basin and Drainage

River or Tributary	Extant or Extirpated	Population Trend
	Los Angeles River Basin	
Big Tujunga Creek	Extant	Declining
Haines Creek	Extant	Unknown
Little Tujunga Creek	Extirpated	N/A
Pacoima Creek	Extirpated	N/A
Santa Anita Canyon Creek	Extirpated	N/A
	San Gabriel River Basin	
East Fork San Gabriel	Extant	Stable
Cattle Canyon	Extant	Unknown
North Fork San Gabriel	Extant	Unknown
West Fork San Gabriel	Extant	Declining
Devil's Canyon	Extant	Unknown
Chileno Canyon	Extirpated	N/A
Bear Creek	Extant	Unknown
Fish Canyon	Extant	Stable
	Santa Ana River Basin	
Santa Ana River	Extirpated	N/A
Mainstem Lytle Creek	Extant	Stable
North Fork Lytle Creek	Extant	Unknown
Middle Fork Lytle Creek	Extant	Unknown
Cajon Creek	Extant	Unknown
East Fork City Creek	Extirpated	N/A
West Fork City Creek	Extant	Unknown
Mill Creek	Extirpated	N/A
Plunge Creek	Extant	Unknown
East Twin Creek	Extirpated	N/A
Waterman Canyon	Extant?	unknown
Hemlock Creek	Extant	unknown
Santiago Creek	Extirpated	N/A
Silverado Canyon	Extirpated	N/A
Harding Canyon	Extirpated	N/A
Lone Pine Canyon	Unknown	Unknown
San Antonio Creek	Extirpated	N/A
	San Jacinto River Basin	
San Jacinto River	Extirpated	N/A
North Fork San Jacinto	Extant	Unknown
South Fork San Jacinto	Extirpated	N/A
Indian Creek	Extant	Unknown
Strawberry Creek	Extirpated	N/A
Poppet Creek	Extant	Unknown
	Santa Clara River Basin	
Santa Clara River	Extirpated	N/A
River or Tributary	**Extant or Extirpated**	**Population Trend**

CRITERIA FOR ENDANGERED SPECIES ACT LISTING

The Santa Ana Speckled Dace is a Distinct Population Segment Which Qualifies As a "Species" Under the ESA

The U.S. Fish and Wildlife Service considers a population to be a Distinct Population Segment (DPS) if it is "discrete" in "relation to the remainder of the species to which it belongs" and it is "significant" to the species to which it belongs. According to the agency's policy regarding recognition of distinct vertebrate populations (USFWS 1996), a species is considered discrete if it is "markedly separated from other populations" because of "physical, physiological, ecological, or behavioral factors;" or it is "delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4 (a) (1) (D)." The policy further clarifies that a population need not have "absolute reproductive isolation" to be recognized as discrete. A population is considered significant based on, but not limited to, the following factors: 1) "persistence of the discrete population segment in an ecological setting unusual or unique for the taxon" 2) "loss of the discrete population segment would result in a significant gap in the range;" 3) the population "represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range;" or 4) the population "differs markedly from other populations of the species in its genetic characteristics" (USFWS 1996).

Santa Ana speckled dace constitute a DPS, based on geographic separation from other populations, genetic distinction from other dace populations, occurrence in a unique ecological setting, and possession of unique phenotypic characteristics.

<u>Discreteness</u>

The Santa Ana speckled dace is markedly separated from other speckled dace populations because of physiological and physical (geographic isolation) factors.

Santa Ana speckled dace have unique phenotypic characteristics (Cornelius 1969; Hubbs et al. 1979). Santa Ana speckled dace are smaller than their speckled dace relatives in the Colorado River drainage (Smith and Dowling 2008). According to Cornelius (1969), the Santa Ana speckled dace is different from other speckled dace based on its meristic and morphometric characteristics. Santa Ana speckled dace have finer scales (69-82 scales in lateral line), a better developed frenum on the upper lip, a longer head, and smaller eggs than other California dace. Cornelius constructed an index to statistically determine the significance of meristic and morphometric differences between the Santa Ana speckled dace and all northern California speckled dace. The index used one meristic count, scale rows on lateral line, and four morphometric proportions: head depth/length upper jaw; orbit width/length upper jaw; head depth/head width through orbit; and head depth/anal fin height. Cornelius' results showed a non-overlap value of 87% between "Group I" speckled dace (Central California coast populations from the San Lorenzo, Pajaro, Salinas, San Luis Obispo, Arroyo Grande and Santa Maria rivers) and "Group II" speckled dace (Santa Ana speckled dace populations from the San Gabriel, Los Angeles, and Santa Ana rivers). While the non-overlap values were slightly less than the normal sub-specific differentiation level of 90%, the geographically closest (with river mouths more than 150 miles apart) Group I (Santa Maria River) and Group II (San Gabriel River) populations have a co-divergence value of 1.76, which is equal to a joint non-overlap of greater than 96%.

The lower significance of the overall group populations is likely due to phenotypic similarities rather than genotypic similarities, indicating that these populations are descended from a common ancestor which then spread into California from two directions, the Group I subspecies from the north, and the Group II from the east, only coming as close to each other as the Santa Maria and San Gabriel rivers, whose river mouths are more than 150 miles apart. Two streams which do not support any speckled dace separate the coastal and Los Angeles basin populations: the Santa Ynez and Santa Clara rivers, which lie between the Santa Maria and Los Angeles rivers, making the possibility of introduction to the Los Angeles basin from the north very unlikely.

Santa Ana speckled dace have long been geographically separated from other dace populations. During the Miocene Era (23 million to 5.3 million years ago) much of California's Central Valley was submerged. More inlets, drainages and bays existed then, before the upheaval of the coastal ranges in the Pleistocene Era (1.9 million to 10,000 years ago). These mountains formed a long peninsula that stretched down to present day San Luis Obispo, and the main outlet to the Pacific was an embayment that reached from this location to what is today Santa Barbara. Before the closing of the old embayment (and once introduced to the Salinas River system via the Monterey Complex), speckled dace could move through the rivers of the Coast Ranges, whose waters flowed south at this time. But dace were blocked from entering the Los Angeles basin by the embayment beginning in Santa Barbara (Cornelius 1969). This embayment was cut off later in the mid-Pleistocene when the Coast Ranges connected with the transversely aligned ranges north of the Los Angeles flood plain. When this happened, a major shift in the drainage of the Central Valley occurred. The closing of the Coast Range blocked the old outlet at the south end of the San Joaquin Valley, and a new outlet was established in San Francisco. Thus the Santa Ana speckled dace could not have come from the same stocks as the coastal speckled dace, because the path from the north into the Los Angeles basin has always been blocked by an impassable obstacle.

This history is supported by current dace population distribution as well. Two rivers that have not historically contained speckled dace separate the Los Angeles basin and coastal populations of speckled dace: the Santa Ynez and Santa Clara rivers. These rivers are located at the heart of the confluence of the Sierra Madre and the San Rafael, Tehachapi, and San Gabriel mountain ranges. They form a "Y" (the Sierra Madre and San Rafael ranges together forming the tail), and effectively pin the Los Angeles basin to the Pacific Ocean. This formation also separates the basin's river systems from the drainages to the north. The headwaters of the Santa Clara River drain the north slope of the San Gabriel Mountains, while the headwaters of the San Gabriel River drain the south slope. It is felt that a transfer of speckled dace across this divide northward is ecologically improbable (Cornelius 1969).

The San Gabriel Mountains underwent uplift during the late Pliocene and early Pleistocene, eventually reaching a peak height of 5,000 feet during the Pleistocene. Analysis of speckled dace in the Los Angeles basin indicates that they do not occur over 3,000 feet (Cornelius 1969). Thus it is apparent that the fish must have crossed the San Gabriel Mountains before they were fully formed. In addition, the presence of the altitude-averse species *Gila orcutti* and *Catostomus santaanae* in the Colorado and Los Angeles basins - though not in the California coastal streams - would indicate that the divide was even lower at the time of crossing, since these fish require even lower elevation habitat than *Rhinichthys osculus*. The movement of these three species was likely through either headwater capture or drainage shifts in existing streams (Cornelius 1969). Minkley et al. (1986) cite the historical connection of the Colorado River to the Death Valley system as the means that conveyed many of Southern California's native fish species to their current habitats. This also corresponds to the work of Lucchitta

(1972) who traces the formation of the Imperial Valley to the filling of the Gulf of California by the historical Colorado River.

During the late Miocene Era the Gulf of California reached up into what is now the Imperial Valley/Salton Sea basin. The non-marine sediments in the area are consistent with deposits from higher up the Colorado River. Fossils of distinctive foraminifera and diatoms have been found in the Imperial Valley, and the general consensus is that the valley was formed during the late Pliocene or Pleistocene (Lucchitta 1972). This would indicate that at this time the Colorado River was on a course that took it through part of the Mojave Desert and the San Bernardino Mountains that sit at the northern boundary of the Imperial Valley.

This corresponds to the timing of the movement of the *Rhinichthys osculus* ssp. into California, which could have moved down the Colorado River toward the Imperial Basin without ever crossing a lowland barrier (Minkley et al. 1986) and from there into the headwaters and drainages of the San Bernardino and San Gabriel mountains. Once the Colorado River filled the Imperial Valley and moved into its present course to the Gulf of California, the fish in the mountain drainages would have been effectively isolated from any other population of dace from the latter part of the Pleistocene through the present day.

Santa Ana speckled dace populations lie south of the Sierra Nevada Mountains and south of the Transverse Mountain range, whereas central coast populations are west of the Sierra Nevada Mountains and north of the Transverse Range; and Owens Valley and Death Valley populations lie east of the Sierra Nevada Mountains and north of the Transverse Range. This geography provides marked physical separation of these populations.

In summary, Santa Ana speckled dace have long been markedly separated physically and geographically from other speckled dace populations both by embayments and by mountain uplift, with estimated divergence times from related Death Valley populations ranging from 229,000 to 41,000 years ago (Smith and Dowling 2008). Santa Ana speckled dace are also markedly separated from other speckled dace populations by their unique meristic and morphometric characteristics (Cornelius 1969; Hubbs et al. 1979).

Santa Ana speckled dace thus meet the criteria for being discrete from all other speckled dace.

Significance

The Santa Ana speckled dace meets relevant criteria for consideration of significance, including marked differences in genetic characteristics, and occurrence in a unique ecological setting.

As discussed more thoroughly above in the section on taxonomy, recent microsatellite analyses (Oakey et al. 2004; Smith and Dowling 2008; Nerkowski 2015; VanMeter 2017; Greaver 2019) demonstrate that Santa Ana speckled dace are genetically distinct from other speckled dace, and should be described as a separate subspecies or species (Greaver 2019).

Oakey et al. (2004) sampled 59 populations of speckled dace from throughout the western U.S., including populations in the Little Colorado River basin, middle and upper Colorado River basin, Los Angeles basin, Lahontan basin, Owens River basin, Columbia River basin, Klamath-Pit, and Bonneville basin. Oakey et al. (2004), who mapped 112 restriction sites in the mitochondrial DNA genome of speckled dace, found that haplotypes of Santa Ana speckled dace from the Santa Ana and San Gabriel Rivers in the Los Angeles basin formed a “well-supported monophyletic assemblage.”

Smith and Dowling (2008) estimated the timing of divergence of speckled dace populations inhabiting Colorado River tributaries, the Great Basin, Amargosa River, Los Angeles Basin (Santa Ana speckled dace), and Columbia River drainages. Smith and Dowling (2008) used mtDNA sequence divergences among speckled dace populations to estimate phylogenetic branch lengths, which were calibrated to geological time with a fossil age estimate. Smith and Dowling (2008) determined that speckled dace likely spread from the upper Colorado River basin to the lower basin and then to the Los Angeles basin about 1.9–1.7 million years ago. Smith and Dowling (2008) determined that Santa Ana speckled dace are not closely related to Owens River, Amargosa River, or northern California lineages, which are divergent members of Columbia Basin and Lahontan Basin clades. Smith and Dowling (2008) found considerable haplotype diversity in the San Gabriel River sample, and estimated divergence times ranging from 229,000 to 41,000 years ago. The long phylogenetic branch leading to the Los Angeles population (Santa Ana speckled dace) is apparently the consequence of rapid molecular evolution of these fishes.

Nerkowski (2015) characterized and identified polymorphic microsatellite markers for speckled dace samples from Southern California (Santa Ana speckled dace from the Santa Ana, San Gabriel, and Los Angeles rivers), Central California Coast (San Luis Obispo and Santa Maria rivers), and Owens River Valley. Nerkowski (2015) identified 23 microsatellite markers and used 7 loci to examine patterns of genetic variation, providing genetic evidence that Santa Ana specked dace populations are discontinuous from populations in the Central California Coast and the Owens River Valley. Nerkowski (2015) confirmed that Santa Ana speckled dace diverged from Colorado Basin populations, and that Central Coast populations were not established as a result of a migration event from the Southern California populations. Nerkowski (2015) found Santa Ana speckled dace to be genetically distinct from speckled dace in other regions within California, and were a discontinuous, highly differentiated population. Nerkowski (2015) postulated that further evaluation of the mitochondrial and nuclear genome may show that Santa Ana speckled dace are reciprocally monophyletic for all markers, suggesting a distinct taxa, or species.

VanMeter (2017) evaluated 74 speckled dace specimens collected from five different watersheds in Southern California (Santa Ana speckled dace), the Central California Coast, and the Owens River Valley. Phylogenetic analysis of mtDNA sequence data by VanMeter (2017) demonstrated that the Santa Ana speckled dace is a genetically distinct population from speckled dace inhabiting the Central Coast or Owens Valley regions, which both differ from Santa Ana speckled dace by a genetic distance of more than 7 percent. VanMeter (2017) concluded that Santa Ana speckled dace form a reciprocally monophyletic clade with respect to the Central Coast dace and the Owens Valley dace, which are sister clades to one another. VanMeter (2017) further proposed the Santa Ana speckled dace constitutes an Evolutionarily Significant Unit (ESU) or DPS that qualifies it as a separate subspecies on the basis that it is geographically separated from other populations, genetically distinct from other dace populations due to restricted gene flow, and possesses unique phenotypic characteristics.

Greaver (2019) provided nuclear DNA sequence data to determine the taxonomic status of Santa Ana speckled dace to elucidate their evolutionary history and the relationships among speckled dace in Southern California (Santa Ana speckled dace), Central California Coast, and Owens Valley regions. Greaver (2019) also compared Santa Ana speckled dace mtDNA sequence data to speckled dace from the Colorado River of Arizona. Greaver (2019) sequenced 3 EPIC intron markers on 54 samples representing all four regions. Based on the mtDNA and microsatellite data alone, Greaver (2019) found strong support that the Santa Ana speckled dace is a reproductively isolated taxon at the species level. Greaver (2019) confirmed this by showing Santa Ana speckled dace to be reciprocally monophyletic for nuclear DNA markers, in conjunction with the mitochondrial DNA marker analyses.

In summary, all of these studies demonstrated marked genetic differences between Santa Ana speckled dace and other speckled dace populations throughout the western U.S. and California, even with the most closely related and geographically adjacent speckled dace populations.

Santa Ana speckled dace inhabit a unique and distinct ecological setting within streams in the rugged canyons of the arid mountain ranges of southern California. Santa Ana speckled dace habitat in the Los Angeles, San Gabriel, Santa Ana and San Jacinto river basins is primarily in perennial stream reaches fed by cool springs. These habitats bear little resemblance to the habitat occupied by the most closely related speckled dace populations in Death Valley and Owens Valley (warm springs and discontinuous desert rivers), or to speckled dace habitat in geographically proximate watersheds in the Central California Coast.

Santa Ana speckled dace thus meet the criteria for significance.

LISTING FACTORS

Destruction, Modification, or Curtailment of Habitat or Range

Dams, Reservoirs, and Water Diversions

Moyle et al. (2015) rated the impacts of dams in limiting the viability of Santa Ana speckled dace populations as "high” meaning it is a factor that could push the species to extinction in 10 generations or 50 years. Virtually all Santa Ana speckled dace streams contain one or more dams and diversions, so stream flows are generally depleted and natural flow regimes are altered (Moyle et al. 2015). Reservoirs created by dams also provide areas where introduced predators and competitors of dace can live and reproduce. Dam and reservoir management actions leading to stream diversions, stream dewatering, flow fluctuations, and channelization are primary threats to Santa Ana speckled dace (USFS 2005). Many of the stream segments downstream of National Forest lands have been dewatered, resulting in isolation of dace and no connection to any downstream populations (USFS 2005).

<u>Los Angeles River Basin</u>

Big Tujunga Dam on Tujunga Creek is particularly a problem for speckled dace because the dam blocks movement of dace and captures large amounts of sediment, which often buries preferred dace habitats when released from the dam (Moyle et al. 2015). The dam has also impacted gravel recruitment and sediment movement in this system; by controlling the rate of water releases, the dam limits the ability of storm events to naturally alter stream features such as pools and spawning areas (USFS 2010). Unpredictable and sometimes very high releases of water from the dam threaten downstream fish. Stream flow and temperatures in Big Tujunga Creek below Big Tujunga Dam have varied so greatly that many fish populations, both native and invasive, could not maintain themselves. The delivery of coarse cobble and gravel substrates downstream is reduced by the dam and regulated flows (USFWS 2014). The dam and reservoir has also resulted in the spread of non-native aquatic species into the upper and lower reaches of Tujunga Creek. Big Tujunga Dam underwent a seismic retrofit from 2007 to 2011, and an interagency Santa Ana Sucker Working Group developed new operating guidelines to balance flood protection, water conservation, and the instream flows required to maintain Santa Ana sucker habitat below the dam (EDAW and SMEA 2009; BonTerra Consulting 2013).

High turbidity below the Big Santa Anita Reservoir seems to have been responsible for the extirpation of fish species from Santa Anita Canyon Creek below that dam.

San Gabriel River Basin

Cogswell Dam on the West Fork San Gabriel River has negative impacts on Santa Ana speckled dace. The dam blocks movement of dace (Moyle et al. 2015). Santa Ana speckled dace are present both upstream and downstream of the dam. If the speckled dace population upstream of the dam is ever extirpated, natural re-colonization will be impossible since the dam will block upstream movement of the source population (USFS 2010). Cogswell Reservoir is managed for flood control and captures large amounts of sediment. Dace habitat in the lower river is vulnerable to unpredictable high water and sediment releases from the dam, which have devastated this stream section several times in the past and smothered preferred dace habitats (Stephenson and Calcarone 1999; Moyle et al. 2015). As of 1995, the West Fork was still recovering from major sediment releases from 1981 and 1991; these sediments buried most of the habitat used by dace until they were flushed out by rainfall and dam water releases in 1988 (Moyle et al. 2015). Even then, the river's recovery was mostly due to a lucky combination of high rainfall leading to more frequent and higher quality releases from the dam. The water stored in Cogswell Dam is normally released after storms have passed (Moyle et al. 1995). Often there is little water in the reservoir during the summer, and the stream is maintained only by seepage from below the dam and from springs, although this flow is reliable enough for CDFW to manage much of the stream below the dam as a wild trout fishery (Deinstadt et al., 1990). The delivery of coarse cobble and gravel substrates downstream is reduced by the dam and regulated flows (USFWS 2014).

In Fish Canyon, Morris Dam isolates the dace population in Fish Canyon Creek from other dace in the San Gabriel River, preventing genetic flow and recruitment between populations (Moyle et al. 2015).

Santa Ana River Basin

Water diversions for human uses have appropriated most of the available water in the Santa Ana River watershed, such that significant pressures are put on natural hydrologic processes (USFWS 2014).

Seven Oaks Dam on the upper Santa Ana River was completed by the Corps in 1999, and serves the primary purpose of flood control for San Bernardino, Riverside, and Orange Counties. Construction of the Seven Oaks Dam and flood control operations of the reservoir have dramatically altered the hydrology of the Santa Ana River. The Biological Opinion for Seven Oaks Dam anticipated periodic water releases to mimic historic flood flows (USFWS 2002), but the releases that have occurred are unable to mimic historic flood flows due to damage to dam infrastructure. The design of the dam physically limits the amount of water that can be released to a small fraction of the river's larger historical peak flows. It is unclear if Seven Oaks Dam has had impacts on Santa Ana speckled dace or contributed to their extirpation from the middle reaches of the river. Poorly timed water releases from Seven Oaks Dam have negatively impacted river habitat and caused take of the federally threatened Santa Ana sucker (*Catostomus santaanae*) in the middle and lower Santa Ana River. Water releases from the dam with high levels of sediment have smothered sucker eggs and active spawning beds in sediment and damaged fish foraging habitat by decreasing water quality.

Many Santa Ana River tributaries have dams and water diversions. PG&E's Lytle Creek hydropower project has significant impacts on speckled dace habitat in Lytle Creek – see the discussion in the section on FERC below. PG&E's Mill Creek hydropower project has guaranteed flows from a recent FERC relicensing that maintain suitable habitat for dace in Mill Creek from Mountain Home Creek to the lower Edison diversion (USFS 2010). The Santiago Creek tributary has water diversions in the Cleveland National Forest that are under special use permits - the USFS has not determined whether they provide for adequate stream flows and water quality (USFS 2010). Fontana Union Water Company owns and operates the Grapeland Tunnel water diversion in Lytle Creek, for municipal use downstream.

The U.S. Forest Service (USFS) has allowed massive and unpermitted water diversions from the West Fork of Strawberry Creek in the San Bernardino National Forest, with adverse effects on aquatic and riparian habitat for Santa Ana speckled dace. The USFS issued a special use permit in 1976 that allowed Nestle to divert up to 162 million gallons of water a year from the West Fork of Strawberry Creek. That permit expired in 1988, but the USFS continued to allow Nestle to operate the diversion structure and illegally divert large amounts of water from the highest elevations of the watershed, even during drought years. Conservation groups sued in 2015 over the continued diversion despite the expired permit (CBD et al. 2015). The USFS simply issued a new permit, without any environmental review or analysis of impacts on dace habitat. While the new permit does have limited mitigation measures for protecting the creek, such as requiring minimum flows in two areas and requiring the company to broadly monitor the impacts of their water diversions, the triggers and actions for mitigation are not defined and fail to ensure needed protections will be provided (CBD 2018). Despite the fact that the USFS could have limited how much water Nestlé can extract from the creek, and despite evidence that pumping may far exceed the company's water rights, Nestle continues to pump millions of gallons a year from Strawberry Creek (CBD 2018). U.S. Geological Survey reports from July 2017 show that, despite heavy winter precipitation across California, Strawberry Creek's streamflow levels were the lowest since the agency began keeping track 96 years ago (CBD 2018).

<u>San Jacinto River Basin</u>

Outside of the National Forest, both the North and South Fork of the San Jacinto River have been diverted for agricultural and domestic use for many years (USFS 2010).

Barriers to Migration and Movement

Flood control structures that do not allow fish migration or movement have isolated dace populations in the San Bernardino and Angeles National Forests (USFS 2005). In the San Bernardino National Forest, Lytle Creek Road and its culvert where the road crosses the creek blocks movement of Santa Ana speckled dace (USFS 2020). Every year the downstream side goes dry and many dace die because they are not able to swim back upstream, and the lip of the culvert is too high for dace to be able to swim back up (USFS 2020). Fish passage barriers in Cajon Creek that block and isolate speckled dace have been created by the railroads (USFS 2020). The loss of connectivity of tributaries through the mainstems of rivers is a primary cause for speckled dace declines (USFS 2010). In many cases, if fish are moved downstream in flood events, they are no longer able to move back up from the mainstem due to migration barriers (USFS 2010).

Also refer to the Dams, Reservoirs, and Water Diversions section above for additional examples of migration and movement barriers.

Urbanization

Moyle et al. (2015) rated the impacts of urbanization in limiting the viability of Santa Ana speckled dace populations as "medium" meaning it is a factor that is unlikely to drive the species to extinction by itself but contributes to increased extinction risk. Most portions of the Los Angeles, Santa Ana and San Gabriel rivers not in public lands are highly urbanized. Urbanization and suburbanization have degraded watersheds containing dace. Extensive river channelization and impoundment has occurred in the middle and lower reaches of all rivers for flood control. These alterations result in the loss of ecological value for dace by changing streams from riparian corridors to canals (Moyle et al. 2015).

Urbanization was a much higher historical threat as dace have already been largely eliminated from urban stream reaches and are now confined to the upper portions of the watersheds where they occur, often on public lands.

Roads

Moyle et al. (2015) rated the impacts of roads in limiting the viability of Santa Ana speckled dace populations as "high" meaning it is a factor that could push the species to extinction in 10 generations or 50 years. The watersheds occupied by speckled dace have some of the highest road densities in California, due to intense urbanization in southern California. Roads exist along most speckled dace streams and negatively impact dace habitats through increased siltation, pollutant inputs such as chemical and trash wastes, along with channel constriction and barriers to upstream movement (Moyle et al. 2015).

The best habitat for speckled dace in Lytle Creek is regularly threatened by encroachment into the wash by heavy equipment by a variety of forest users to protect infrastructure including public roads, public utilities and private access routes (Moyle et al. 2015).

Agricultural Activities

Moyle et al. (2015) rated the impacts of agricultural activities in limiting the viability of Santa Ana speckled dace populations as "medium" meaning it is a factor that is unlikely to drive the species to extinction by itself but contributes to increased extinction risk. Agriculture is a greatly reduced threat from the past because much of the agricultural land in the Santa Ana speckled dace's range has already been urbanized. However, runoff from remaining dairy and citrus operations is a source of pollution in some streams (Moyle et al. 2015).

Pollution

Urbanization has caused water quality degradation in the Los Angeles, Santa Ana and San Gabriel rivers. Wastewater-dominated rivers - such as the Santa Ana River - are subject to increased inputs of regulated and unregulated contaminants, which degrade water quality and fish habitat suitability (USFWS 2014). 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 (USFWS 2014). The lower reach of the Los Angeles River is identified as impaired for pH, ammonia, lead, coliform, trash, scum algae, total dissolved solids and turbidity. The State Water Resources Control Board lists sections of the Santa Ana River as impaired by heavy metals, pathogens, bacteria, and nutrients. The board also lists sections of the San Gabriel River as impaired by bacteria, pH, and heavy metals (lead, copper).

While water quality impairment is of concern in portions of the Santa Ana speckled dace's occupied range, it is important to note some of these areas (e.g., the lowest reach of the Los Angeles River, which is an extremely altered concrete-lined channel) are no longer suitable habitat for most fishes, regardless of water quality issues.

There is a high risk of spills of hazardous materials from trucks and trains into stream habitat occupied by dace along high use transportation corridors, such as I-15 through Cajon Pass and State Route 330 paralleling City Creek (USFS 2010). In 2009, a spill involving spoil piles (excess soil from an excavation) stored along Highway 330 resulted in soil entering into Schenk Creek, which enters East Fork City Creek (USFWS 2012b), although no analysis for impacts to speckled dace was completed. In the 1990s, dumping of trash and toxic materials (soap, motor oil, and mercury), was known to occur in the East Fork San Gabriel River (USFWS 2012b). The USFS, CDFW, and BNSF Railroad have been moving speckled dace in Cajon Creek into headwater tributaries to protect them from highway or railway spills (Moyle et al. 2015).

Livestock Grazing

Moyle et al. (2015) rated the impacts of livestock grazing in limiting the viability of Santa Ana speckled dace populations as "low" meaning it may reduce dace populations but extinction is unlikely as a result. Livestock grazing is present at low intensities in some watersheds where Santa Ana speckled dace occur. Livestock grazing can negatively impact water quality and aquatic and riparian habitat for Santa Ana speckled dace. Damage to riparian areas by livestock grazing in the western U.S. is well documented. Free-ranging cattle strongly prefer riparian areas due to the availability of water, shade, and increased forage. Cattle spend 5 to 30 times as much time in these cool, productive zones relative to other areas (Roath and Krueger 1982; Skovlin 1984; Clary and Medin 1990). Cattle prefer to browse young willow and cottonwood shoots, eventually eliminating these important woody species from streamside locations (Kauffman et al. 1983; Kovalchik 1987; Case and Kauffman 1997). Grazing in riparian areas can jeopardize fish species (Kauffman and Krueger 1984; Knapp and Matthews 1996), alter stream morphology and hydrology, increase soil erosion and sediment deposition in streams, and degrade and contaminate water quality (Chaney et al. 1990; Belsky et al. 1999).

Mining

In-stream mining alters the channel geomorphology and bed elevation, may induce channel incision and erosion, and can require water diversion, clearing, and excavation. Mining for gravel and sand removes necessary substrates from the watershed and discharges fine residual sediment. These activities have occurred in the Santa Ana River (USFWS 2014).

Moyle et al. (2015) rated the impacts of mining in limiting the viability of Santa Ana speckled dace populations as "low" meaning it may reduce dace populations but extinction is unlikely as a result. Instream mining activities can displace dace from preferred habitat, but the effects are mostly localized (Moyle et al. 2015).

Speckled dace in Cattle Creek (a tributary to the East Fork San Gabriel River) may be adversely influenced by mining operations (Moyle et al. 1995). A rock quarry in Fish Canyon has encroached on optimal speckled dace habitat; however, the mining company is in the process of restoring fish habitat (Moyle et al. 2015). The CEMEX mining company is seeking permits to reestablish aggregate mining in the Lytle Creek channel, though this is downstream of the national forest and known occupied dace habitat.

Suction dredging to find precious minerals occurred most frequently on U.S. Forest Service lands in the San Gabriel River and Los Angeles River watersheds. Sluicing and high banking, techniques used to find precious minerals, were likely occurring in the San Gabriel River and to a lesser extent in Big Tujunga Creek (USFWS 2014), prior to the banning of recreational suction dredge mining in 2016. Moyle et al. (2015) noted that recreational mining had been increasing in popularity with spikes in the value of gold, and still occurred in many locations. Suction dredging in the San Gabriel River basin, Cajon Wash, and Lytle Creek may have negatively affected habitats used by dace and other aquatic species (Moyle et al. 2015). As of 2016, suction dredging was banned in California streams and the CDFW is not issuing any dredging permits. Legacy impacts to dace habitat from suction dredging may remain and benefits from the ban on suction dredging may be difficult to detect.

Some mining activities have continued in the East Fork San Gabriel River, but without the use of suction dredging equipment (USFS 2010). The USFS has documented potential impacts to speckled dace habitat in the lower East Fork San Gabriel River, at Heaton Flat and Oaks Day Use, areas with increasing recreational activities and unauthorized mining (USFS and WRPI 2019a,b). The USFS and WRPI (2019a,b) found elevated and/or increasing levels of specific conductivity in these stream reaches from anthropogenic activities including unauthorized mining and artificial dams, posing a detrimental threat to native fish such as Santa Ana speckled dace. Heaton Flat had conductivity of 258.13 μS/cm in May 2019 and 277.33 μS/cm in July 2019; Oaks Day Use measured 458 μS/cm in October 2016 and 291.5 μS/cm in July 2019 (USFS and WRPI 2019a,b). The surveys note that conductivity was below the 310 μS/cm EPA standard to support diverse aquatic life without resulting in an unacceptable effect, but that previous studies (Morgan et al. 2007) suggested a conductivity level below 247 μS/cm is ideal for macroinvertebrate health and below 171 μS/cm is optimal for fish health. USFS and WRPI (2019) noted that the steady increase in recreational activities and unauthorized mining activities coupled with reduced stream flow may exceed EPA conductivity thresholds and likely shift the Upper East Fork River into a habitat not suitable for certain species of fish or macroinvertebrates.

Fernandez (2019) evaluated geomorphic alterations from small-scale gold mining and excessive recreation, and effects on native fish habitat and water quality in a 16-mile stretch of the East Fork San Gabriel River in the Angeles National Forest. Small-scale gold mining and construction of artificial recreational dams corresponded with high number of unnatural pools, increased "slow" waters and fewer riffles, higher levels of fine sediments, decreased substrate variability, damage to riparian vegetation, bank instability, increased channel width and erosion, and general degradation of native fish habitat (Fernandez 2019).

Concentrated Recreational Use

Thousands of people from the Los Angeles metropolitan area and adjacent urban communities use wilderness and non-wilderness areas within the Angeles and San Bernardino National Forests for recreation. The impact of large numbers of people using these accessible stream areas include destruction of streambank vegetation, streambank erosion, and disposal of untreated human waste and other refuse into the creeks, all of which degrade water quality. Extremely high levels of recreation use have negative impacts on speckled dace in the West, East, and North Forks of the San Gabriel River, Santa Ana River, Lytle Creek, Mill Creek, and

Big Tujunga Creek (Swift 2003; USFS 2010; O'Brien et al. 2011; Moyle et al. 2015). A major problem is the many small dams constructed in dace habitat for water play, swimming, and bathing; these dams raise water temperatures, reduce the amount of spawning habitat, create barriers for upstream movement of speckled dace, and result in large accumulations of trash (USFS 2010; Moyle et al. 2015). The Fisheries Resource Volunteer Corps and other groups are working with the Angeles and San Bernardino National Forests to remove dams and trash from fish streams (USFS 2010; USFWS 2012a).

Moyle et al. (2015) rated the impacts of recreation in limiting the viability of Santa Ana speckled dace populations as "medium" meaning it is a factor that is unlikely to drive the species to extinction by itself but contributes to increased extinction risk. Heavy recreational use in streams (including camping, dam building for water play, swimming, and off-road vehicle use) may displace dace from optimal habitats, further stress fish in suboptimal habitat, and fragment and alter habitats (Moyle et al. 2015). Heavy recreational use can also disturb dace spawning and feeding behavior (Moyle et al. 1995).

The Angeles National Forest (ANF 2016) surveyed the East Fork San Gabriel River and compared stream conditions between a lower reach (above Camp Williams), which had 8 recreation dams, and an upper reach (Oaks Day Use), which had 29 recreation dams. The upper reach had more disturbance and more fine material, which can impair aquatic food production and decrease survival of young fish. Fernandez (2019) evaluated geomorphic alterations from small-scale gold mining and excessive recreation, and effects on native fish habitat and water quality in a 16-mile stretch of the East Fork San Gabriel River in the Angeles National Forest. Small-scale gold mining and construction of artificial recreational dams corresponded with high number of unnatural pools, increased "slow" waters and fewer riffles, higher levels of fine sediments, decreased substrate variability, damage to riparian vegetation, bank instability, increased channel width and erosion, and general degradation of native fish habitat (Fernandez 2019).

Off-Road Vehicle Use

Off-road vehicles could adversely affect Santa Ana speckled dace by damaging both riparian and in-stream habitat. Off-road driving along stream banks can degrade bank stability, cause erosion, and damage riparian plant communities (USFWS 2014). Off-road vehicles may also drive through the river and disturb sediments, create increased turbidity, potentially crush fish, and otherwise disturb substrates that fish require for feeding and rearing young (USFWS 2014).

The San Gabriel Canyon Off Highway Vehicle Area is located at the confluence of the East and West Forks of the San Gabriel River in the Angeles National Forest. USFS fish surveys in 2009 noted very localized negative impacts to dace habitat from OHV activity, immediately downstream from two well-used OHV crossings, and documented changes in physical habitat and benthic macroinvertebrate communities, vehicular traffic in the river, disturbance from OHV trails and river crossings, and trash (Chapman 2009; ECORP 2009). Catch rates of speckled dace in the West Fork of the San Gabriel River were very low in 2009 in comparison with previous surveys (Baskin and Haglund 2002; ECORP 2007), with 197 dace captured in 2007 and only 50 dace in the same reaches in 2009 (ECORP 2009). However, presumed causes were fluctuations of the San Gabriel Reservoir water level, which allowed predation on dace by largemouth bass and invasion of green sunfish into the survey reaches, which also preyed on dace (ECORP 2009). Resurveys of the same stream reaches in the OHV area in 2011 only located a single speckled dace (Chambers Group 2012) and no dace were located in 2013. It is unclear whether periodic reservoir inundation or OHV use and crossings are the direct or prominent cause for lower fish habitat and ecological community values within these reaches (Chambers Group 2012; ECORP 2013).

The San Gabriel Canyon OHV area is supposedly currently being managed by the USFS to reduce impacts to fish (primarily listed Santa Ana suckers) and is being monitored to determine the effectiveness of management actions (USFWS 2014). These management measures include establishing OHV capacity limits, providing designated OHV stream crossings, closure on weekdays, signage, monitoring and enforcement, and removal of rock dams (SGRD 2012-2017). However, due to lack of funding the USFS effectiveness monitoring program is no longer functional (although daily monitoring occurs when the OHV area is open), and habitat and population monitoring has been “problematic” (SGRD 2012-2017). The USFS annually documents numerous incidents of non-compliance with resource protection measures by OHV users, such as improperly crossing streams, driving in the stream or reservoir, damaging vegetation, and driving in closed areas (SGRD 2012-2017). The USFS claimed that increased public outreach, strict enforcement, and placement of visual barriers in 2014 resulted in higher levels of compliance with OHV regulations in the use of designated stream crossings (SGRD 2014-2017). However, during 2014 fish surveys biologists reported OHV use outside of permitted areas and in the stream channel, OHV use of unauthorized river crossings, lack of flagging and boundary markers in lower sections, and large amounts of trash (ECORP 2014). Biologists found multiple native fish in the OHV area with injuries and observed dead native fish (including one speckled dace) exhibiting damage suspected to be from OHV activity, although changes in water quality or stream habitat during a recent storm event was postulated as a possible cause (ECORP 2014).

Non-paved U.S. Forest Service and other roads in the mountainous areas are of concern for impacts to dace habitat, given the friable soils in this region that easily erode into streams as well as their facilitation of access for intensive human recreational use (Moyle et al. 2015).

Logging

Moyle et al. (2015) rated the impacts of logging in limiting the viability of Santa Ana speckled dace populations as "low” meaning it may reduce dace populations but extinction is unlikely as a result. Forest thinning and other forestry practices in the national forests where Santa Ana speckled dace occur require roads. Most forest roads are unimproved and serve as sources of sediment input to streams which support dace. Forest roads also provide corridors for recreational access.

Disease and Predation

Petitioners are unaware of any information regarding disease or natural predation being threats to Santa Ana speckled dace. The impacts of non-native predators which may jeopardize Santa Ana speckled dace are discussed below in the section on introduced species.

Overutilization for Commercial, Recreational, Scientific or Educational Purposes

Commercial or scientific harvest does not appear to be a contributing factor in the decline of the Santa Ana speckled dace. As discussed in the section above on recreation impacts, heavy human recreational use along streams that currently or formerly supported Santa Ana speckled dace has degraded water quality and dace habitat.

Inadequacy of Existing Regulatory Mechanisms

Federal Protections

Existing federal regulatory mechanisms that have the potential to provide some form of protection for the Santa Ana speckled dace include: overlap with other ESA listed species and their designated critical habitat; protection under National Forest Plans due to occurrence on federal forest lands; consideration under the National Environmental Policy Act or the Clean Water Act; and FERC relicensing.

<u>Overlap with ESA Listed Species</u>

Santa Ana speckled dace may derive some benefit from occupying a few of the same streams as the Santa Ana sucker (*Catostomus santaanae*), which is protected as a threatened species under the federal Endangered Species Act. Speckled dace and suckers may utilize similar stream habitats and have some overlap in the San Gabriel and Los Angeles watersheds, but Santa Ana suckers are capable of occupying higher mountain streams and lower elevation alluvial floodplains in these watersheds than speckled dace (Swift et al. 1993; Moyle 2002).

In the San Gabriel River, Santa Ana speckled dace and Santa Ana sucker both occur in the West Fork, North Fork, and East Fork, and in Cattle Canyon Creek. In the Los Angeles River basin, populations of Santa Ana speckled dace and Santa Ana sucker may overlap in portions of Big Tujunga Creek. There is likely little overlap of these species in the Santa Ana watershed since Santa Ana suckers occur in the lower and middle reaches of the mainstem Santa Ana River, but speckled dace do not occur in the lowlands and have been extirpated from the middle reaches of the Santa Ana River.

Designated critical habitat for the Santa Ana sucker in stream reaches that support Santa Ana speckled dace include: the West, North, and East Forks of the San Gabriel River, and tributary Cattle Canyon Creek; portions of Big Tujunga Creek in the Los Angeles River basin; and Mill Creek (where dace are extirpated) and City Creek in the Santa Ana River basin (USFWS 2010).

To improve habitat and reduce impacts on Santa Ana suckers, the Forest Service is conducting annual removal of small hand-made dams from the East, West and North forks of the San Gabriel River and the Big Tujunga River on the Angeles National Forest (USFWS 2012a). This will likely reduce impacts to speckled dace in these stream reaches as well.

Santa Ana speckled dace may derive some benefit from occupying stream reaches that are designated as critical habitat for the Arroyo toad (*Bufo californicus*), which is protected as an endangered species under the federal Endangered Species Act. However, arroyo toads utilize somewhat different aquatic habitat than speckled dace, primarily in low gradient stream reaches. Adult arroyo toads breed in shallow, sandy pools, and juveniles are typically found in reaches with sand substrate or fine gravel bars. The designated critical habitat for the arroyo toad appears to only overlap with Santa Ana speckled dace in Cajon Wash (USFWS 2011).

<u>Habitat Conservation Plans</u>

The Santa Ana speckled dace is not currently a covered species under any ESA Habitat Conservation Plans in southern California (USFWS 2020). However, it is proposed as a covered species under the Upper Santa Ana River Habitat Conservation Plan that is in preparation by water resource agencies of the Santa Ana River Watershed, in partnership with the USFWS, CDFW, and several other government agencies and stakeholder organizations (USARSRA 2020).

National Forest Plans

U.S. Forest Service (USFS) lands encompass much of the current native range of the Santa Ana speckled dace. The majority of the dace's range on USFS lands is not under wilderness management. Wilderness designation would offer no direct regulatory protection for dace, but does reduce some human-induced impacts on stream habitats. For example, motorized equipment is excluded from these areas. Dace habitat on USFS lands is not subject to the development pressures existing on private land. However, this protection likely is partially offset by the extensive recreational impacts on Southern California National Forest lands.

Santa Ana speckled dace are listed as a Region 5 U.S. Forest Service "Sensitive Species." Forest Service objectives for designated sensitive species (Forest Service Manual 2670.22, 2670.32, and 2670.44) include: management practices to ensure that species do not become threatened or endangered because of USFS actions; maintain viable populations of native fish in habitats distributed throughout their geographic range on USFS lands; management objectives for populations and/or habitat of sensitive species; assist states in achieving their goals for conservation of endemic species; review programs and activities as part of the NEPA process to determine their potential effect on sensitive species; avoid or minimize impacts to species whose viability has been identified as a concern; if impacts cannot be avoided analyze the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole (a decision must not result in loss of species viability or create significant trends toward federal listing); and establish management objectives in cooperation with states when projects on USFS lands may have a significant effect on sensitive species population numbers or distributions.

The Land Management Plan for the four Southern California Forests directs the USFS to take conservation actions to prevent listing of sensitive species (LMP part 2 WL 1). Implementation of priority conservation strategies is identified in the LMP as a method to meet this objective. The USFS developed a Conservation Strategy in 2010 for Santa Ana speckled dace in the Angeles, San Bernardino, and Cleveland National Forests (USFS 2010) The Conservation Strategy consists of guidelines for conservation and recovery of speckled dace in these National Forests. The Conservation Strategy identifies translocations (including reintroduction and population reinforcement) as necessary to expand speckled dace occupation of historic distribution in these National Forests; it also identifies critical actions such as maintaining or securing permanent, year-round surface water and improving connectivity of stream reaches, protecting streams with populations of dace from damaging spills of hazardous materials, and preventing extremely large high intensity fires.

The management strategies in the speckled dace Conservation Strategy appears to consist mostly of management directives and goals from the USDA Forest Service Manual and the 2005 Land Management Plans for the four Southern California National Forests.
It has a menu of recommended conservation practices that "should be considered" for all land or wildlife management actions on the National Forests where Santa Ana speckled dace do or could occur, including sharing information, preparing management plans, minimizing and mitigating impacts from channel modification, protecting riparian vegetation, ensuring adequate stream flows, conducting fish rescue after emergencies (such as wildfire, floods, or hazardous spills), controlling and eradicating invasive species, identifying fish passage barriers, using fuel

management to reduce wildfires, conducting regular habitat surveys, and pursuing reintroduction and population augmentation efforts.

It is important to note that the speckled dace Conservation Strategy does not provide substantive or guaranteed protections for speckled dace or their habitats – it merely provides management recommendations, which it is presumed the USFS will “strive” to follow for management actions on the National Forests. A good example of the USFS failure to implement or adhere to the Conservation Strategy was provided after conservationists exposed that the USFS had for decades allowed Nestle to continue illegal, massive, unpermitted diversions from the West Fork of Strawberry Creek, which was formerly speckled dace habitat. In 2015, well after the Conservation Strategy was developed, the USFS responded to the decades of illegal diversions by issuing a new permit for continued water diversion, without any environmental review or analysis of impacts on dace habitat. This action contradicted the 2010 Conservation Strategy which states that the USFS will "ensure adequate instream flows are secured and maintained."

The San Bernardino National Forest apparently has been developing an unpublished Santa Ana speckled dace relocation plan, and updated the Conservation Strategy in 2015 or 2016, but did not provide an updated version as part of a FOIA request (USFS 2020). A Santa Ana speckled dace working group (biologists from the U.S. Geological Survey, U.S. Forest Service, and California Department of Fish and Wildlife) has been working on reintroducing speckled dace to Strawberry and East Twin Creeks (USFS 2020).

As of 2016, the San Bernardino National Forest was planning on using Caltrans mitigation funds in cooperation with CDFW and the Riverside-Corona Resource Conservation District to implement a captive breeding program for Santa Ana speckled dace and to conduct speckled dace reintroduction and translocations in the San Bernardino National Forest (USFS 2020).

Source populations being considered for speckled dace reintroductions were Lytle, Plunge, and Cajon Creeks; City Creek was considered but rejected because the USFS did not have a genetic analysis for the post-2005 dace found in the stream (USFS 2020). Locations that have been identified for speckled dace translocation and reintroduction are Waterman Canyon, Mountain Home Creek, Fredalba Creek, Etiwanda Creek, Alder Creek, Day Creek, and Cucamonga Creek (USFS 2020).

The USFS noted concern from biologists that the viability of existing dace populations could be impacted by removal of dace from source populations; if current populations of dace are stressed and low in numbers, the removal of hundreds of fish may have negative effects on the populations (USFS 2020). Biologists also expressed concerns about inadvertently spreading diseases or other invasive species during dace translocation efforts; when dace are taken from a source population and then immediately translocated to a different watershed, other organisms may also be moved (USFS 2020).

The Riverside-Corona Resource Conservation District developed a reintroduction plan with the San Bernardino National Forest and CDFW to breed populations of speckled dace in an off-site refugia and captive breeding facility in order to reduce potential impacts to wild populations of dace and to reduce the possibility of transporting diseases (USFS 2020). Dace collected from the source populations would be treated for any diseases before entering the facility.

The Forest Service did not provide any information on whether speckled dace reintroductions had begun yet, where source populations were located, or whether a captive breeding facility was used (USFS 2020), but the Riverside-Corona RCD informed Petitioner that speckled dace reintroductions were ultimately conducted in upper Plunge Creek, Waterman Canyon (East Twin Creek), and Hemlock Creek, a tributary to the Santa Ana River above Seven Oaks Dam (pers. comm. with Kerwin Russell, Riverside-Corona RCD fisheries biologist, 2020). The reintroductions were reportedly successful, with reintroduced speckled dace reportedly still recently inhabiting the lower portion of Plunge Creek and Hemlock Creek, with "limited numbers" still in Waterman Canyon (K. Russell, pers. comm., 2020). The reintroduction program has since been discontinued (K. Russell, pers. comm., 2020).

It is important to note that Santa Ana speckled dace reintroduction attempts into the Santa Clara River were not successful, despite dace being sympatric with Santa Ana suckers.

<u>National Environmental Policy Act</u>

The National Environmental Policy Act (NEPA) requires federal agencies to consider the effects of management actions on the environment. NEPA also requires federal agencies to fully and publicly disclose the potential environmental impacts of all proposed projects. Actions taken by federal agencies (such as the Army Corps of Engineers, U.S. Forest Service, and Federal Energy Regulatory Commission) with the potential to impact Santa Ana speckled dace and their stream habitat are subject to the NEPA process. The NEPA process requires these agencies to describe a proposed action, consider alternatives, identify and disclose potential environmental impacts of each alternative, and involve the public in the decision-making process. The public can provide input on what issues should be addressed in an Environmental Impact Statement and can comment on the findings in an agency's NEPA documents. Lead agencies are required to take into consideration all public comments received in regard to NEPA documents during the comment period. However, NEPA does not explicitly prohibit federal agencies from choosing alternatives that may negatively affect imperiled species. Even if Santa Ana speckled dace or their habitat are present in a federal agency's project area, NEPA does not prohibit these agencies from choosing project alternatives that could negatively affect individual dace, dace populations or potential dace habitat.

<u>Clean Water Act</u>

The Clean Water Act (CWA) exists to establish the basic structure for regulating the discharge of pollutants into U.S. waters, and for regulating quality standards of U.S. surface waters. Under the CWA, the U.S. Environmental Protection Agency (EPA) implements pollution control programs and sets wastewater standards for industry and water quality standards for all contaminants in surface waters. Theoretically the CWA should provide some protection for stream habitats used by Santa Ana speckled dace. However, The CWA contains no specific provisions to address the conservation needs of rare species. Implementation of the CWA, and the Section 404 program in particular, has fallen far short of Congress's intent to protect water quality (e.g., see Morriss et al. 2001).

Under Section 404 of the CWA, discharge of pollutants into waters of the U.S. is prohibited absent a permit from the U.S. Army Corps of Engineers (Corps). The Corps is the federal agency with primary responsibility for administering the section 404 program. Under section 404, nationwide permits may be issued for certain activities that are considered to have minimal impacts, including minor dredging and discharges of dredged material, some road crossings, and minor bank stabilization. The Corps seldom withholds authorization of an activity under nationwide permits unless the existence of a listed threatened or endangered species would be jeopardized. Activities that do not qualify for authorization under a nationwide permit, including projects that would result in more than minimal adverse environmental effects, either individually or cumulatively, may be authorized by an individual permit or regional general permit, which are typically subject to more extensive review. Regardless of the type of permit deemed necessary under section 404, rare species such as the Santa Ana speckled dace may receive no special consideration with regard to conservation or protection absent listing under the ESA.

While the CWA may regulate pollutant discharge, it does not restrict all potential contaminants. The CWA does not address the leading cause of pollution today, “nonpoint” source pollution. Many pollution standards for industries are out of date, and new pollutant sources from pesticides and pharmaceuticals are constantly emerging. Also, much of the aging infrastructure for industries which attempted to address pollution during the early years of the CWA is in need of upgrades.

De facto evidence that the Clean Water Act alone cannot protect Santa Ana speckled dace and their habitat is that other aquatic species which overlap with the range and habitat of the Santa Ana speckled dace have not been adequately protected by the CWA. For example the Santa Ana sucker, which shares river habitat with speckled dace in the Santa Ana River, San Gabriel River; and Big Tujunga Creek, had to be protected under the federal Endangered Species Act as threatened in 2000, despite decades of presumed CWA protections.

FERC Relicensing

The Federal Energy Regulatory Commission (FERC) authorizes the construction, operation and maintenance of non-federal hydropower projects and reconsiders licenses under the Federal Power Act (FPA) every 30 to 50 years. The FPA requires FERC to assure that each hydropower project achieves a balance of beneficial uses of the affected waters and lands when making a licensing decision. Under FPA section 10(a), the fundamental purpose of each license is to assure that a project is “best adapted to a comprehensive plan of development” of the affected river basin for the beneficial uses of energy generation, water supply, flood control, recreation, and fish and wildlife (See 16 U.S.C. § 803(a)). FPA section 4(e) requires FERC to give “equal consideration to energy conservation, the protection, mitigation of damage to, and enhancement of, fish and wildlife (including related spawning grounds and habitat), the protection of recreational opportunities, and the preservation of other aspects of environmental quality” (FPA § 4(e); See 16 U.S.C. § 797(e)). Further, FPA section 10(j) requires that a license “adequately and equitably protect, mitigate damages to, and enhance, fish and wildlife (including related spawning grounds and habitat) affected by the development, operation, and management of the project….” (16 U.S.C. § 803(j)(1)). Section 10(j) of the FPA allows the U.S. Fish and Wildlife Service (USFWS) to conduct environmental reviews and to make recommendations during project relicensing that have the potential to add conditions and mitigations that could benefit native fish such as the Santa Ana speckled dace.

Under the Clean Water Act (CWA) Section 401, FERC may license a hydropower project only if the state where the project discharges certifies that the project will comply with applicable water quality standards. FERC must include in the license any conditions the state requires in order to certify the project. Under the Fish and Wildlife Coordination Act (FWCA), FERC is supposed to give fish and wildlife resources "equal consideration" with hydropower and other purposes of water resource development, and incorporate the recommendations of federal and state fish and wildlife agencies. Measures suggested by USFWS to mitigate for project impacts to fish and wildlife resources and to provide protection and enhancement - or an equivalent level of protection - must be accepted by FERC and incorporated into the license unless FERC determines that the recommendations are inconsistent with the FPA or other applicable law. Section 18 of the FPA gives the USFWS mandatory conditioning authority to prescribe upstream or downstream fish passage; these prescriptions must be incorporated into the license by FERC.

While FERC is required by law to address these factors in the license process, they are provided substantial deference in their implementation of them. State and federal wildlife agency recommendations for fish passage and protection measures can be rejected by FERC if they make a determination that there is not substantial evidence of need. FERC is the federal arbiter of conflicts between federal and state fishery agencies and hydropower developers, who often resist mitigation and compensation measures because they can be expensive and result in reduced power generation. Historically, FERC has failed to adequately protect native fish during licensing and relicensing; given inadequate consideration to fish and wildlife issues in its licensing decisions; been reluctant to impose license conditions for protection of fish and wildlife; and favored hydroelectric development over conservation of fish and wildlife (Bodi and Erdheim 1986). The Lytle Creek project FERC relicensing process, as discussed below, is an instructive example of how state and federal wildlife agency attempts to add protections for native fish during the relicensing project, in this case specifically for Santa Ana speckled dace, are sabotaged by the FERC process.

There are several hydropower dams in the Santa Ana River basin owned by Southern California Edison (SCE) and regulated by FERC. These include the Lytle Creek project (P-1932), Santa Ana River 1 & 3 (P-1933), and the Mill Creek 2/3 (P-1934) hydroelectric projects, located on Lytle Creek, Santa Ana River, and Mill Creek, respectively. A final FERC license was issued for these SCE projects in 2003. The permits run through 2033. Issues regarding protection and conservation of Santa Ana speckled dace were considered during the licensing.

The Lytle Creek project diverts up to 24.6 cubic feet per second (cfs) of water from Lytle Creek at the diversion dam for the purposes of power generation by SCE and water delivery to the Fontana Union Water Company (“Fontana”) (FERC 2003). After the diversion is used for energy generation it is discharged into Fontana’s canal, which holds water rights for the waters diverted by the project as well as asserted water rights for the entire flow of the creek (FERC 2003). A minimal amount of water flows around the dam, through the gates and valves, and from the sandbox in the form of “leakage”, quantified at 1.5 cubic feet per second (“cfs”) but largely unknown (FERC 2003). The bypass reach - downstream of the diversion before water reenters the creek in the Fontana canal - is dry during long portions of the year (FERC 2002). The past and current licenses provide no requirement to deliberately release flows into the bypass reach (FERC 2003). Large runoff events resulting in flows above 24.6 cfs are allowed to seasonally spill over the dam into the bypass reach (FERC 2003). Approximately 41 percent of flow leaving the project and entering the bypass reaches the Fontana canal; the remaining flow in the bypass reach is lost through infiltration into the substrate, presumably benefiting groundwater sources, the water table, and riparian vegetation (FERC 2003).

Santa Ana speckled dace and rainbow trout have been found in the bypass reach and are negatively impacted by the project because past and existing flows result in the stranding and concentration of fish in the bypass reach as the streambed goes dry (FERC 2002). In 2001, the Forest Service filed its preliminary Section 4(e) conditions requiring, among other things, a minimum flow release from the dam of 3 cfs, or inflow, so long as the releases did not interfere with existing water rights (FERC 2003). The USFWS and California Department of Fish and Game (CDFG) recommend that SCE release a continuous, year-round instream flow of 6 cfs, or inflow, into the Lytle Creek bypass reach to allow the establishment of a riparian corridor and provide habitat for speckled dace and rainbow trout (FERC 2003). In 2002, FERC rejected the 6 cfs recommendation and instead recommended a minimum flow of 3 cfs, or inflow, into the upper portion of the bypass reach except when such a release would adversely affect existing water rights (FERC 2003). CDFG and the USFWS acquiesced to FERC's 3 cfs recommendation, but without the exception for interference with existing water rights (FERC 2003).

In 2002, SCE, USFS, West San Bernardino County Water District, and the cities of City of San Bernardino, and Fontana filed a settlement agreement removing the minimum 3 cfs requirement in favor of maintaining the lower, existing leakage flows (FERC 2003). Water users persuaded the agencies to remove the requirement for minimum flows to maintain the water user's existing rights. The Forest Service removed the 3 cfs minimum flow, required construction and maintenance of the bypass channel to maximize above ground flow, and monitoring requirements. FERC then used the USFS elimination of minimum flow requirements under FPA 4(e) as a justification to reject the FPA 10(j) recommendations of minimum flow from the USFWS and CDFG (FERC 2003). No other explanation was provided. The Environmental Assessment ("EA") performed for the Lytle Creek project was premised on the minimum flow recommendations of 3 cfs initially proposed by the USFS and FERC. The EA failed to address whether relying on the lower existing leakage flows for is beneficial or detrimental for maintaining suitable habitat for Santa Ana speckled dace. The estimated leakage flow is 1.5 cfs, less if SCE asserts rights to recapture leakage, while the EA addressed estimated minimum flows of 2 cfs or above, without accounting for any loss of flow from percolation or pumping (FERC 2002, 2003).

The Lytle Creek project permit did require installation of a fish screen at the Lytle Creek diversion dam, but no minimum flow releases for fish - only continuation of leakage from the dam for instream flows. No 401 certification was issued for the Lytle Creek project. The Santa Ana project permit required fish screens to be installed at the Alder Creek diversion and instream flow releases for the first time in 100 years. A 401 certification was issued for the Santa Ana project. The Mill Creek project permit had no instream flow requirement for the new license, only continuation of existing leakage from the dam, and required no water quality monitoring. No 401 certification was issued for the Mill Creek project.

A request for a rehearing regarding instream flow issues was denied by FERC in 2005. The fact that FERC licenses come up for review so infrequently (every 30 to 50 years) gives little chance to reduce hydropower project impacts on Santa Ana speckled dace or improve habitat conditions under the FERC license. The Lytle Creek, Santa Ana, and Mill Creek project permits will not come up for relicensing until 2033.

In the San Gabriel River, the City of Pasadena owns the Azusa hydropower project (P-1250) and Pine Canyon Dam. The license for this project was issued by FERC in 1989 and expired in 2018. In 2016 the City of Pasadena applied for an exemption for the project as a small conduit hydroelectric facility and requested administrative surrender of the FERC license, which would exempt the project from the FERC process. The California Department of Fish and Wildlife (CDFW) contested the exemption application in 2016, and CDFW and the U.S. Forest Service asked for a fish population study. CDFW and USFS noted that fish surveys in the upper San Gabriel River above the San Gabriel Reservoir from 2007-2008 (O'Brien et al. 2011) did not include an inventory of the reservoir nor did they survey below the San Gabriel or Morris Reservoirs, but that surveys upstream of the project identified Santa Ana speckled dace and it is likely that the species may be present within the stream reaches affected by this project (see

CDFW and USFS comments in Kleinschmidt 2016). CDFW and the USFS further noted that continued operation and maintenance of the existing project as well as the operation of the San Gabriel Hydroelectric Project has the potential to affect habitat conditions in the stream reaches below and above the San Gabriel Reservoir and therefore may affect dace populations present in those reaches. Pasadena is refusing to conduct a fish study (Kleinschmidt 2016). As of February 2020 FERC has not acted upon the surrender of license and application for exemption from licensing, but in December 2018 FERC granted a 1 year continuance of project operation (FERC 2018). In December 2018 the State Water Resources Control Board denied Pasadena's request for a water quality certification pursuant to section 401(a)(1) of the Clean Water Act (SWRCB 2018).

State Protections

Existing state regulatory mechanisms that have the potential to provide some protection for Santa Ana speckled dace include listing as a species of special concern, and consideration under CEQA environmental review.

Species of Special Concern

The State of California considers the Santa Ana speckled dace a ''species of special concern.'' This designation does not provide any regulatory or substantive protection for the species. Santa Ana speckled dace is not listed as endangered or threatened by the State, and ''species of special concern'' are afforded no protection under the California Endangered Species Act.

California Environmental Quality Act

CEQA requires full public disclosure of the potential environmental impact of proposed projects. CEQA also obligates disclosure of environmental resources within proposed project areas and may enhance opportunities for conservation efforts. However, CEQA does not guarantee that such conservation efforts will be implemented.

The public agency with primary authority or jurisdiction over the project is designated as the lead agency under CEQA, and is responsible for conducting a review of the project and consulting with other agencies concerned with resources affected by the project. Under the CEQA guidelines a finding of significance is required if a project has the potential to ''reduce the number or restrict the range of a rare or endangered plant or animal.'' The Santa Ana speckled dace would qualify as a rare species under the CEQA guidelines and thus could be given the same consideration under CEQA as those species that are officially listed with the state. Under CEQA, Species of Special Concern must be considered during the environmental review process, with an analysis of the project impacts on the species, only if they meet the criteria of sensitivity under Section 15380 of the CEQA Guidelines. However, project impacts to Santa Ana speckled dace may not be analyzed if project proponents claim insignificant impacts to non-listed species and the project does not have population-level or regional effects or only impacts a small proportion of the species' range.

Once significant impacts are identified, a lead agency may either require mitigation for effects through changes in the project or decide that overriding considerations justify approval of a project with significant impacts. If significant impacts remain after all mitigation measures and alternatives deemed feasible by a lead agency have been adopted, a lead agency is allowed under CEQA to approve a project despite environmental impacts if it finds that social or economic factors outweigh the environmental costs. Thus projects are routinely approved that cause significant environmental damage, such as resulting in the loss of habitat supporting state-listed of special concern species. It is also important to note that CEQA is not, nor was it ever intended to be, a habitat protection mechanism. Protection of listed species and their habitat through CEQA is, therefore, not assured.

Other Natural or Anthropogenic Factors

Drought

Some dace populations (e.g. in Silverado Canyon) suffered severe losses or extirpation during the drought in the late 1980s (USFS 2005). Drought conditions contributed to dramatically reduced dace numbers in Big Tujunga Creek (Moyle et al. 1995). Research was just published in Science Magazine (Williams et al. 2020) concluding that the western United States has been in a continuing mega-drought since 2000, the worst drought since the 1500s. Williams et al. (2020) warn that extreme warming will exacerbate any dry spell making it longer, severer and more widespread, subjecting the Western U.S. and areas of Mexico with a severe long drought.

Wildfires and Flooding

Wildfire and subsequent flooding and debris torrents have had a major impact on Santa Ana speckled dace. Flash flooding with extreme run-offs is typical of post fire-flooding conditions in both the San Gabriel and San Bernardino mountains. Wildfire can eliminate vegetation that shades streams and moderates water temperature. The loss of riparian vegetation may impact water transport, sediment transport, water quality, and flow regime. Catastrophic fires can accelerate the delivery of fine sediment to streams, increasing turbidity and degrading the permeability of stream substrates. Large wildfires may threaten fish by isolating populations and causing local extirpations. Streams scoured during flood events after large fires generally cannot be re-occupied by natural upstream movement due to barriers (natural and artificial), stream channelization, and other factors that have altered the lower portions of nearly all rivers occupied by dace (USFS 2010; Moyle et al. 2015).

Santa Ana speckled dace populations appear to have been extirpated as a result of large wildfires and flooding in 2003-2004, 2006, and 2008, in Santiago Creek, Harding Canyon, and Strawberry Creek (USFS 2010; Moyle et al. 2015). The dace population in City Creek was almost lost following fires and flooding in 2003-2004; and dace declined severely in Tujunga Wash after the 2009 Station Fire, but then rebounded (O'Brien and Stephens 2009).

Moyle et al. (2015) rated the impacts of fire in limiting the viability of Santa Ana speckled dace populations as "high" meaning it is a factor that could push the species to extinction in 10 generations or 50 years. Fire frequency, duration and intensity are increasing in Southern California. Predictions are that fire frequency, intensity, and duration will continue to increase in Southern California over the next century, due to increasing temperatures and changes in precipitation patterns (Fried et al. 2004; Lenihan et al. 2008; Westerling and Bryant 2008), resulting in more debris torrents and landslides.

Several rescue attempts have been made to try and avoid the loss of dace populations after severe wildfires: dace were removed from City Creek, Lytle Creek, Plunge Creek and Big Tujunga Wash following the 2003 and 2005 fires and held in captivity for future reintroduction when the flooding threat passes, and habitat conditions have improved (USFS 2010).

Introduced Species

Moyle et al. (2015) rated the impacts of alien species in limiting the viability of Santa Ana speckled dace populations as "high" meaning it is a factor that could push the species to extinction in 10 generations or 50 years.

Alien fish species are common in the reservoirs and highly altered stream reaches of the Los Angeles, Santa Ana and San Gabriel rivers. Brown trout (*Salmo trutta*), hatchery-stocked rainbow trout (*Oncorhynchus mykiss*) and red shiners (*Cyprinella lutrensis*) can directly compete with or prey on speckled dace (Moyle et al. 1995). Although brown trout were thought to have contributed to extirpation of Santa Ana speckled dace from San Antonio Creek, Santa Ana speckled dace were abundant in City Creek prior to 2003 flooding despite the presence of brown trout (USFS 2010). Bass (*Micropterus* spp.) may also prey on native cyprinids and are present in Tujunga Creek below Tujunga Dam (O'Brien pers. obs. 2012, per Moyle et al. 2015). On the West Fork of the San Gabriel River there is some evidence that dace populations are inversely related to the abundance of largemouth bass (Haglund and Baskin 2002). Establishment of red shiners was thought to have contributed to dramatic declines of Santa Ana speckled dace in Big Tujunga Creek (Moyle et al. 1995). Red shiners directly compete for food and space with dace and prey upon dace eggs (Moyle et al. 1995). The Forest Service has concern that introduced mosquitofish (*Gambusia*) could have a significant impact on dace; an abundance of mosquitofish was noted West Twin and East Twin Creeks in 2009 (USFS 2010).

American bullfrogs (*Lithobates catesbeiana*) and alien crayfishes may also prey on dace at various life stages (Moyle et al. 2015). Bullfrogs have been observed in Big Tujunga (Haines Creek) and the Santa Ana River (USFWS 2014).

Invasive vegetation can also reduce the quality of speckled dace habitat by choking waterways, increasing flooding, reducing stream diversity, and creating a severe fire hazard leading to increased numbers of human caused fires and habitat damage (Moyle et al. 2015; USFS 2010). Some invasive plants respond aggressively to fire and are able to out-compete native plants under this artificial fire regime.

Giant reed (*Arundo donax*) has altered aquatic habitats in some sections of the Santa Ana River so that it is no longer suitable for native fishes, including speckled dace (Bell 1997). Stream reaches where giant reed dominates the riparian vegetation are characterized by increases in pH and ammonia and decreases in dissolved oxygen (Moyle et al. 2015). Giant reed uses excessive amounts of water and can alter the hydrology of a river system. Although efforts are underway to remove giant reed from many streams in southern California, it is very difficult to remove and is present in all watersheds where Santa Ana speckled dace are found (Moyle et al. 2015). The increase of arundo, tamarisk and tree-of-heaven is of concern in Santa Ana speckled dace watersheds (USFS 2010).

Large interagency programs to deal with invasive plants are increasing in the Santa Ana, San Gabriel, and Los Angeles River systems. The Forest Service is conducting some invasive plant removal projects in speckled dace habitat and is currently working on multiple watershed level invasive plant removal projects (San Gabriel River, Mill Creek, Tujunga Canyon, and coastal Santa Ana Mountains).

Climate Change

The most noticeable and widespread impacts of climate change on aquatic habitats in southern California will be continued increase in water temperatures and changes to the timing, frequency and duration of drought and flooding events. Water temperatures will increase by approximately 0.7ºC by 2099, based on conversion factors developed by Eaton and Scheller (1996). Although this increase is seemingly small (and is probably an underestimate), it may be significant to fish already exposed to summer temperatures above 20ºC (Moyle et al. 2015). For example, elevated temperatures may stress fish so that autoimmune function is repressed, making them more susceptible to disease (Moyle et al. 2015). White spot disease infections have already been detected in speckled dace collected from the East Fork San Gabriel River (Warburton et al. 2001). Elevated air temperatures associated with climate change will change the periodicity and magnitude of peak and base flows in streams. Predictions are that stream flow will increase in the winter and early spring and decrease in the fall and summer (Knox and Scheuring 1991; Field et al. 1999; Stewart et al. 2004; Stewart et al. 2005; CDWR 2006; Knowles et al. 2006).

Hydrographs that mimic natural flow regimes more closely may actually benefit speckled dace populations, as their populations can reestablish themselves faster than those of alien fish species (Gido et al. 1997; Valdez et al. 2001; Propst and Gido 2004). However, decreases in summer base flows may further isolate speckled dace populations (Moyle et al. 2015). Dace in Cajon Creek, North Fork Lytle Creek, West Fork City Creek, Silverado Canyon and the San Jacinto River become isolated by the presence of dry stream reaches during most of the year, preventing repopulation and genetic mixing between stocks (Moyle et al. 1995). Fire frequency, intensity and duration will almost certainly increase in southern California over the next century due to increasing temperatures and changes in precipitation patterns (Fried et al. 2004; Lenihan et al. 2008; Westerling and Bryant 2008), further threatening the stability and quality of speckled dace habitats.

Moyle et al. (2013) considered Santa Ana speckled dace to be “critically vulnerable” to the effects of climate change. The predicted impacts from climate change will exacerbate all existing threats to Santa Ana speckled dace (Moyle et al. 2015). Santa Ana speckled dace are likely to experience severe impacts, given the already hot and arid nature of the mostly desert streams they occupy, coupled with intense urban and suburban expansion in the region (Moyle et al. 2015).

Population Fragmentation

Santa Ana speckled dace persist mostly in small, fragmented, populations (Moyle et al. 2015). This makes the species especially vulnerable to random events, environmental factors, and loss of genetic variability. Moyle et al. (2015) noted that Santa Ana speckled dace are restricted to areas that are increasingly prone to catastrophic fire, debris flows, intensive water consumption, pollution, invasive species, and expanding urbanization and suburban development. Small population sizes increase the rate of inbreeding and may allow inbreeding depression. Loss of genetic variability reduces the ability of small populations to respond successfully to environmental stresses. Random events, such as floods or variations of annual weather patterns, or other environmental stresses and human-caused factors, can increase the risk of losing small, fragmented populations.

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