Petition to List Three Populations of Speckled Dace (*Rhinichthys osculus nevadensis*) in the Death Valley Region Under the Endangered Species Act:

Amargosa Canyon Speckled Dace
Long Valley Speckled Dace
Owens Speckled Dace

Owens speckled dace photo by Joe Ferreira, CDFW

CENTER for BIOLOGICAL DIVERSITY

Because life is good.

June 8, 2020

Notice of Petition

Submitted to the U.S. Fish and Wildlife Service on June 8, 2020.

Petitioner Center for Biological Diversity formally requests that the U.S. Fish and Wildlife Service ("USFWS") expand the endangered listing of the Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) under the federal Endangered Species Act ("ESA") to include speckled dace populations in Amargosa Canyon and Owens Valley, California. Based on the best available information, Amargosa Canyon and Owens Valley speckled dace are the same subspecies as Ash Meadows speckled dace, and should be listed as endangered. In addition, petitioner requests that the USFWS list Long Valley speckled dace as endangered, as a separate subspecies. Long Valley speckled dace is recognized by extensive genetic analysis as a separate subspecies, but has yet to be formally described. Alternatively, Petitioner requests that the USFWS list each of the Amargosa Canyon, Owens, and Long Valley speckled dace populations as endangered Distinct Population Segments.

Long Valley speckled dace may have recently been extirpated in the wild. Owens speckled dace remain in their natural habitat in only one location. Most of the remaining habitat for Amargosa Canyon speckled dace is under imminent threat of dewatering of the Amargosa River and its tributaries due to excessive groundwater extraction. All three populations qualify for protection as endangered under the ESA. Should the USFWS determine that any or all of these speckled dace populations warrant listing as threatened under the ESA, petitioner requests immediate inclusion of a 4(d) rule to address specific threats outlined in this petition.

Petitioner requests that the USFWS expand critical habitat for the Ash Meadows speckled dace to encompass current and former habitat areas for speckled dace in Amargosa Canyon, Owens Valley and Long Valley, concurrent with listing; or designate critical habitat for each speckled dace population concurrent with listing as a DPS.

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 speckled dace are freshwater 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 speckled dace populations and their habitat.

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Executive Summary

Three unique populations of speckled dace which inhabit the Death Valley region of California are critically imperiled and warrant protection under the Endangered Species Act. Recent genetic analyses reveal that speckled dace populations in Amargosa Canyon and Owens Valley, California are the same subspecies as the Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*) in western Nevada, which has been listed as a federally endangered species since 1984. Long Valley speckled dace is recognized by genetic analysis as a separate subspecies that has yet to be formally described.

These speckled dace are small cyprinid fish which live in freshwater streams and springs in the desert environments of Amargosa Canyon, Long Valley, and Owens Valley.

Amargosa Canyon speckled dace are confined to the Amargosa Canyon reach of the Amargosa River, and its tributary Willow Creek. These dace have been extirpated from a warm spring near Tecopa and their range in Amargosa Canyon has been constricted by groundwater diversions which reduce surface flow in the Amargosa River.

Long Valley speckled dace occurred in the isolated Long Valley volcanic caldera, just east of Mammoth Lakes, in Mono County, California. They have apparently been extirpated from all of their former habitats, including Hot Creek, Little Alkali Lake, and various isolated springs and ponds in Long Valley. A former population in Whitmore Hot Springs which was thought to be stable in 2009 appears to have been lost, based on 2019 surveys which failed to locate any speckled dace. Long Valley speckled dace may now be extirpated in the wild and now only exist in a managed refugium.

Owens speckled dace historically occupied most small streams and springs in the Owens Valley, California, but they have been extirpated from nearly half of their former habitats. They persist in three locations in northern Owens Valley. The only native habitats occupied by Owens speckled dace are several isolated springs in Fish Slough. They also occur in irrigation ditches in Round Valley and near Bishop.

The most severe threat to Amargosa Canyon and Owens speckled dace is dewatering of their unique river and spring habitats due to excessive groundwater extraction for agriculture, rural residential development, and urbanization. Water withdrawals are impacting aquifer sources which feed the Amargosa River. Groundwater extraction has already eliminated most of the springs on the Owens Valley floor which were once habitat for speckled dace, and further groundwater depletion threatens the springs at Fish Slough, the only remaining native habitat for Owens speckled dace. Geothermal energy development in Long Valley has altered the hydrology of hot springs which were formerly dace habitat.

Other threats to speckled dace in the Death Valley region include habitat alteration for agricultural use, river channelization, vegetation clearing, livestock grazing, off-road vehicles, and recreational development of hot spring water sources. Introduced species of fish, crayfish and bullfrogs predate upon on and compete with speckled dace, and invasive plants such as saltcedar are severely altering spring and riparian habitats along the Amargosa River. Changes in precipitation, snow and runoff in the Death Valley region due to climate change will result in reduced stream flows and inadequate aquifer recharge to sustain many of the ephemeral streams and springs which speckled dace rely on.

TABLE OF CONTENTS

NATURAL HISTORY

Description

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

> 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.

Moyle et al. (2015) provide descriptions for the Amargosa Canyon, Long Valley, and Owens Valley speckled dace populations:

> Amargosa Canyon speckled dace are visually similar to other *Rhinichthys osculus* subspecies. However, dace from Amargosa Canyon are characterized by a comparatively smaller head depth, shorter snout-to-nostril length, longer anal-to-caudal length, more pectoral fin rays, and fewer vertebrae than other forms. Speckled dace captured during a summer, 2010, survey of Amargosa Canyon ranged from 20 to 92 mm in fork length with a mean of 51 mm (Scoppettone et al. 2011).
>
> Long Valley speckled dace are distinguished by high numbers of pectoral and pelvic fin rays, high lateral line scale count, low lateral line pore count, and the absence of maxillary barbels (Sada et al. 1995). The following mean counts (standard error) are from Long Valley speckled dace collected in Whitmore Hot Springs and at an unnamed spring at Little Alkali Lake (Sada 1989): lateral line scales 61.7 (1.4); lateral line pores 19.0 (5.0); dorsal rays 8.0 (0.0); anal rays 7.0 (0.0); pectoral rays 13.0 (0.4); pelvic rays 7.4 (0.2).

Owens speckled dace are highly variable. A morphometric comparison of all extant populations in the Owens basin found that, although populations differ significantly for many characteristics, there is also high morphological overlap between populations. The frenum was well developed only in the now extirpated Little Lake population. Maxillary barbels occurred in most populations, which separates Owens Valley fish from conspecific populations in the Walker River/Lahontan basin. Speckled dace in the northern Owens Valley have maxillary barbels on at least one side, a high lateral line scale count, a moderate lateral line pore count, and moderately sized fins. Benton Valley populations were described as having low lateral line scale and pore counts, maxillary barbels on at least one side, and comparatively long pelvic fins. The following ranges in mean counts are for four speckled dace populations in the Owens River drainage: lateral line scales 59.3-70.7; lateral line pores 11.6-61.7; dorsal rays 7.8-8.0; anal rays 7.0-7.1; pectoral rays 12.0-13.9; pelvic rays 7.0-7.6; total vertebrae 36.9-38.1.

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). Morphological differences among speckled dace populations isolated in different watersheds led early ichthyologists to describe 12 separate species (Jordan and Evermann 1896). Based on the flexible nature and plastic morphology of the species, all speckled dace were later collapsed into a single species, *Rhinichthys osculus* (Hubbs et al. 1974).

Recent genetic analysis supports a return to some of the original taxonomy. 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. A number of forms are now recognized as separate taxa by ichthyologists due to their distinctive morphology, diverse habitats, isolation from other dace populations, and genetic differentiation.

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 still the primary way to identify species, it cannot be assumed that the only way to identify species is by visual identification and a lack of interbreeding (Baumsteiger and Moyle 2018). Cryptic evolutionary lineages exist that can only be identified through genetic and/or genomic approaches, such as Baumsteiger and Moyle (2018) found for speckled dace and Baumsteiger et al. (2017) found for another group of cyprinids (California roach/hitch).

Gilbert (1893) described *Rhinichthys nevadensis* from Ash Meadows, Nevada, but the subspecific name *R. o. nevadensis* has also been assigned to speckled dace in both the Amargosa River system and the Owens Valley (La Rivers 1962; Moyle 1976). Since the 1980s, some ichthyologists have placed speckled dace from Amargosa Canyon and the Owens Basin in separate undescribed subspecies (Williams et al. 1982; Deacon and Williams 1984), based on morphometric differences.

Sada et al. (1995) conducted a morphological and electrophoretic study of all extant speckled dace populations in the Death Valley region, which includes the Owens and Amargosa river systems, both of which were tributaries to pluvial Lake Manly during the Pleistocene (Miller 1946; Hubbs and Miller 1948). Sada et al. (1995) found that all the isolated populations in the Owens River hydrographic basin (Owens Valley and Long Valley) show genetic and morphological differences from each other but, with one exception, not enough for them to be regarded as separate subspecies. The exception was the Long Valley speckled dace population in Whitmore Hot Spring, which differed enough from other dace populations to be regarded as a separate subspecies (Sada et al. 1995). The Whitmore Hot Springs population represented the last extant population of Long Valley speckled dace, but may recently have been extirpated (Parmenter, pers. comm., 2020). This was the only speckled dace population known with a private fixed allele, the D allele of the PEPA locus (Sada et al. 1995). This was possibly the result of long isolation within the 700,000 year-old Long Valley Caldera (Hill et al. 1985). Sada et al. (1995) found that Owens speckled dace are closely related to Amargosa River speckled dace and probably should be placed within the same subspecies, but each isolated population should be recognized as a distinct population segment for management purposes.

Oakey et al. (2004) conducted a comprehensive genetic study of *R. osculus* throughout its entire range, using mtDNA restriction site mapping, paired with geologic evidence. The analysis of Oakey et al. (2004) supports both the distinctive nature of the Long Valley speckled dace and the grouping of the other Owens basin dace populations with those of Amargosa Canyon and Ash Meadows. The affinity between Amargosa Basin and Owens Basin speckled dace is likely the result of their former occasional contact in pluvial Lake Manley (Hubbs and Miller 1948; Oakey et al. 2004). Oakey et al. (2004) found that the speckled dace populations of the entire Death Valley system (the Owens, Amargosa and Mojave river drainages) form a monophyletic clade, however, Long Valley dace were clearly differentiated within this grouping and thus represent a distinct taxon in need of formal taxonomic description.

Using microsatellite and mtDNA analyses, Furiness (2012) identified multiple distinct dace populations in Death Valley. Furiness (2012) used 11 sample sites in the Death Valley system and 1 sample site in the Lahontan system to determine population structure and differentiation, placing Owens Valley dace central to all other Death Valley populations, although they were deemed significantly different from many populations. Furiness (2012) used microsatellite and mtDNA analyses to show that some dace populations were significantly different from all other populations: Bradford Spring and Jackrabbit Outflow in the Ash Meadows region of the Amargosa River system; Poore Creek in the Lahontan River system; and Whitmore Hot Spring in the Long Valley region of the Owens River system. Furiness (2012) found that the Oasis Valley (in the Amargosa River system) and Whitmore Hot Spring dace populations were significantly distinct.

The taxonomic status of the Oasis Valley speckled dace remains a question. Furiness (2012) considered it a putative subspecies that has not been formally described. But Baumsteiger and Moyle (2018) describe it as simply another population of *R. osculus nevadensis*, similar in status to the Amargosa Canyon or Owens Valley populations. This petition does not specifically cover the Oasis Valley speckled dace.

Nerkowski (2015) characterized and identified polymorphic microsatellite markers to examine the regional relationships among Southern California, Central California and Owens River Valley speckled dace populations. Highly significant geographic structure exists in dace in the Owens River Valley, congruent with the regional differentiation elucidated by mtDNA sequence data. The degree of population differentiation was correlated with isolation by distance.

Moyle et al. (2015) proposed updated systematics for the five Death Valley speckled dace forms, concluding that the Owens Valley, Amargosa Canyon and Ash Meadows populations represent distinct population segments within the subspecies *R. o. nevadensis*, while the Long Valley speckled dace is an undescribed subspecies. These isolated speckled dace populations have long independent evolutionary histories, with distinctive adaptations to local environments (Moyle et al. 2015).

VanMeter (2017) and Greaver (2019) used microsatellite and mtDNA analyses to determine the evolutionary history and monophyletic relationship among speckled dace in Southern California, the Central California Coast, and Owens Valley, determining that Santa Ana speckled dace in Southern California are genetically distinct from populations inhabiting the Central Coast or Eastern Desert regions.

Baumsteiger and Moyle (2018) tested the hypotheses of Sada et al. (1995) regarding population structure of speckled dace in Death Valley, with analysis of ~163,000 single nucleotide polymorphisms of speckled dace samples from Death Valley, the Lahontan Basin, the Pacific Northwest, and all over California. Baumsteiger and Moyle (2018) found three clearly defined groups of dace, including one group containing all Death Valley speckled dace complex samples. The preliminary conclusions of Baumsteiger and Moyle (2018) are that these three groups represent separate species within currently recognized speckled dace. Baumsteiger and Moyle (2018) further found strong population structure likely representing three distinct subspecies within the newly identified Death Valley species: Long Valley; Humboldt and Walker Rivers; and Ash Meadows/Owens Valley/Amargosa River populations. Isolated analyses on each proposed subspecies found distinct population segments within the Owens, Amargosa, and Ash Meadows basins, consistent with the subspecies status proposed by Sada et al. (1995). Baumsteiger and Moyle (2018) state:

> The final subspecies designation we propose (and fully supported by our analyses) is for the Ash Meadows/Amargosa/Owens group of locations. Proposed by Sada et al. (1995), this larger group should all be included under the current subspecies *R. o. nevadensis*. Structure within this subspecies also supports designation of Distinct Population Segments (DPSs) in each basin, Owens, Ash Meadows, and Amargosa. This fits with the extreme isolation of these basins and the amount of anthropogenic activity surrounding their waters, which threaten their existence. Careful analysis of the details surrounding the legal assignment of populations as DPS under the Endangered Species Act will be necessary but should be highly supported given our overall findings. *(p. 9)*

Range

Speckled dace in general are 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).

As described above, *Rhinichthys osculus nevadensis* occurs in Ash Meadows and Oasis Valley, Nevada; and the Amargosa Canyon and Owens Valley, California. An undescribed subspecies of *R. osculus* occurs in Long Valley, California.

Amargosa Canyon speckled dace are confined to the Amargosa River in Amargosa Canyon, California, and its tributary Willow Creek, including the Willow Creek Reservoir (Moyle et al. 2015). Historically, speckled dace were found in a warm spring just north of Tecopa but that population is extirpated (Moyle et al. 2015). The range of speckled dace in Amargosa Canyon has likely been constricted by groundwater diversions which have reduced surface flow in the Amargosa River.

Owens speckled dace historically occupied most small streams and springs in the Owens Valley, California, but now are only known to occupy three disjunct areas in the northern Owens Valley: Fish Slough, Round Valley, and areas in and around Bishop (Moyle et al. 2015). The Fish Slough populations occur in several isolated springs. The populations in Round Valley and the Bishop area occur in ditches which are not natural habitats.

Long Valley speckled dace occurred in the isolated Long Valley volcanic caldera, just east of Mammoth Lakes, in Mono County, California, including Hot Creek and various isolated springs and ponds (Moyle et al. 2015). Long Valley speckled dace were extirpated from all but one of their historic sites, including Hot Creek, and the sole remaining population within their native range was in Whitmore Hot Springs (Moyle et al. 2015). However, recent surveys revealed no speckled dace at this site, and they are thought to be extirpated in the wild (S. Parmenter, pers. comm. 2020).

Amargosa Canyon speckled dace, Owens speckled dace, and Long Valley speckled dace have all suffered range reductions, as discussed in detail for each population in the section on Historic and Current Distribution and Abundance, below.

Life History

Little information has been published on the specific life-history adaptations of speckled dace from the Amargosa Canyon, Owens Valley or Long Valley, so the species account is largely based on information from other dace populations (Moyle et al. 2015).

Feeding

Baltz et al. (1982) described speckled dace as active, omnivorous bottom browsers. 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. Diet varies according to prey availability. In general speckled dace prey opportunistically on the most abundant small invertebrates in their habitat, which may change with season (Moyle 2002). Preference of forage items may also be influenced by presence of other fishes that share similar habitats (Johnson 1985). Amargosa Canyon speckled dace show a preference for foraging in the riffles of their streambeds and pools (Moyle et al. 2015).

Reproduction and Growth

Speckled dace reach maturity by their second summer (Constantz 1981). Peak spawning of Amargosa Canyon dace is thought to occur in early spring (March), with spawning activity reduced or absent in late spring and summer, based on class sizes observed in May and July in Amargosa Canyon (Williams et al. 1982). Scoppettone (2005) noted speckled dace reproduction occurring at temperatures between 17.5 and 24.0ºC. Females produce 190-800 eggs, depending on size and location (Moyle 2002). 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). In general, speckled dace live three years and attain a maximum size of 80 mm SL in inland basins, but dace may reach 110 mm FL and live up to six years (Moyle 2002). Owens speckled dace rarely exceed 50 mm SL (Moyle et al. 2015).

Movement and Activity

Speckled dace are usually found in loose groups in appropriate habitats, although they avoid large shoals except while breeding. They can be active both day and night. In areas where bird predators are scarce 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 temperatures, with dace apparently staying active all year if water temperatures remain above 4ºC (39.2ºF) (Moyle 2002). Some speckled dace are active throughout the year, including the winter months (Moyle et al. 2015).

Movement of dace depends on habitat conditions. Flooding is known to contribute to the downstream dispersal of the species, and when extreme conditions such as floods, droughts or winter freezing eliminate local populations, speckled dace from nearby areas can recolonize or repopulate available habitats, if accessible (Sada 1990; Pearsons et al. 1992; Gido et al. 1997). Following a devastating flood, densities of speckled dace in the Colorado River, Arizona, returned to pre-flood levels after eight months, recolonizing from upstream and stream margin areas (Valdez et al. 2001). Such recolonization may be of particular importance in the Amargosa River where large but infrequent flood events are a defining characteristic of the desert hydrograph (Moyle et al. 2015).

However, Amargosa Canyon speckled dace do not often move to new locations (Moyle et al. 2015). Genetic analysis by Sada et al. (1995) indicated that dace populations within the Death Valley region rarely exchange genetic material. There is no direct hydrologic connection between Ash Meadows, the Amargosa Canyon, Oasis Valley, and the Owens Valley/Long Valley areas, so it would be virtually impossible for individual dace to move between populations.

Habitat Requirements

Amargosa Canyon speckled dace occur in freshwater streams and springs in the Amargosa River basin. The Amargosa River is a perennial river that flows through the Amargosa Canyon, with water levels that fluctuate seasonally. Unlike other speckled dace, which usually prefer moving water, Amargosa Canyon dace prefer pool-like habitat with deep, slow water (Moyle et al. 2015). Typical substrate consists of gravel, cobble, rock, or boulder (Springer 2008). In contrast to other populations of speckled dace, the Amargosa Canyon speckled dace has adapted to warmer pool-like springs unique to the Amargosa River. Amargosa River speckled dace can withstand relatively warm water temperatures (Baltz et al. 1982), and have been found to live in temperatures as high as 28–29ºC (Moyle 1998).

Williams et al. (1982) found speckled dace to be rare within the Amargosa River Canyon but abundant in Willow Creek and Willow Creek Reservoir. In contrast, Scoppettone et al. (2011) found speckled dace in robust numbers in the Amargosa Canyon but rare in Willow Creek. Summer water temperatures ranged little (23.4-24.8°C) in Amargosa River Canyon during the 2010 survey, while dissolved oxygen ranged from 6.2 to 8.6 mg/L, conductivity ranged from 2,044 to 5,318 µS/cm, and pH ranged from 7.9 to 8.3. Water temperatures were generally warmer in the river than in Willow Creek where they ranged from 25.2 to 28.7 °C (Scoppettone et al. 2011). Williams et al. (1982) reported the physical characteristics for Willow Creek, a small, clear stream with low flow (1 cfs) and fine sand/silt substrates: pH of 7.7, dissolved oxygen of 5-6 mg l-1, total dissolved solids of 700 ppm, and water temperatures of 21-28° C. The reservoir was turbid, with a substrate of easily roiled fines. The periphery of the reservoir has dense stands of salt-cedar and cattails (Williams et al. 1982). Scoppettone et al. (2011) made the following daytime measurements in Willow Creek: dissolved oxygen 7.1–12.1 mg/L, conductivity 1,027–1,082 µS/cm, and pH 7.6– 8.4. The high dissolved oxygen (12.1 mg/L) was probably due to the lower station having shallow water (<4 cm deep), with little flow and exposure to the sun, all of which are conditions promoting higher photosynthesis.

Riparian vegetation does not appear to drive Amargosa Canyon dace distribution, because no significant difference in abundance and density of speckled dace was observed between open water and highly vegetated reaches of Amargosa Canyon (Scoppettone et al. 2011), but vegetation can affect water levels and quality in streams and springs.

Speckled dace are known to occupy a variety of habitats in the Owens Basin, ranging from small cold water streams to hot-spring systems, although they are rarely found in water exceeding 29˚C (Moyle et al. 2015). They also have been found in irrigation ditches in and near Bishop. Despite the large variety of habitats apparently suitable to speckled dace in the Owens Basin, their disappearance from numerous localities since the 1930s and 1940s suggests they are vulnerable to habitat modifications and predation and/or competition by alien fishes. Speckled dace in the Owens Valley appear to persist in periodically disturbed human-created habitats, and areas where alien predatory fishes are excluded by poor water quality or insufficient water depth (Moyle et al. 2015).

Long Valley speckled dace are adapted to spring habitats, according to morphometric analysis of both extant and museum specimens by Sada (1989), based on their deep-bodied form. Their recent habitat in Long Valley was the shallow (<50 cm), clear outflow of a single spring, including two open pools in a marshy area; the narrow, nearly invisible, channel flows through a dense growth of bulrush, which provided cover for dace (Moyle et al. 2015). However, recent field surveys found no dace in this habitat, and they are thought to be extirpated in the wild (S.

Parmenter, pers. comm. 2020). The only remaining Long Valley speckled dace occupy a CDFW-managed refugium.

Ash Meadows speckled dace are also are adapted to spring habitats, and are restricted to large warm water springs and the related outflows of Ash Meadows in Nevada. They rely on undisturbed flows from the Ash Meadows basin aquifer to maintain suitable habitat.

Hydrogeology of Death Valley Region Dace Habitats

<u>Amargosa River Basin</u>

The Amargosa River spans 185 miles between Nevada and California's shared border and is the only free-flowing river in the Mojave Desert. It rises in the Oasis Valley near Beatty, Nevada; followed by a ~50 mile dry stretch; then it rises again at Ash Meadows, followed by a ~20 mile dry stretch; it then rises again in the "Middle Amargosa," first at Shoshone Spring, then at Tecopa, and finally in the Amargosa Canyon, flowing continuously most of the way to Dumont Dunes; followed by a ~10 mile dry stretch; and its final rising is at Saratoga Spring; before a ~50 mile dry stretch to its terminus at Badwater Basin.

The Amargosa River is a unique ecosystem that forms pools of water from springs at higher temperatures scattered along the river course, rather than one continuously flowing river. Most speckled dace rely on moving water and are adapted to stream flows, but Death Valley region speckled dace have developed unique adaptations to the desert ecosystem (Moyle et al. 2015). All populations of Death Valley region speckled dace rely on substantial groundwater aquifers discharging at the surface in springs to maintain suitable habitat.

The Amargosa Basin is located above a carbonate-rock province that stores water as an aquifer. Precipitation in the forms of snow and rain are the source of the water, however parts of the Amargosa Basin receive less than three inches of precipitation per year (Dettinger et al. 1995). Much of the precipitation occurs in the mountains of southern and central Nevada and discharges to the Amargosa River basin (Zdon et al. 2015). California Valley is also a key hydrological link for the Amargosa Canyon, connecting mountain snowmelt on Mt. Charleston to both the Amargosa River and its tributary Willow Creek.

Some amount of the spring discharge in the Amargosa Basin is comprised of fossil groundwater – water which fell as precipitation during the last glacial period and which has been in long-term storage in the carbonate aquifer system. According to hydrogen isotope studies, groundwater in the Amargosa Basin is likely tens of thousands of years old (Davisson 2014). Consequently, as this water discharges, it is likely there is a background level of drawdown in the aquifer, though at an order of magnitude far beneath that which results from groundwater pumping.

When precipitation occurs, plants collect nearly all the available water. However, the leftover surface runoff can recharge groundwater storage (Dettinger et al. 1995). Remaining precipitation percolates into the soil as water, then flows and resides throughout the pores of the carbonate-rock. The recharge process (from any source water) is quite rare in the Amargosa Desert due to the arid climate, accentuating the importance of the aforementioned fossil groundwater to the surface water resources of the Amargosa Basin and the aquatic organisms which rely on them.

When water enters the carbonate-rock aquifers, water moves into the deeper portions of the aquifer, flowing downgradient and leveling the water table. The flow rate depends on the aquifer substrates' permeability, gravity and pressure gradient, and other geologic or hydrologic barriers (Dettinger et al. 1995). Occasional storm events can cause significant streamflow discharge in the form of flash floods. Otherwise, the Amargosa River consists of ephemeral streams rising at isolated spring systems like Oasis Valley, Ash Meadows, and the Amargosa Canyon (Belcher et al. 2018). Groundwater rises to the surface and meets feeder springs to form the Amargosa River; the Amargosa River is entirely dependent on groundwater sources. Eventually, the water exits the system and discharges at springs or other water bodies via shifting into other nearby aquifers, by transpiring into plants, or evaporating into the air. The Amargosa Canyon speckled dace relies on this process for spring and stream habitats.

According to isotopic, geochemical, and noble gas analyses by Zdon, et al. (2015), the Middle Amargosa River area (Shoshone, Tecopa, Amargosa Canyon) has groundwater sourced from a combination of three flowpaths:

- Water that moves through carbonate rocks beneath the northern portion of the Nopah Range into Chicago Valley, then toward the Amargosa River;
- Water that moves from Pahrump Valley through the low, faulted divide into California Valley then towards the river; and
- Water that moves southward from the Ash Meadows area (itself a mixture of waters from different sources).

A recent study estimates that 75% of the Middle Amargosa's water comes from Mt. Charleston and the Pahrump Valley, and 25% from the Ash Meadows flowpath to the north (Zdon 2020).

Zdon et al. (2015) noted that the Pahrump Valley aquifer appears to be a primary aquifer for recharging the Amargosa River basin in the area of Tecopa and the Amargosa Canyon. Groundwater flows southwest through the carbonate aquifer from Spring Mountains and beneath Pahrump Valley toward the Tecopa-Shoshone-Chicago Valley areas (Zdon et al. 2015). When the water reaches the southern end of the Resting Spring Range, the path shifts southwest toward Tecopa and the Amargosa River, and thence into the Amargosa Canyon.

A second flow path for groundwater exists: occasional runoff from the southeastern slope of the Nopah Range and the western and northern slopes of the Kingston Range flows toward California Valley and west towards the Nopah Range's southern tip. An additional flowpath from Mt. Charleston flows underneath the Pahrump Valley and Charleston View and collects with water from the Kingston Range in California Valley. This path directs water toward Willow Creek and Willow Spring, where the water surfaces. Willow Creek is a spring-fed stream that runs to the northeast of China Ranch before flowing into the Amargosa Canyon portion of the Amargosa River (Zdon 2014). Willow Creek is an important contributor to the Amargosa River, and it is known Amargosa Canyon speckled dace habitat.

A final flowpath to the Middle Amargosa runs from Ash Meadows down the trace of the river. This water, in turn, is sourced from a mixture of water from: the carbonate aquifer province to the north and northeast of Ash Meadows; water flowing westward from Pahrump Valley and Mount Charleston; and some amount of water flowing southeast along the trace of the river from Beatty, crossing a hydrographic divide in the Amargosa Desert and mixing with waters sourced from the north and east of Ash Meadows. This water then flows southward along the trace of the river past Eagle Mountain, emerging in Shoshone and thence to a lesser degree in Tecopa and the Amargosa Canyon (Zdon 2014).

Anything that shifts groundwater or river flow patterns throughout these sources will change or deplete the flow of the Amargosa River. Thus, the integrity of these water sources is critical for the Amargosa Canyon speckled dace's habitat.

Owens Valley

The Owens Valley is a long north-south trending valley on the eastern side of the Sierra Nevada mountains, with the Owens River historically as its centerpiece. Significant water, both in surface flow and in subsurface flow from snow melt, comes off of the Sierra Nevada and into the valley, and pre-development there was an enormous system of valley bottom wet meadows and springs which sustained a rich biodiversity. In the early 20th century, the city of Los Angeles purchased ranches and their water rights, and constructed the Los Angeles Aqueduct to divert surface water from the many streams running off of the Sierra Nevada down to Los Angeles to feed urban growth. In the 1970s, the city began to augment this surface water diversion with groundwater pumping. Residents of Owens Valley noted changes in vegetation as drawdown to groundwater levels began, ultimately within 10 years a loss of 20 to 100 percent of plant cover occurred on 26,000 acres of the valley floor (Danskin 1998). After much litigation between Inyo County and Los Angeles, water usage in the valley is now governed by a Long Term Water Agreement, which put some restrictions on the amount of groundwater pumping that could occur by Los Angeles. Nonetheless, springs have declined across the Owens Valley, resulting in extirpation of Owens speckled dace from numerous locations (Moyle et al. 2015).

One spring system which remains intact, although it is in a declining state, is the Fish Slough system. Fish Slough is situated on the southern end of a low mesa which is perched above the north end of the Owens Valley, called the Volcanic Tablelands. CDFW (2019) describes Fish Slough as "the largest remaining spring complex in Southeastern California." While Fish Slough has a very small topographic watershed, it has a more complex groundwater-shed. There is an arm of the Owens Valley system that cuts due north from Bishop, called the Tri-Valley area (referring to Benton Valley, Hammil Valley, and Chalfant Valley). Tri-Valley receives significant groundwater flow from snowmelt on the west slope of the White Mountains and thus has relatively shallow groundwater. Recent isotopic analysis shows that water discharging at Fish Slough comes from two sources – the first being groundwater from geothermal sources associated with the Long Valley caldera and other sources to the northwest in the Volcanic Tablelands, and the second being groundwater from the Tri-Valley area flowing southward through Hammil Valley into Fish Slough (Zdon et al. 2019).

Long Valley

The Long Valley groundwater basin underlies Long Valley, which is characterized by mostly dry desert mountain ranges to the north and east, and the Sierra Nevada to the south and west. Abundant precipitation and snowmelt in the Sierra contributes substantial surface flow in tributaries of the Owens River, and subsurface flow into the groundwater basin. Long Valley is situated within the Long Valley Caldera, an area of intensive geothermal and seismic activity and historic volcanism. The seismic activity circulates water deeply toward the mantle, causing intense geothermal heating. This circulated water tends to be of far more ancient origin. Thus groundwater discharging at the surface can be thought of as from two discrete sources: one sourced from meteoric water which has percolated down from the Sierra Nevada and discharges in coldwater springs; and the other sourced from geothermal sources, deeply circulated ancient water, which is discharged in thermal springs (Farrar et al. 1987).

STATUS

Historic and Current Distribution and Abundance

Amargosa Canyon

Amargosa Canyon speckled dace are restricted to the Amargosa Canyon portion of the Amargosa River and its tributaries, especially Willow Creek and Willow Creek Reservoir (Williams et al. 1982; Scoppettone et al. 2011).

Historically, Amargosa Canyon dace were also found in a warm spring just north of Tecopa (Miller 1938) but that population is extirpated (Moyle et al. 2015). Overall, the range of dace in Amargosa Canyon may have been reduced by water diversion which may reduce surface flow in Amargosa Canyon (Moyle et al. 2015).

The map in Figure 1 depicts the historical and current status of Amargosa Canyon speckled dace, based on locality data from Sada (1989), CAS (2020), CDFW (2020), UMMVZ (2020), and information from Moyle et al. (2015).

During a 1981 fish survey of Amargosa Canyon that included Willow Creek, speckled dace comprised 1% and mosquitofish 40% of the fish collected (Williams et al. 1982).

Scoppettone et al. (2011) found speckled dace to be abundant throughout Amargosa Canyon in summer of 2010, except in the lowest reaches which are subject to drying (Scoppettone et al. 2011). Scoppettone et al. (2011) recorded 3,429 Amargosa Canyon speckled dace individuals during sampling from June 21 to August 12, 2010; dace represented 40% of the total catch, while mosquitofish only represented 8%. It is possible that speckled dace scarcity in the lower reach of Amargosa Canyon was due to stranding avoidance behavior (Scoppettone et al. 2011). The seasonality of survey efforts and extended sampling period may explain the large disparity of abundance from more recent survey results.

Furiness (2012) found that Willow Creek supported a small population of speckled dace.

Fish surveys by the USBLM in fall of 2014 found that Amargosa Canyon speckled dace "appear to be doing fairly well" in Amargosa Canyon (Otahal 2015).

Hereford (2016) compared relative abundance and distribution of speckled dace in Amargosa Canyon during 2010 and 2014 to investigate the effects of saltcedar removal. Hereford (2016) surveyed from June 21 to July 29 in 2010; and from October 6-8 in 2014. 572 dace were recorded in 2010, and 960 dace were recorded in 2014; however, the catch per unit effort decreased by 15.5% from 2010 to 2014 (Hereford 2016). Differing sampling seasons may have affected the catch results, since summer juveniles would have reached trapping length by October, which is when the 2014 surveys were conducted.

Davis and Halvorson (2016) surveyed the Amargosa Canyon speckled dace population in 2014 and 2016. 960 dace were recorded in 2014, and 616 dace were recorded in 2016 (a decline of 36%). However, the 2016 surveys were conducted from September 2-4, so that seasonal variation and population recruitment may have affected the survey results (Davis and Halvorson 2016). Davis and Halvorson (2016) found that speckled dace occur most frequently throughout the upper and middle reaches of the Amargosa River. The upper reach appeared to experience the greatest decline in dace abundance, with a 57% decrease in catch per unit effort from 2014 to 2016 (Davis and Halvorson 2016).

Figure 1. Amargosa Canyon speckled dace status. Created by CBD using locality data from Sada (1989), CAS (2020), CDFW (2020), UMMVZ (2020), and information from Moyle et al. (2015).

Long Valley

Long Valley speckled dace had been extirpated from all but one of their historic collection sites, including Hot Creek (Moyle et al. 2015). Until recently, the sole remaining population within the native range was in Whitmore Hot Springs (Sada 1989). Whitmore Hot Springs has been developed and is operated as a swimming pool by Mono County. Spring discharge of approximately 2 cfs is lightly chlorinated and feeds an alkali marsh of roughly 1 acre.

The map in Figure 2 depicts the historical and current status of Long Valley speckled dace based on locality data from Sada (1989), CAS (2020), CDFW (2020), UMMVZ (2020), and information from Moyle et al. (2015)..

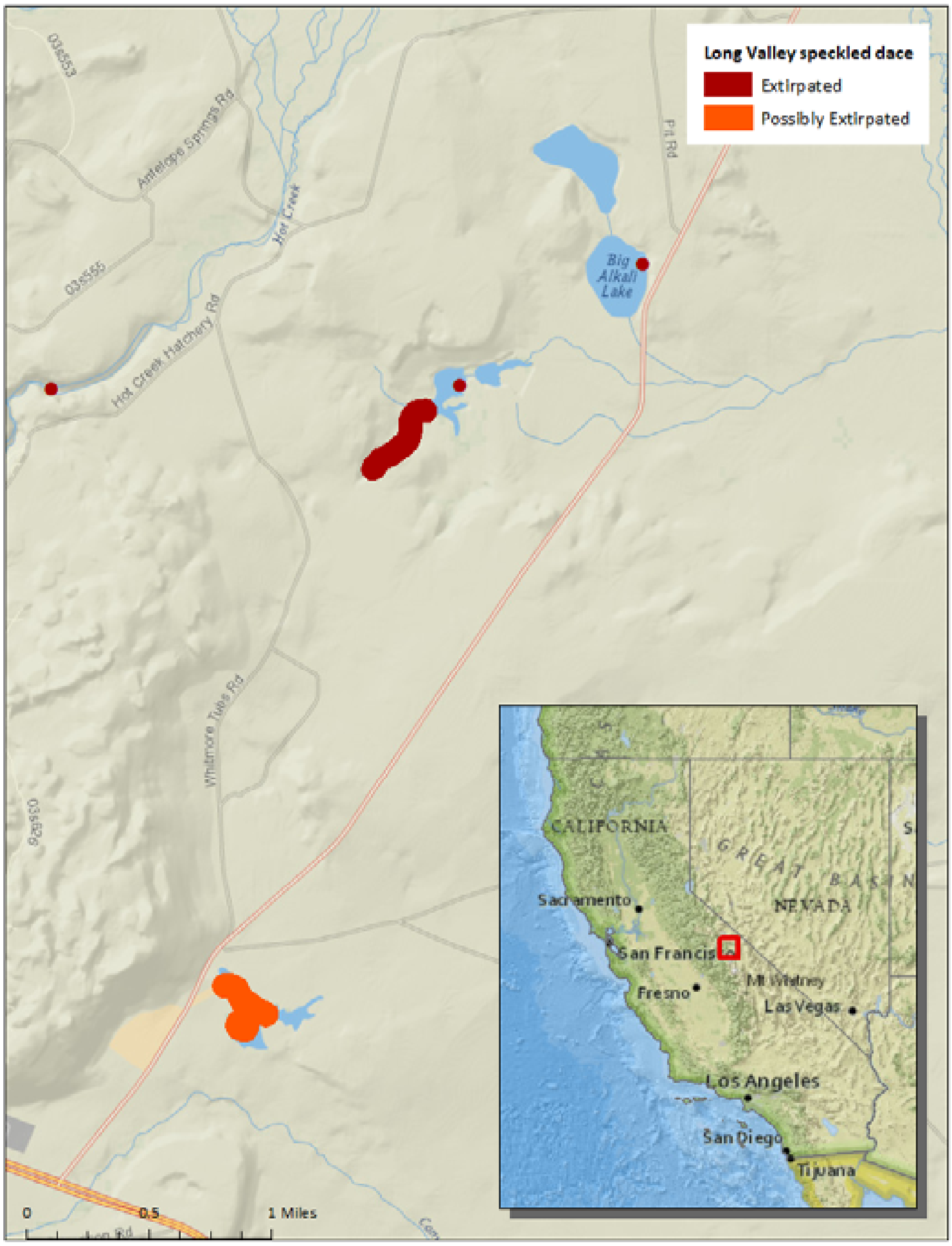

Figure 2. Long Valley speckled dace status. Created by CBD using locality data from Sada (1989), CAS (2020), CDFW (2020), UMMVZ (2020), and information from Moyle et al. (2015).

Sada (1989) surveyed 40 historical sites and likely aquatic habitats (springs) for speckled dace in Long Valley in 1988 and 1989, and was only able to find speckled dace at two locations - Whitmore Hot Springs, and at an unnamed, unmapped spring at Little Alkali Lake. In 1989, dace occupied 250 yards of stream at Whitmore Hot Springs and two large shallow ponds that did not exceed half a meter in depth (Sada 1989). The dace population here appeared to be heavily parasitized in some years (Sada 1989; S. Parmenter, CDFW, pers. comm. 2009, per Moyle et al. 2015).

The dace population at Little Alkali Lake was subsequently extirpated (Sada 1989). Dace occupied an estimated 600 meters of stream between the spring source and the lake. Fish were not believed to occupy the spring source, where water temperatures exceeded 28˚C, or Little Alkali Lake itself. When Little Alkali Lake was surveyed in 1999, large numbers of western mosquitofish (*Gambusia affinis*) were observed but speckled dace appeared to be absent (S. Parmenter, CDFW, pers. comm. 2009, per Moyle et al. 2015).

The Bureau of Land Management and CDFW are cooperating in an ongoing project to restore the unnamed spring tributary to Little Alkali Lake to expand the range of Long Valley speckled dace. To date, three fish barriers have been constructed and experiments are under way to eradicate mosquitofish by a combination of mechanical removal and spring diversion under freezing temperatures (S. Parmenter, CDFW, pers. comm. 2014, per Moyle et al. 2015).

Speckled dace were last sampled in Hot Creek in 1962 but were likely extirpated due to alterations to the system, including the creation and operation of Hot Creek Hatchery, as well as introduction of non-native trout to the stream (Sada 1989). Non-native trout are also abundant in Crowley Lake, which is connected to Hot Creek via the upper Owens River.

Surveys in 2002 and 2009 by CDFW found the Whitmore Hot Springs dace population to be relatively stable (S. Parmenter, CDFW, pers. comm. 2009, per Moyle et al. 2015).

CDFW started translocating a few Long Valley speckled dace from Whitmore Hot Springs to an undisclosed location near Bishop (S. Parmenter, CDFW, pers. comm. 2009, per Moyle et al. 2015). On average, 6 additional fish from the Whitmore Springs population are translocated to the refuge population annually in an effort to minimize genetic drift.

Unfortunately, field surveys in 2019 failed to locate any speckled dace in the outflow from Whitmore Hot Springs (S. Parmenter, CDFW, pers. Comm. 2020) and it is feared that they are now extirpated in the wild. The only remaining speckled dace individuals are “stable” in a CDFW-managed refugium at an undisclosed location.

Owens Valley

Moyle et al. (2015) reviewed California Department of Fish and Wildlife files and museum records from the University of Michigan Museum of Zoology (UMMVZ 2020) and the California Academy of Sciences (CAS 2020), dating back to the 1930s. These sources indicated that speckled dace historically occupied most small streams and springs in the Owens Valley. Comprehensive surveys of Owens Basin aquatic habitat in 1988 and 1989 (124 survey sites) determined that dace had been extirpated from 8 of the 17 sites where they were historically recorded in the Owens Valley (Sada 1989). Speckled dace no longer occupied the Owens River, valley-floor springs, springs at Little Lake, two historic habitats near Benton, Fish Slough, the upper Owens River, or Hot Creek (Sada 1989). Sada (1989) reported the extirpation of speckled dace from Benton Valley and the persistence of a single small population remaining in the East Fork Owens River drainage at lower Marble Creek, near Benton. The lower Marble Creek population was subsequently eliminated during the Tri-Valley Flood of 1989 (Moyle et al. 2015). Sada (1989) discovered dace at two new locations in the Owens Valley, but they have since been extirpated from these locations also (Moyle et al. 2015).

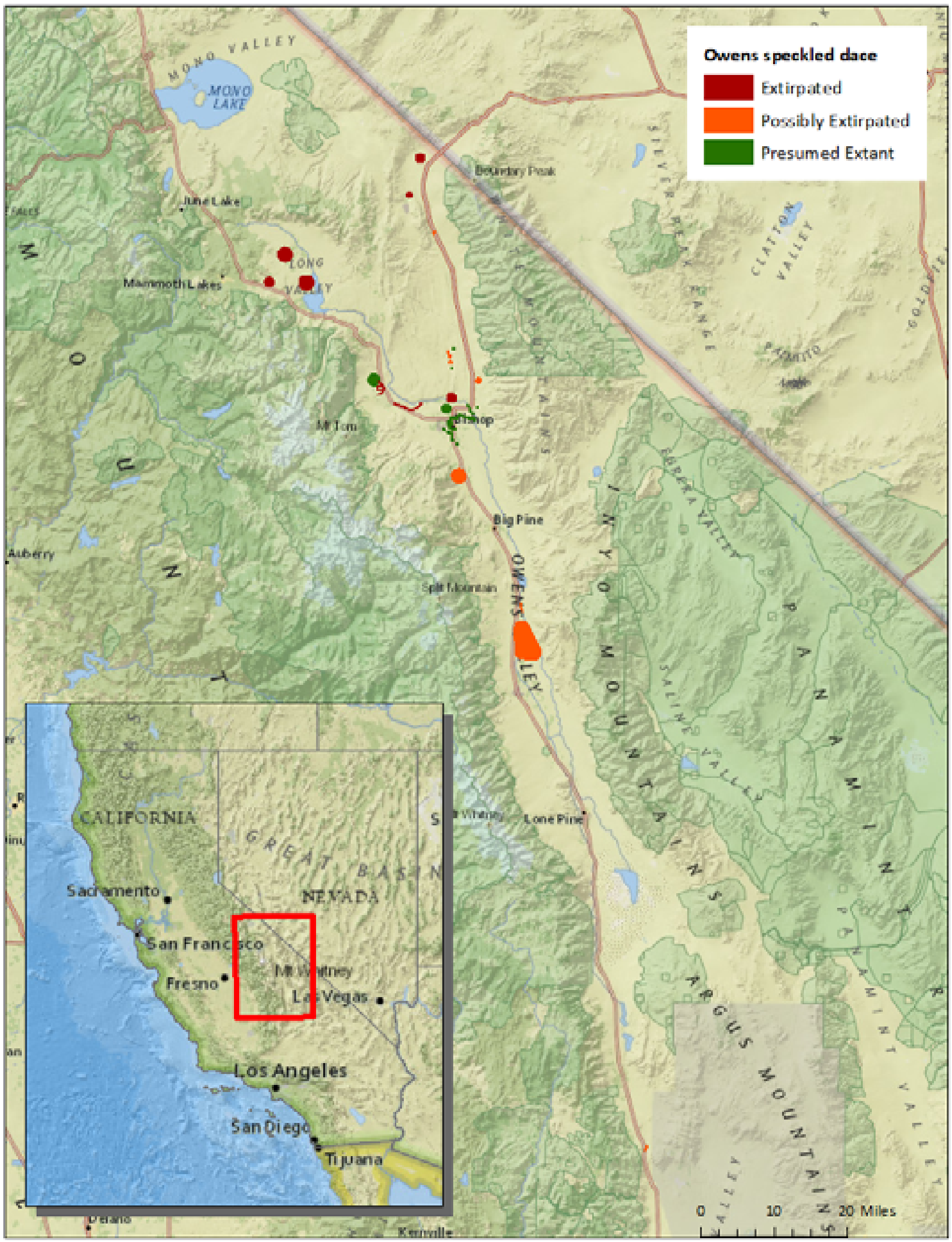

Figure 3. Owens speckled dace status. Created by CBD using locality data from Sada (1989), CAS (2020), CDFW (2020), UMMVZ (2020), and information from Moyle et al. (2015).

Sada (1999) was able to locate Owens speckled dace in 1999 throughout a 1 km irrigation ditch in northeastern Bishop (in the northwest one-quarter of Section 6, Township 7S, Range 33E), downstream from historical populations (Sada 1989) in the North Fork of Bishop Creek and several irrigation ditches located near the Tri County Fairgrounds.

The map in Figure 3 depicts the historical and current status of Owens speckled dace, based on locality data from Sada (1989), CAS (2020), CDFW (2020), UMMVZ (2020), and information from Moyle et al. (2015).

Owens speckled dace are now only known to occupy three disjunct areas in the northern Owens Valley: Fish Slough, irrigation ditches in Round Valley, and in and around Bishop (Moyle et al. 2015). Waterways within each of these areas are frequently or consistently interconnected, but speckled dace dispersal among the three population areas appears to be largely severed by both the presence of alien brown trout in intervening waterways and stream channelization (Moyle et al. 2015). Moyle et al. (2015) note that speckled dace no longer occupy irrigation ditches between Bishop and Big Pine or Little Lake, in Inyo County, nor have dace been relocated in Warm Springs, where CDFW biologists planted 75 speckled dace in 1983 (Sada 1989). The only remaining natural habitat occupied by Owens speckled dace is in the springs of Fish Slough.

Population Trends

Historic data for the abundance of Amargosa Canyon speckled dace are lacking, but Scoppettone et al. (2011) assumed the population was larger in the past, prior to heavy urbanization and the introduction of non-native species. Speckled dace populations in Amargosa Canyon appear to fluctuate, possibly in response to flow patterns in Amargosa Canyon and interactions with introduced mosquitofish; it is likely that flood events favor native speckled dace by flushing mosquitofish from the system (Moyle et al. 2015). Amargosa Canyon speckled dace have been extirpated from a spring near Tecopa (Moyle et al. 2015). Resurvey efforts in Amargosa Canyon have shown a decline in catch per unit effort from 2010-2014 and 2014-2016 (Hereford 2016; Davis and Halvorson 2016), but seasonality and length of survey efforts may be a factor.

The BLM has a commitment to survey for Amargosa Canyon speckled dace every three years throughout the Amargosa Canyon and the Grimshaw Basin for the duration of the 20-year Amargosa River Area of Critical Environmental Concern Implementation Plan. Environmental variables are supposed to be measured with these surveys to record habitat conditions for Amargosa Canyon speckled dace (USBLM 2006b, p. 185). It is unclear whether these surveys are actually occurring. Petitioner sent a Freedom of Information Act request to the USBLM in March of 2020 asking for these surveys, but the BLM has failed to respond to the FOIA request.

There are few data available on the historic abundance of speckled dace in Owens Valley, but given its greatly diminished range, it is undoubtedly much less numerous than it once was (Moyle et al. 2015). In the streams and irrigation ditches around Bishop, where dace were widespread, they occurred at low densities, but quantitative abundance estimates were lacking (Sada 1989). The most comprehensive surveys of speckled dace habitat in the Owens Basin determined that dace had been extirpated from 47% (8 of 17) of sites where they had been historically recorded (Sada 1989). More recently, they are limited to several irrigation ditches in Round Valley and near Bishop, and the natural habitat in the springs of Fish Slough (S. Parmenter, pers. comm. 2020).

There are few data available on the historic abundance of Long Valley speckled dace, but given the extirpation of all but one of the historically identified populations it is undoubtedly much less numerous than it once was (Moyle et al. 2015). According to the U.S. Fish and Wildlife Service (1998), Long Valley speckled dace were continuing to decline. As of 2020, it appears they have been extirpated in the wild, and the only remaining individuals are several hundred in a CDFW-managed refugium (S. Parmenter, pers. comm. 2020).

CRITERIA FOR ENDANGERED SPECIES ACT LISTING

Death Valley Region Speckled Dace are Distinct Population Segments Which Qualify 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" and "quantitative measures of genetic and morphological discontinuity provide evidence of this separation"; 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).

Should the Service elect not to list the Ash Meadows, Amargosa Canyon and Owens Valley populations as a single subspecies and Long Valley dace as a separate subspecies, we request that it consider populations of speckled dace as distinct population segments, based on their geographic separation and isolation from other dace populations, genetic distinction from other dace populations, occurrence in a unique ecological setting, and possession of unique phenotypic characteristics.

Discreteness

All Death Valley populations of speckled dace are completely isolated from each other, and markedly separated from other populations of speckled dace.

Mussman (2018) employed a molecular clock to determine origin of speckled dace lineages in the Death Valley region in California and Nevada. Divergence dates of distinct speckled dace lineages within the Death Valley region (Long Valley, Owens, Ash Meadows, Amargosa Canyon, and Oasis Valley) conformed to documented Pleistocene hydrological connections among basins, as demonstrated from reduced representation genomic analyses. The Death Valley region speckled dace lineages are narrowly endemic relicts of a Pleistocene ecosystem that now persists in small desert oases.

The nearest dace population in Ash Meadows is far upstream along the Amargosa River from the Amargosa Canyon population, and there is no direct surface hydrologic connection and thus no ability for these populations to come into contact. The outlet of the Amargosa River is in Badwater Basin in Death Valley, and thus it is not connected to any other river or other populations of speckled dace. Morphologically, Amargosa Canyon speckled dace are much smaller than most speckled dace and differ from other forms in head depth, snout-to-nostril length, anal-to-caudal length, number of pectoral fin rays, and number of vertebrae (Scoppettone et al. 2011; Moyle et al. 2015), as discussed above in the description section.

Differing ecological and behavioral factors for Amargosa Canyon speckled dace include preference for pool-like habitat with deep, slow water rather than moving water, and adaptation to warmer pool-like springs (Moyle et al. 2015). As discussed in the section on taxonomy above, Amargosa Canyon speckled dace are genetically distinct from all other speckled dace populations (Sada et al. 1995; Oakey et al. 2004; Furiness 2012; Baumsteiger and Moyle 2018).

Owens speckled dace occur only in the northern Owens Valley, in an isolated river basin which terminates at the endorheic Owens Lake; south of Big Pine nearly all the flow in the Owens River is diverted into the Los Angeles Aqueduct. Owens speckled dace have no opportunity to contact other speckled dace populations. Although Owens speckled dace are highly variable morphologically, they differ in some characteristics from other nearby speckled dace, such as the presence of maxillary barbels occurring in most Owens populations, which separates Owens Valley fish from conspecific populations in the Walker River/Lahontan basin. Owens speckled dace occupy a variety of habitat types in the Owens Basin. As discussed in the section on taxonomy above, Owens speckled dace are closely related to and likely the same subspecies as Amargosa River and Ash Meadows speckled dace (Sada et al. 1995; Oakey et al. 2004; Furiness 2012; Baumsteiger and Moyle 2018), but show genetic differences from Long Valley dace and are genetically distinct enough to warrant recognition as a DPS (Sada et al. 1995; Baumsteiger and Moyle 2018). Highly significant geographic structure exists in dace in the Owens River Valley, congruent with the regional differentiation elucidated by mtDNA sequence data; the degree of population differentiation is correlated with isolation by distance (Nerkowski 2015).

Long Valley speckled dace were completely isolated from other populations of speckled dace with no possibility of contact or dispersal, as they occurred in the isolated Long Valley volcanic caldera and until recently persisted only in Whitmore Hot Springs and an undisclosed location near Bishop where a few dace from Whitmore Springs have been relocated. Morphologically, Long Valley speckled dace have a deep-bodied form and differ from other speckled dace forms in numbers of pectoral and pelvic fin rays, line scale and pore counts, and the absence of maxillary barbels (Sada 1989; Sada et al. 1995; Moyle et al. 2015), as discussed above in the description section. A significant ecological difference for Long Valley speckled dace is their adaption to spring habitats (Moyle et al. 2015). As discussed in the section on taxonomy above, Long Valley speckled dace are genetically distinct from all other speckled dace populations, to the degree that they should be regarded as a separate subspecies (Sada et al. 1995; Oakey et al. 2004; Furiness 2012; Baumsteiger and Moyle 2018).

Significance

As discussed above, Amargosa Canyon, Owens, and Long Valley speckled dace populations differ markedly from other populations of the species in their genetic characteristics (Sada et al. 1995; Oakey et al. 2004; Furiness 2012; Baumsteiger and Moyle 2018). Furiness (2012) performed haplotype analysis for multiple speckled dace populations throughout the western United States, and found marked differences in genetic characteristics for Death Valley region speckled dace. These dace populations have genetic diversity that is not found elsewhere in California or any nearby basins. On-going genomic studies at U.C. Davis are providing support for the distinctness of these dace populations (P.B. Moyle, pers. comm., 2020).

Each population of Death Valley region speckled dace has a unique ecological setting, influenced by the particular hydrogeologic system the fishes are located in, and the abiotic factors influencing ecosystem processes within those habitats.

Amargosa Canyon speckled dace are located in one of the hottest, driest parts of the Mojave Desert in riparian habitat characterized by willows, cottonwoods, California sawgrass, three square bulrush, atriplex species, and other Mojave Desert riparian species, as well as invasive plants such as phragmites and tamarisk. Water quality is general highly alkaline and spring temperatures tend to be relatively cool. This part of the Mojave Desert experiences withering temperatures in the summer, as high as 120°F, and generally warm winters.

Owens speckled dace occupy habitats in low-elevation Great Basin desert areas, with riparian habitat at Fish Slough characterized by rabbitbrush and three square bulrush, with invasive plants such as phragmites. Water quality, while alkaline, is less so than in Amargosa Canyon, and spring temperatures tend to be 15 degrees warmer than air temperature (Zdon et al. 2019). The northern Owens Valley is generally a transition zone from the hotter and drier Mojave Desert to the cooler Great Basin desert, experiencing hot summers and cold winters.

Long Valley speckled dace generally occupy outflow from thermal springs, indicating a tolerance for high temperatures. The ecosystem they inhabit is high Great Basin desert, meaning temperatures are cooler in the summer and much colder in the winter. Snow and freezing temperatures are very common in this area, and surface water not subject to thermal heat quickly freezes over. As such, Long Valley speckled dace have adapted themselves to a habitat wherein water is sufficiently warmed by thermal sources so as to not to freeze in winter, but not so warm that it is inhospitable for life.

Death Valley Region Speckled Dace Qualify for an Endangered Listing

Under the ESA, species may be listed as either endangered or threatened. "Endangered" means a species is in danger of extinction throughout all or a significant portion of its range.

Long Valley speckled dace qualify as endangered since the subspecies may have recently been extirpated in the wild, and there are numerous significant threats to suitable habitat. Owens speckled dace remain in their natural habitat in only one location, and face multiple threats. Most of the remaining habitat for Amargosa Canyon speckled dace is under imminent threat of dewatering of the Amargosa River and its tributaries due to excessive groundwater extraction. All three populations clearly qualify for protection as endangered under the ESA. Should the USFWS determine that any or all of these speckled dace populations warrant listing as threatened under the ESA, petitioner requests immediate inclusion of a 4(d) rule to address specific threats outlined in this petition.

LISTING FACTORS

Destruction, Modification, or Curtailment of Habitat or Range

Groundwater Extraction for Agriculture and Development

Amargosa Canyon

The major threat to Amargosa Canyon speckled dace is the potential dewatering of its unique habitats in the Amargosa River and tributaries. Groundwater extraction for agriculture, rural residential development, and urbanization results in water withdrawals from aquifer sources which feed the Amargosa River (Riggs and Deacon 2002). The Amargosa Canyon receives much of its recharge flow from areas on the western slopes of the nearby Spring Mountains but, along with springs on the eastern side of Death Valley, is partially dependent on regional groundwater movement through large, ancient aquifers that extend into western Utah and central Nevada (Dettinger and Cayan 1995; Deacon et al. 2007).

Dettinger et al. (1995) defined sustainable yield of a carbonate-rock aquifer as "equal to that fraction of total discharge that can be captured by pumping without causing unacceptable effects. This will be less than or equal to the [aquifer's] total discharge and will be less than or at most equal to the total rate of natural recharge and inflow to an area." As development intensifies in Nevada and southern California, water-level declines within carbon-rock aquifers are a concern. These declines can cause reduced spring flow and other natural discharge reductions when water withdrawals become significant (Dettinger et al. 1995, p. 74). Heavy withdrawal rates can change flow directions and rates between carbonate-rock aquifers and aquifers of other rock types (Dettinger et al. 1995, p. 72). Over-pumping water from carbonate-rock aquifers may result in reduction of spring flow from carbonate-rock and basin-fill aquifers, water-level decline within wells, the drying of some streams, playas, and/or meadows, and changes of water chemistry (Dettinger et al. 1995, p. 74).

Groundwater withdrawal and pumping often causes changes in groundwater discharge patterns and quantities. This may result in loss of groundwater-dependent vegetation and a reduction or total elimination of spring flow (Zdon 2014, pp. 12-13). As water level withdrawals increase, drying events increase. Groundwater withdrawal and pumping can cause Amargosa Canyon speckled dace to experience shifting water levels within their pools. Drastic over-pumping of water sources can lead to the extirpation of fish populations and favors establishment of invasive species, as seen in the Ash Meadows spring system (Myers 1971, p. 39).

In order to supply the city of Las Vegas, the Southern Nevada Water Authority (SNWA) proposes to mine large quantities of this water from several different valleys which lie within the Ash Meadows groundwater basin (Breen 2004; Southern Nevada Water Authority 2004; Vogel 2004). Ash Meadows water in turn creates a partial flowpath for the Middle Amargosa area, ultimately sustaining the habitat of the Amargosa Canyon speckled dace, at least partially (Davisson 2014). If SNWA proceeds with its planned withdrawals in the Ash Meadows groundwater basin, it could upset the hydrologic balance of the Amargosa River's flowpaths, inducing interbasin flow into the targeted basins and potentially incrementally reducing flow in the Amargosa Canyon.

Agriculture and exurban development in the Amargosa region are withdrawing increasing amounts of water from the aquifer, producing noticeable declines in the water level of closely-monitored Devils Hole, Nevada, habitat of the endangered Devils Hole pupfish (*Cyprinodon* *diabolis*) (Riggs and Deacon 2004; Bedinger and Harrill 2006). If Amargosa region water withdrawals continue to increase, it is highly likely that Amargosa River flows will be greatly reduced or even disappear entirely during dry years. Already, diversions of springs and outflows on private land in the Tecopa area have reduced flows in the river and local pupfish populations as well.

Irrigation accounted for more than 80% of the Death Valley region's groundwater withdrawals from 1913 to 1998 (Moreo et al. 2003, p. 7). Studies have been conducted to estimate the groundwater levels throughout Nye County during 2006 and again in 2017 (Moreo et al. 2017). However, the 2006 estimates are suspected to be three to ten times greater than groundwater evapotranspiration rate presented in the 2017 study. Moreo et al. (2017) concluded the 2006 groundwater depth was substantially overestimated by three to ten times the estimates from the 2011-2012 study (Moreo et al. 2017, p. 47).

The amounts of groundwater withdrawals in the Death Valley region were approximately 62,900 acre-feet in 1999, and 55,700 acre-feet in 2006 (Moreo and Justet 2008, p. 4). This includes withdrawals in the Pahrump Valley for domestic and agricultural use, and withdrawals in the Amargosa Farms region of Amargosa Valley, Nevada, primarily for agricultural use. Groundwater withdrawals for irrigation decreased from 1999 to 2006, while domestic withdrawals appeared to increase steadily.

The Pahrump Valley is one of the most significant contributors to the Amargosa Canyon groundwater system (Zdon 2014). The Amargosa Canyon speckled dace habitat requires groundwater flow to supply and establish pools for the daces' survival. Pahrump Valley pumping records date back to 1959, when the initial groundwater usage was 1,159 acre-feet per year (AFY). Pumping increased dramatically in 1968 when the maximum groundwater withdrawal was 47,950 AFY. Withdrawal amounts were about 20,000 to 25,000 AFY during the 1980s.

Pahrump Valley has seen significant residential development since the 1990s, with a concomitant increase in the number of domestic wells. There are as many as 11,000 domestic wells in Pahrump Valley, with an allocated duty of 2 AFY per well, yielding an implicit 22,000 acre-feet of water rights for domestic wells (NDWR 2017). Additionally, there are as many as 59,175 acre-feet of water rights allocated for Pahrump Valley. This gives a total potential legal withdrawal level of over 80,000 AFY (26 billion gallons). Actual pumping is far below that level – estimated at 16,085 AFY in 2016, but that is based on certificated water rights only, and does not include pumping for domestic wells, which may be as much as 22,000 AFY (Zdon 2020).

While it is currently unexploited by pumping in any significant fashion, there have also been numerous threats to the southern Pahrump Valley groundwater flowpath, through Charleston View. Charleston View is the largest contiguous block of undeveloped private land in Inyo County, California, and has been the target of numerous residential development proposals over the years (Kelley 2005). It was also the location of the proposed Hidden Hills solar thermal project, which would have used substantial amounts of groundwater to generate solar energy. Current groundwater development in the area is limited to a few scattered ranchettes, though there is at least one hydroponic farm. Expansion of domestic or agricultural groundwater use in Charleston View poses a dire threat to the groundwater which sustains the habitat required by the Amargosa Canyon speckled dace.

A second concern for groundwater levels in the Amargosa region is pumping in the town of Amargosa Valley, Nevada for agricultural use. This area is home to Nevada's largest dairy, and there are thousands of acres of irrigated farmland used for alfalfa to feed these cows. Average pumping in Amargosa Valley from 1983 to 2015 was 12,350 AFY (Zdon 2020). In 2015, pumpage was 16,192 acre-feet. There are 26,472 acre-feet of water rights allocated in the basin.

The discussion of water rights warrants a further note on perennial yield. Perennial yield in the Amargosa Desert hydrographic basin (Basin 230) is 24,000 AFY; perennial yield in the Pahrump Valley hydrographic basin (Basin 163) is 20,000 AFY. Per Nevada water law, the Amargosa Desert total pumpage is below perennial yield and thus sustainable; Pahrump Valley total pumpage is likely above perennial yield when domestic well usage is included, and thus unsustainable. Nevada State Engineer order 1293 (NDOWR 2017) is designed to bring the basin within balance, meaning bringing total pumpage below the perennial yield. There are two problems with using perennial yield as a target for pumpage. First, given climate change and overly optimistic historical modeling, it's likely that the amount of recharge is far less than was estimated for these basins. Secondly, the concept of perennial yield is that you pump out of the ground what comes in as recharge. However, assuming these basins are in stasis, that amount of water is currently discharged through springs and evapotranspiration. Thus the logical conclusion of perennial yield is the full capture of discharge and evapotranspiration. This would result in the drying of all surface water features in the Amargosa River and the extinction of the Amargosa Canyon speckled dace. Therefore, the concerns delineated above regarding pumpage in the Amargosa Desert and Pahrump Valley basins remain valid, regardless of whether or not the Nevada Division of Water Resources considers basins to currently or eventually be in “balance” or not.

This pumping may already be having an effect. Zdon (2020) presents data from several monitoring wells across the Amargosa Basin, including on flowpaths which source the springs in the Amargosa Canyon. According to Zdon (2020):

> Based on a review of limited shallow groundwater levels and springs in the Shoshone – Tecopa area, the groundwater system appears to be going through a period of very slow hydrologic decline. Decreases in spring flow at Chappo Spring have been noted previously (Andy Zdon & Associates, 2014). That decrease in spring flow is likely due to the long-term groundwater level declines that were noted in Pahrump Valley. Springs in the Tecopa area have also decreased in flow since the 1960's, at least partially the result of the bore hole at Bore Hole Spring and likely due to the number of wells used to tap the hot springs in Tecopa Hot Springs by private residents. In both cases, given the expanse of the groundwater system and the distant nature of the groundwater extraction that could most affect the groundwater system that feeds the [Amargosa River], changes to groundwater flow in springs and groundwater levels in wells will occur very slowly. These are changes that may only be noticeable on a generational basis.

While the effect of the massive amount of pumping occurring in the Amargosa Basin groundwater-shed have been theorized for decades, data by Zdon (2014, 2020) shows such declines are occurring right now.

Another recent analysis (Halford and Jackson 2020) confirms that groundwater levels are declining and are forecast to continue declining in the Amargosa Basin if current pumping levels continue. Their analysis and modeling shows significant declines from predevelopment conditions in surface discharge in all areas of the middle Amargosa Basin including Chicago Valley, Shoshone area, and Tecopa/California Valley, all of which are flow paths to the

Amargosa Canyon. There is some disagreement between Halford and Jackson (2020) and Zdon (2020) as to future conditions in the Shoshone and Tecopa areas. While Halford and Jackson (2020) predict minimal ongoing drawdown in those areas, due to a decrease in overall pumping in Pahrump Valley, data and modeling by Zdon (2020) show continued drawdown. Additionally, Halford and Jackson's boundary of expected continued drawdown includes a portion of the Amargosa Wild and Scenic River, and comes right to the edge of the Amargosa Canyon. With a horizon of only 80 years, this modeling may not reflect the true extent of the potential for reduction in discharge in the Amargosa Canyon. Given that Halford and Jackson (2020) are relying on modeling, while Zdon (2020) has empirical monitoring data from the middle Amargosa area, the combination of their analyses suggests that flows in the Amargosa Canyon will continue to decline into the future.

Owens Valley

Moyle et al. (2015) consider groundwater extraction to be a "high" threat for Owens speckled dace, since groundwater extraction has eliminated a majority of springs on the Owens Valley floor which would have provided habitat for speckled dace. Currently, the Owens speckled dace lives in natural springs at Fish Slough, and in irrigation ditches in Round Valley and near Bishop. Thus the natural habitat at Fish Slough is the highest priority for conservation, and the groundwater depletion which threatens those springs is of grave concern.

Fish Slough is comprised of a set of springs north of Bishop. These springs are of central ecological importance to the Eastern Sierra region, as the largest remaining spring complex in southeastern California, a national natural landmark, a designated Area of Critical Environmental Concern, and a state ecological reserve (CDFW 2019). These springs, set just a bit above the floor of the Owens Valley, are sourced from regional precipitation and snowmelt which is channeled through deep aquifers to discharge at Fish Slough. Water feeding these springs is sourced from a combination of water from the Tri-Valley groundwater basin and older, more sodic groundwater sourced from geothermal areas to the northwest across the Volcanic Tablelands (Zdon et al. 2019). There has been a multi-decadal decline both in groundwater levels in the Tri-Valley groundwater basin, and in discharge at the Fish Slough springs (CDFW 2019). Declines in groundwater levels in the Fish Slough area have persisted annually, escalating since 2005, regardless of the amount of annual precipitation recorded, suggesting their regional sourcing.

CDFW has expressed concern about ongoing declines in groundwater levels and spring discharge at Fish Slough. "There is a high potential for irreversible impacts to groundwater-dependent ecosystems and endangered species if groundwater declines are not halted, as spring flows within Fish Slough are diminishing dramatically within the spring closest to the Tri-Valley area and may cease entirely within the next decade. This loss will result in permanent loss of spring-obligate wetlands, and the desiccation of this unique feature" (CDFW 2019, *internal citations omitted*).

Long Valley

Long Valley is a massive caldera and thus a system of robust geothermal activity. The spring waters which historically sustained Long Valley speckled dace habitats were sourced from this geothermal activity – indeed, the area is known for its natural hot and warm springs. Geothermal energy development has occurred within the Long Valley caldera, and there is cause for concern for the surface waters which historically have sustained the Long Valley dace.

Geothermal energy development is known to alter discharge quantity, geochemistry and temperature at surficial water features adjacent to production sites – indeed, such changes are considered to be the rule, not the exception (Sorey 2000).

Geothermal energy development in the Long Valley caldera has already caused significant changes to surficial thermal water features there. Monitoring of such features subsequent to the development of the Casa Diablo geothermal facility has shown "a cessation of spring flow at Colton Spring, 2 km east of Casa Diablo"; "declines in water level in Hot Bubbling Pool, 5 km east of Casa Diablo… of 1.2m"; and a 30-40% reduction in thermal water content in the springs at Hot Creek Fish Hatchery (Sorey 2000). This reveals that impacts from geothermal development may extend beyond a hyper-localized reach, which has important implications for the springs which historically supported populations of Long Valley speckled dace. Whitmore Hot Springs is less than six miles away from the Casa Diablo geothermal facility, and it is conceivable that it, or other thermal surface water features, could be affected by operations there. Geothermal developer Ormat has already expanded the facility once and has discussed further expansion. Such development presents a threat to the Long Valley speckled dace ever being restored to its native habitat.

Dams and Water Diversions

The primary water diversion of concern for the Amargosa Canyon speckled dace is that of groundwater, which is discussed above. The only surface water diversion affecting the Amargosa Canyon speckled dace is that at China Ranch, the farming operation on Willow Creek. China Ranch collects water from Willow Spring in the Willow Creek reservoir and uses it to irrigate date palms. There is a substantial portion of Willow Creek which does not get impounded at the reservoir, and continues to flow down the channel to the Amargosa River, even at periods of low flow. The date palms are irrigated with drip irrigation, and excess water percolates into and recharges the shallow aquifer which then supports levels in Willow Creek. China Ranch is under a permanent conservation easement held by The Nature Conservancy to limit development and water usage at China Ranch – current usage is as high as it will ever be. Additionally, the landowner at China Ranch has conducted active habitat restoration to support populations of the Amargosa Canyon speckled dace. While it is clear that increased flows in Willow Creek would potentially increase speckled dace numbers, due to the conservation protections in place and the active beneficial habitat management activities undertaken by the landowner, agricultural use at China Ranch does not appear to represent a significant threat to the Amargosa Canyon speckled dace.

Owens speckled dace have historically been threatened by dams and water diversions. Dams on the mainstem Owens River have likely reduced potential dace habitat by flow regulation and elimination of floodplain inundation; regulation of the Owens River has impacted floodplain habitat extent and quality (Moyle et al. 2015). Alteration of the Owens River has made the prospects for restoration of Owens speckled dace habitat to be low, and thereby reduced the speckled dace's range to its current few populations.

Long Valley speckled dace have been substantially impacted by surface water diversions. The Hot Creek fish hatchery likely contributed to the extirpation of dace in Hot Creek through diversion of water and construction activities in the 1960s (Moyle et al. 2015). It is likely that Hot Creek had the most robust Long Valley speckled dace population of any in Long Valley. Additionally, numerous springs throughout Long Valley have been altered and diverted for recreational use by swimmers and bathers. In particular, the Long Valley speckled dace's final remaining habitat at Whitmore Hot Springs is the outflow from a public swimming pool, impacted by chlorine and other chemicals and susceptible to perturbations due to ongoing diversions.

Habitat Alteration

Amargosa Canyon speckled dace generally do not experience habitat alternation in the mainstem Amargosa River. However, habitats along Willow Creek in the area of China Ranch have been substantially altered over the years for agricultural use.

Owens speckled dace are threatened by habitat alteration. Speckled dace are highly sensitive to impacts that simplify their habitat or reduce cover (Moyle et al. 2015). In the Owens Valley, channelization and vegetation clearing may impact dace populations (Moyle et al. 2015).

Long Valley speckled dace have experienced significant habitat alteration due to recreational development of water sources. Their last natural habitat at Whitmore Hot Springs was the outflow from a swimming pool. They are feared to be extirpated in the wild.

Urban and Rural Development

Increasing human population growth around Tecopa and in the Amargosa Basin groundwater-shed potentially threatens aquatic habitats for Amargosa Canyon speckled dace in the Amargosa River, from increasing groundwater withdrawals causing declining spring flows (Moyle et al. 2015).

Moyle et al. (2015) consider urbanization and rural residential development to be a “medium” threat for Owens speckled dace. Around Bishop, alteration of streams is occurring for water diversion, flood control, and landscaping; and ditches are being converted to covered pipelines (Moyle et al. 2015).

Livestock Grazing

Livestock grazing along rivers and around springs can negatively impact water quality and aquatic and riparian habitat for 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 degrade habitat for native 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).

Taylor et al. (1989) documented that cattle grazing around desert springs in the Pahranagat Valley, Nevada degraded water quality, caused fish mortality, and negatively impacted native fish populations, including for Pahranagat speckled dace (*Rhinichthys osculus velifer*). Urine and feces from cattle at two Pahranagat springs caused an increase in ammonia and nitrites in the water, which are toxic to fish in chronic amounts. The increases in ammonia and nitrites caused an increase in bacteria such as *Pseudomonas aeruginosa*, *Aeromonas hydrophila*, and coliforms. This resulted in increased oxygen needed by nitrifying bacteria and a decrease in oxygen available for fish, and an increase in fish mortality at the springs. Removal of cattle from one of the springs quickly reversed these conditions (Taylor et al. 1989).

Sada (1989) noted that aquatic habitats in Long Valley had been “intensively impacted” by livestock grazing, so that few sites provided suitable speckled dace habitat. Moyle et al. (2015) consider livestock grazing a “high” threat for Long Valley speckled dace. Reduction in riparian vegetation and trampling of stream banks and springs by cattle has impacted much of the limited Long Valley speckled dace habitat (e.g., Whitmore Springs, Little Alkali Lake) by increasing sediment input into pools and channels, increasing solar input, and reducing habitat complexity and cover (Moyle et al. 2015). Heavy damage by grazing is thought to have contributed to the extirpation of the Long Valley speckled dace population in an unnamed spring at Little Alkali Lake (Moyle et al. 2015). Cattle continue to seriously degrade Long Valley speckled dace habitats (Moyle et al. 2015).

Sada (1989) noted that potential speckled dace habitats in the East Fork Owens River were heavily grazed by cattle. Livestock grazing also occurs in the Fish Slough area, presenting a threat to the Owens speckled dace.

Recreation

Moyle et al. (2015) considered the increasing popularity of off-road motorized vehicle recreation to be a substantial threat to Owens speckled dace and a growing threat to the Amargosa River and its watershed. Off-highway vehicular use creates impacts to sensitive desert and aquatic habitats (Moyle et al. 2015). Off-road activities are difficult to regulate and although regulations are in place that ban the use of off-road vehicles in sensitive areas, riparian areas, and streambed habitat, degradation from illegal vehicle use still occurs (Moyle et al. 2015). Trespass off-road vehicles have been a common problem in Amargosa Canyon in the past, and fences and barriers need to be properly maintained (Moyle et al. 2015).

Recreation impacts are a significant threat to Long Valley speckled dace. The water source that supported the sole remaining Long Valley speckled dace habitat, Whitmore Hot Springs, is now a public swimming pool. The effluent maintained sufficient flows to support this dace population, but a spill of over-chlorinated water was a threat (Moyle et al. 2015). Whitmore Hot Springs is operated by the county of Mono as a public facility, and public health laws require disinfection (Moyle et al. 2015). This population is now feared to be extirpated.

Moyle et al. (2015) consider recreation impacts to be a “medium” but substantial threat for Owens speckled dace, since alteration to thermal spring habitats in the Owens Valley for swimming and other recreation continues.

Disease and Predation

Other populations of speckled dace have suffered from disease outbreaks and parasitism (Stone et al. 2007, p. 135). Some invasive species are known to introduce non-native parasites and disease into freshwater ecosystems (Stone et al., 2007, p. 131). Sada (1989) documented “heavy parasite infestation” of Long Valley speckled dace at Whitmore Hot Springs in 1989.

Invasive fish, such as mosquitofish, as well as introduced crayfish and bullfrogs are known to predate on speckled dace – see the section below on introduced species.

Overutilization for Commercial, Recreational, Scientific or Educational Purposes

Overutilization of Death Valley area speckled dace for commercial, recreational, scientific or educational purposes is not known to be a factor.

Inadequacy of Existing Regulatory Mechanisms

Federal Protections

Existing federal regulatory mechanisms that have the potential to provide some form of protection for Death Valley populations of speckled dace include: overlap with other ESA listed species and their designated critical habitat; coverage under Habitat Conservation Plans; occurrence on federally protected land; and consideration under the National Environmental Policy Act or the Clean Water Act.

Overlap with ESA Listed Species

Death Valley populations of speckled dace could potentially benefit from overlap with other ESA listed species and protections afforded by their designated critical habitat.

The Owens pupfish (*Cyprinodon radiosus*) is protected under the ESA as an endangered species. However, there are only four populations of Owens pupfish in existence, and only one of them, the Fish Slough population, is near habitat for speckled dace (USFWS 2009). Owens speckled dace have been extirpated from Warm Springs (Sada 1989), one of the remaining Owens pupfish locations. Owens pupfish inhabit three spring-fed ponds and a man-made marsh in Fish Slough. There are only a few CNDDB occurrences of Owens pupfish near or adjacent to extant populations of Owens speckled dace. There is no designated critical habitat for the Owens pupfish.

The Owens tui chub (*Gila bicolor* ssp. *snyderi*) is listed as an endangered species under the ESA. The only viable Owens tui chub populations are in headwater springs of Hot Creek and in approximately 8 miles of the Owens River below Long Valley Dam, areas which are also designated as critical habitat for the chub. However, Owens speckled dace have been extirpated from the Owens River and Hot Creek (Sada 1989), so there is no overlap with Owens tui chub critical habitat.

The Fish Slough milk-vetch (*Astragalus lentiginosus* var. *piscunensis*) is listed as a threatened species under the ESA. This plant is endemic to Fish Slough, where it occupies alkali flats along a 10 km stretch of spring-fed wetlands from the northeast spring almost to the Owens River. The designated critical habitat area for the Fish Slough milk-vetch parallels but does not overlap with extant Owens speckled dace in a small portion of Fish Slough. Critical habitat for Fish Slough milk-vetch only consists of the ring of alkaline habitat around the seasonally and permanently flooded wetland habitat in Fish Slough itself, so there is no overlap with Owens speckled dace.

The Amargosa vole (*Microtus californicus scirpensis*) is listed as an endangered species under the ESA. It occurs only in the vicinity of Tecopa Hot Springs and the northern end of the Amargosa Canyon. The Amargosa vole occurs in isolated wetland habitats along a riparian segment of the Amargosa River, where bulrush is a dominant perennial overstory species. Amargosa Canyon speckled dace have been extirpated from the vicinity of Tecopa (Sada

1989). Extant Amargosa Canyon speckled dace only overlap with designated critical habitat for the Amargosa vole in a short stretch of upper Amargosa Canyon.

The southwestern willow flycatcher (*Empidonax traillii extimus*) is listed as an endangered species under the ESA. Critical habitat for the southwestern willow flycatcher only overlaps with extant Amargosa Canyon speckled dace in small reaches of the Amargosa River and Willow Creek.

In summary, there is a no overlap of Long Valley speckled dace and negligible overlap of Owens speckled dace with any designated critical habitat for other ESA listed species. There is very little overlap of Amargosa Canyon speckled dace with designated critical habitat for the ESA listed Amargosa vole and southwestern willow flycatcher.

Habitat Conservation Plans

Death Valley area speckled dace are not currently covered under any ESA Habitat Conservation Plans in California or Nevada (USFWS 2020).

Occurrence on National Park and BLM Lands

The Amargosa Canyon speckled dace is listed as a BLM "Special Species" and as such must be considered when addressing proposed projects and management practices. Pre-construction, construction, decommissioning activities, and other activities are required to implement a 0.25 mile setback buffer from federally listed fish species (USBLM 2016, p. 107); however, the Amargosa Canyon speckled dace is not a federally listed species.

The Amargosa Canyon was designated as an Area of Critical Environmental Concern (ACEC) by the BLM in 2002, but there is no official BLM management plan for the Amargosa River or the Amargosa Canyon speckled dace. Congress designated more than 26 miles of the Amargosa River in Inyo and San Bernardino counties as scenic, wild or recreational in 2009. However the BLM has failed to create a management plan for the Amargosa River through Amargosa Canyon, as required under the Wild and Scenic Rivers Act. Conservation groups filed a lawsuit against the BLM in 2018, and a settlement agreement requires the BLM to finalize a Wild and Scenic River management plan for the Amargosa River by December 2024.

National Environmental Policy Act

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 U.S. Bureau of Land Management with the potential to impact Death Valley region populations of speckled dace and their 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 Death Valley region populations of 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 dace habitat.

Clean Water Act

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 speckled dace in the Death Valley region. 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. The Corps can issue nationwide permits 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 Death Valley region speckled dace may receive no special consideration with regard to conservation or protection absent listing under the ESA.

In 2018 the Trump administration proposed to eliminate Clean Water Act protections for wetlands and streams that are not "physically and meaningfully connected" to larger navigable bodies of water. Under these new regulations, intermittent streams, springs and isolated water bodies in both the Owens and Amargosa basins would be exempt from the CWA, and therefore Death Valley speckled dace will receive no protections under the CWA.

State Protections

Existing California state regulatory mechanisms that have the potential to provide some form of protection for Death Valley region populations of speckled dace include: listing as a species of special concern; consideration under CEQA; or protection through California's Sustainable Groundwater Management Act.

Species of Special Concern

The state of California lists Amargosa Canyon speckled dace, Long Valley speckled dace, and Owens speckled dace as ''species of special concern.'' This designation does not provide any regulatory or substantive protection for these fish populations. They are 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.'' Death Valley region speckled dace would qualify as 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 Death Valley region 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 through CEQA is, therefore, not assured.

California Sustainable Groundwater Management Act

The California Sustainable Groundwater Management Act (SGMA) was intended to be a framework for sustainable long-term groundwater management, ostensibly bringing order to a chaotic patchwork of local groundwater regulation. However, SGMA's most significant protective provisions only apply to basins designated as medium or high priority under the Act. It is due to quirks in groundwater management that the Amargosa Basin, Owens Valley and Long Valley are categorized as low priority basins under SGMA. In the Amargosa Basin, there is a significant issue of groundwater over-appropriation – however most pumping is occurring in Nevada and therefore out of the reach of SGMA. In the Owens Valley, the majority of the basin is regulated by the Inyo County/Los Angeles Department of Water and Power Long-Term Water Agreement, and thus in 2019 was given a de-prioritized SGMA designation, from high priority to low priority. However, the Tri-Valley basin is not part of the water agreement. CDFW actually petitioned to the California Department of Water Resources to reconsider and continue managing Tri-Valley as a high priority basin, but CDWR demurred. As such, there is no protective mechanism in place to ensure regulation of groundwater resources in the Tri-Valley area, and over-appropriation of groundwater continues to lead to declines in spring flow at Fish Slough.

Other Natural or Anthropogenic Factors

Introduced Species

Introduced Fish

The introduction of non-native centrarchid predators such as largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), and Sacramento perch (*Archoplites interruptus*) into springs and small streams can rapidly drive dace populations to extinction and the introduction of these invasive fish species has been implicated in extirpation of isolated dace populations (Moyle et al. 2015). Other introduced fishes that may be competitors with or predators of speckled dace are western mosquitofish (*Gambusia affinis*), brown bullhead (*Ameiurus nebulosus*) and various species of trout (*Salmo* and *Oncorhynchus* spp) (Moyle et al. 2015). Mosquitofish likely aggressively compete with speckled dace for food (Caiola and Sostoa 2005), as well as being a known predator of fish larvae and eggs (Meffe 1985; Mills et al. 2004).

Scoppettone et al. (2005) found that in the Ash Meadows region, native fishes dominate in warm water spring-pools while non-native fishes dominate in marshy habitats and cool water spring-pools.

Owens speckled dace and Long Valley speckled dace are significantly threatened by introduced fish. In 1988, the only extant populations of Long Valley speckled dace were found in springs where no other fish species were present (Sada 1989; Moyle et al. 2015). Subsequently, the population of speckled dace in an unnamed spring at Little Alkali Lake became extirpated concurrent with the discovery of mosquitofish in the spring system (Sada 1989; Moyle et al. 2015). The single remaining Long Valley speckled dace population could easily be extirpated by introduction of another fish species into its limited habitat (Moyle et al. 2015). Competition and/or predation from mosquitofish could play a major role in the decline of Amargosa Canyon speckled dace (Otahal 2015; Moyle et al. 2015). It is assumed that native fishes were likely found in greater abundance in the Amargosa River prior to the invasion of mosquitofish (Moyle et al. 2015).

Introduced Amphibians and Crustaceans

Introduced crayfish compete with, prey upon, and alter the behavior of native fishes (Light 2005). The red swamp crayfish (*Procambarus clarkii*) has been recorded throughout the Ash Meadows region and has played a role in the local extirpation and reduction of native dace (Kodric-Brown and Brown 2007). Red swamp crayfish are a threat to Amargosa Canyon speckled dace (Otahal 2015). It is assumed that native fishes were likely found in greater abundance in the Amargosa River prior to the invasion of crayfish (Moyle et al. 2015).

A population of introduced tiger salamanders exists within 3 miles of Whitmore Hot Springs (S. Parmenter, CDFW, pers. comm. 2009, per Moyle et al. 2015), walking distance for adult salamanders. Colonization of the springs by these predatory amphibians could eliminate the last remaining natural population of Long Valley speckled dace, if it still exists (Moyle et al. 2015).

Competition and/or predation from bullfrogs could play a major role in the decline of Amargosa Canyon speckled dace (Otahal 2015; Moyle et al. 2015).

Oasis speckled dace populations are impacted by invasive crayfish and bullfrogs (NDOW 2012).

Non-Native Plants

Speckled dace populations in springs are threatened by introduction and growth of cattails (*Typha* spp.), which can significantly reduce dace habitat by filling in open water habitat and shallow pools and marshes, altering food webs, and removing water through transpiration (Moyle et al. 2015). This is of concern for Owens Valley and Long Valley speckled dace (Moyle et al. 2015).

Invasive saltcedar (*Tamarix* spp) is overwhelming riparian ecosystems across the southwestern United States and it has the potential to significantly alter speckled dace habitats and ecosystem properties (Davis and Halvorson 2016). Historically, stochastic events such as fire and flood periodically cleared large areas of riparian vegetation, keeping stream channels open and dynamic (Benda et al. 2003; Kozlowski et al. 2010), but today, these same processes serve as agents for the spread of saltcedar (Wiesenborn 1996). Because saltcedar has a substantially greater water demand than native vegetation, increases in saltcedar density in the riparian zone result in a corresponding increase in water lost to transpiration (Duncan and McDaniel 1998). Saltcedar also shades river systems, decreasing food resources within the waterway (Otahal 2015). Saltcedar increases fire risk (Drus et al. 2012), can change stream morphology (Auerbach et al. 2013), increases soil salinity (Ohrtman et al. 2012), and causes other potentially detrimental ecosystem effects (El Waer et al. 2018).

Saltcedar is proliferating and altering aquatic habitats in Amargosa Canyon (Scoppettone et al. 2011). Its spread threatens to form a saltcedar monoculture throughout the Amargosa River floodplain (Scoppettone et al. 2011). Saltcedar is a significant threat to flow levels in the Amargosa River and to Amargosa Canyon speckled dace (Zdon 2014; Otahal 2015), and it is assumed that native fishes were likely found in greater abundance in the Amargosa River prior to the invasion of saltcedar (Moyle et al. 2015).

The USBLM launched a saltcedar removal program in 2013 within the range of the Amargosa speckled dace, with more than 75 acres treated by 2015 and plans to treat another 100 acres (Otahal 2015). Removal of saltcedar has been found to increase the abundance of native fishes, such as pupfish and speckled dace, while reducing the abundance of invasive species, such as crayfish and mosquitofish (Kennedy et al. 2005, p. 2080).

Climate Change

Climate change is a direct and significant threat to the Amargosa Canyon, Long Valley, and Owens populations of speckled dace. The Amargosa River canyon exists in an exceptionally arid region and is fed by isolated desert springs and subsurface aquifer flow; this is a precarious ecosystem, vulnerable to geologic and anthropogenic disruption. Fed by rain and snow melt at high elevation in the desert mountain ranges, desert aquifers in the Death Valley region will likely receive less recharge as the region warms (Riggs and Deacon 2004). This decline in regional water supply will be compounded by growing human demand for water both locally and in southern Nevada, which will only increase as the climate gets hotter and more arid. The thermal spring systems which comprise a major portion of Long Valley and Owens speckled dace habitat are fed by aquifers dependent on snow melt for recharge. It is predicted that climate change will lead to a reduction in snow pack in the eastern Sierra Nevada due to warmer temperatures and a shift in precipitation toward rainfall in late winter and early spring months. However, since the Owens Valley is at the base of the southernmost portion of the Sierra Nevada, where the range attains maximum elevations, the effects of climate change could be mitigated to some extent by retention of snow pack in this portion of the range, where snowmelt is likely to maintain flows in most Owens Valley streams. However, it is also possible that snow pack will be reduced in the portion of the Sierra Nevada spanning from Bishop to June Lake; this region is most proximate to remaining Long Valley speckled dace habitats and snow pack retention will likely be critical to maintaining stream flows and aquifer recharge in Long Valley. In any case, climate change predictions indicate that snow will not persist as long into the hotter months and stream flows will likely be reduced in late summer or early fall. A hotter, drier, future climate, paired with an ever-increasing human demand for decreasing water resources in the Owens Basin, suggest that dace habitat may be threatened by drying conditions in the future.

Moyle et al. (2013) rated the Amargosa Canyon speckled dace, Owens speckled dace, and Long Valley specked dace as “critically vulnerable” to climate change, indicating extinction is likely within the next 100 years if measures to counter climate change effects are not taken.

Isolated Populations

Small, isolated populations have a greater risk of extinction than more robust populations with larger ranges. Small populations run the risk of reaching a genetic “bottleneck,” and the population becomes progressively more homogenous (Nei et al. 1975, p 8).

Amargosa Canyon speckled dace are limited to the Amargosa River within the Amargosa Canyon and its tributary Willow Creek, in water bodies which are often more pool-like than continuous. Outside of occasional flooding events, the Amargosa River does not expand. As a result, the Amargosa Canyon speckled dace is limited to the water levels of the Amargosa River and rarely, if ever, migrates elsewhere. If local extirpation occurs, there is little or no potential for Amargosa Canyon speckled dace recolonization (Meffe and Vrijenhoek 1988, p. 158).

Owens speckled dace are threatened due to the isolated nature of populations; only a handful of populations remain, mostly isolated from one another in the northern Owens Valley. As habitat is altered or otherwise made inaccessible to dace, small, isolated, populations are created with no gene flow to other populations. These populations are particularly vulnerable to genetic drift or bottlenecking and to stochastic events which sharply increase probability of extirpation. Isolated populations of dace are susceptible to habitat loss and alteration, and to the establishment of alien fishes (Williams and Sada 1985). For example, the extirpated Benton Valley populations occurred in small springs and stream segments that were altered and occupied by introduced predators (Sada 1989).

Long Valley speckled dace had only one remaining population within their native range, at Whitmore Hot Springs (Moyle et al. 2015). It is possible that this population has been extirpated, and the remaining fishes live in an artificial refuge near Bishop managed by CDFW (S. Parmenter, pers. comm. 2020).

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