Emergency Petition to List the Oasis Valley Speckled Dace (Rhinichthys nevadensis nevadensis) As Endangered or Threatened Under the Endangered Species Act

Oasis Valley speckled dace photo by U.S. Bureau of Land Management

Center for Biological Diversity
July 2, 2024
Notice of Petition

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Petitioner Center for Biological Diversity formally requests that the U.S. Fish and Wildlife Service (USFWS) list the Oasis Valley speckled dace as endangered or threatened under the federal Endangered Species Act (ESA).

The Oasis Valley speckled dace is one of four Distinct Population Segments (DPSs) of the Amargosa speckled dace (Rhinichthys nevadensis nevadensis), a subspecies of the desert speckled dace (Rhinichthys nevadensis). Fisheries biologists with the U.C. Davis Center for Watershed Sciences and California Department of Fish and Wildlife have identified four DPS of Amargosa speckled dace: Amargosa River, Owens, Ash Meadows, and Oasis Valley. The Oasis Valley speckled dace DPS is the subject of this emergency listing petition. The Center will separately submit listing petitions for the Amargosa River speckled dace and Owens speckled dace; and the Ash Meadows speckled dace is already listed as endangered under the ESA.

The Oasis Valley speckled dace qualifies for immediate, emergency protection as endangered under the ESA. It is only known to exist in about a dozen springs in the Oasis Valley. Suitable habitat for the Oasis Valley speckled dace is under existential threat due to proposed massive gold mining projects and associated groundwater drawdown that could dry out springs and their outflows. Oasis Valley speckled dace are also threatened by existing water diversions and aquatic habitat alteration, trampling and habitat damage by non-native cattle and burros, groundwater pumping for solar energy development, predation and competition from invasive species, and climate change.

Should the USFWS determine that the Oasis Valley speckled dace warrants listing as threatened rather than endangered 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 designate critical habitat for the Oasis Valley speckled dace 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.

Petitioner the Center for Biological Diversity is a nonprofit environmental organization dedicated to the protection of native species and their habitats. The Center is supported by more than 1.7 million members and online advocates throughout the country. The Center works to secure a future for all species, great and small, hovering on the brink of extinction. The Center submits
this petition on its own behalf and on behalf of its members and staff with an interest in protecting speckled dace populations and their habitat.

We are requesting that this petition be considered on an emergency basis, since this rare endemic dace population is immediately threatened by a mining project currently in NEPA review, as well as six other mining projects in different stages of development. Under Section 4(a)(7) of the Endangered Species Act, the USFWS has the authority to promulgate an emergency listing rule for “any emergency posing a significant risk to the well-being of any species of fish or wildlife.” The Oasis Valley speckled dace faces such an emergency and warrants immediate action.

References for this petition have been uploaded to a folder provided by the FWS Branch of Domestic Listing. They can also be downloaded here: https://drive.google.com/drive/folders/1tENxUFmCzCvWBlC4KwNTgFhsX8ech?usp=sharing

Submitted this 2nd day of July, 2024:

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Executive Summary

Speckled dace are small cyprinid fish. Genetically distinct and hydro-geographically isolated speckled dace populations inhabit freshwater streams and springs in the arid environments of the Mojave and Great Basin deserts. The Oasis Valley speckled dace is a distinct population segment of the Amargosa speckled dace (*Rhinichthys nevadensis nevadensis*). It occurs only in a few springs in Southern Nevada’s Oasis Valley. The Oasis Valley hydrographic area is located at the headwaters of the Amargosa River and is home to multiple endemic species of conservation concern, which are reliant on aquatic habitats sustained by shallow groundwater.

The groundwater resources which sustain Oasis Valley and the Amargosa River are imminently threatened by numerous proposed gold mining projects surrounding the Oasis Valley, including what is potentially the largest greenfield gold discovery in the U.S. in more than a decade. Dewatering and production pumping for these massive mining projects is modeled to cause significant and widespread drawdown of groundwater levels across Oasis Valley, potentially leading a decrease in quantity of spring discharge and a loss or degradation of Oasis Valley speckled dace habitat. Simulated cumulative pumping from several of these gold mines shows widespread drawdown of surface water and groundwater along the length of the Amargosa River in Oasis Valley.

Invasive species are a significant threat to Oasis Valley speckled dace and their habitat, particularly non-native ungulate grazing (cattle and burros), invasive predators (such as bullfrogs, crayfish and mosquitofish), and invasive plants that alter spring habitat, such as saltcedar. Other threats to Oasis Valley speckled dace include existing water diversions and aquatic habitat alteration, and groundwater pumping for solar energy development. Changes in precipitation, snow, and runoff in the Mojave Desert region due to climate change will result in reduced stream flows and inadequate aquifer recharge to sustain many of the perennial springs which Oasis Valley speckled dace rely upon.

In light of the present and ongoing threats to their continued existence, Oasis Valley speckled dace warrant immediate protection under the Endangered Species Act to avoid extinction.
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NATURAL HISTORY

Description

Speckled dace are small, cyprinid fish with an elongated body, a small but distinct hump present behind the head, and a subterminal mouth. They are silver in color, with brown or black blotching on sides. Adult speckled dace are typically under 100 mm. (NDOW 2022b, p. 393).

Moyle et al. (2015, p. 435, internal citations omitted) provided 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. 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. Once fully developed, the dorsal fin usually has 8 rays and originates well behind the origin of the pelvic fins. The anal fin has 6-8 rays. Pharyngeal teeth (1,4-1,1 or 2,4-2,2) are significantly curved with a minor grinding surface. The maxilla usually has a small barbel at each end. The snout is connected to the upper lip (premaxilla) by a small bridge of skin (frenum). Most fish larger than 3 cm have distinctive dark speckles on the upper and sides of the body, a dark lateral band that extends to the snout, and a spot on the caudal peduncle. The rest of the body is dusky yellow to olive, with the belly a paler color. Breeding adults of both sexes have fins tipped by orange or red, while males also have red snouts and lips and tiny tubercles on the head and pectoral fins.

Taxonomy

The genus Rhinichthys is widely distributed and abundant in North America and has eight recognized species. However, most species are highly variable and may encompass complexes of unrecognized species or subspecies (Moyle 2002, p. 160-164). Morphological differences among speckled dace populations isolated in different watersheds led early ichthyologists to describe 12 separate species (Jordan and Evermann 1896, p. 305-308). 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, p. 97). Speckled dace (Rhinichthys osculus) considered as a single species would have the widest geographic range of any freshwater dispersing fish in western North America. Much of the resistance to breaking Rhinichthys osculus into separate species has stemmed from lack of definitive morphological characters (Smith et al. 2017, p. 47). 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, p. 8). Cryptic evolutionary lineages exist that can only be identified through genetic and/or genomic
approaches, such as Baumsteiger and Moyle (2018, *entire*) found for speckled dace and Baumsteiger et al. (2017, *entire*) found for another group of cyprinids, California roach/hitch. Recent genetic analysis supports a return to some of the original speckled dace taxonomy. 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.

Gilbert (1893, p. 230) 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 (Moyle 2002, p. 161). Since the 1980s, some ichthyologists have placed speckled dace from Amargosa Canyon, the Owens Valley, and Oasis Valley Basin in separate undescribed subspecies (Williams et al. 1982; Deacon and Williams 1984, p. 110), based on morphometric differences.

The dynamic geologic history of the Great Basin region has produced many isolated watersheds with endemic fish species. Because speckled dace from these watersheds cannot be differentiated readily by morphometrics and meristics, this has led to the widely accepted hypothesis that the dace’s adaptability and ability to cross geologic barriers has resulted in interbreeding among neighboring populations, maintaining the dace as a single species. Moyle et al. (2023, *entire*) investigated this hypothesis by looking at speckled dace populations in California which are the result of at least three separate colonization events of isolated watersheds. Moyle et al. (2023, *entire*) synthesized results from taxonomic, genetic, and zoogeographic studies in combination with the findings of a recent genome-based analysis (Su et al. 2022, *entire*), to demonstrate that there are distinctive evolutionary lineages within the speckled dace complex.


Baumsteiger and Moyle (2018, p. 4-7) tested the hypotheses of Sada et al. (1995, p. 358) 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, p. 4) 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, p. 8) were that these three groups represent separate species within currently recognized speckled dace. Baumsteiger and Moyle (2018, p. 8-9) 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, p. 358). Baumsteiger and Moyle (2018, p. 9) 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
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.

Mussman (2018, *entire*) used a molecular clock to evaluate divergence dates of six distinct *Rhinichthys* lineages within the Owens and Amargosa drainages, which mostly conform to documented Pleistocene inter-basin hydrological connections. The results of Mussman (2018, p. 121) validate these lineages as ESUs eligible for protection. Mussmann et al. (2020, *entire*) evaluated conservation units for speckled dace in the Owens and Amargosa basins, using multiple approaches in a comparative framework, accumulating statistical results from independent studies and evaluating congruence among genetic data sets. Mussmann et al. (2020, p. 15-16) validated distinct three distinct lineages (Oasis Valley, Owens River, and Long Valley) and argued that Amargosa Canyon speckled dace is eligible for protection as a DPS.

Su et al. (2022, *entire*) attempted to determine evolutionary lineages within California populations of speckled dace using population genetic and genomic information, using restriction site-associated DNA sequencing to extract thousands of single-nucleotide polymorphisms across the genome to identify genetic differences among all the samples from 38 locations in the western USA. Su et al. (2022) performed principal component analysis, admixture analysis, estimated pairwise values of the genetic differentiation index FST, and constructed molecular phylogenies to characterize population genetic and phylogenetic relationships among sampled speckled dace populations. Their analyses detected three major lineages of speckled dace in California that align with geography: (1) Sacramento River, central California coast, Klamath River, and Warner Basin; (2) Death Valley and Lahontan Basin; and (3) Santa Ana River basin, in southern California (*Id.*, p. 699-701). These lineages fit well with the geologic history of California, which has promoted long isolation of populations of speckled dace and other fishes. Su et al. (2022, p. 697) concluded that the presence of distinct evolutionary lineages indicates that speckled dace in California should be managed with distinct population segments to preserve within-species diversity.

Su et al. (2022, p. 703) found that speckled dace from Death Valley region (Owens River, Amargosa River, and Long Valley) and the Lahontan Basin are most closely related to each other. Death Valley and the Lahontan Basin are isolated geological basins, so speckled dace from these two geographic regions represent a single lineage composed of two distinct sub-lineages with a common ancestor (*Id.*, p. 706). Within the Death Valley lineages, the Amargosa and Owens River populations only show small genetic differences, a finding consistent with the work of Mussmann et al. (2020). Smith et al. (2017, p. 60) found that speckled dace from the Amargosa River shared haplotypes with dace from the Owens Valley. Dace from Oasis Valley, Nevada (the headwaters of the Amargosa River), and from Ash Meadows (Bradford Spring) are sister lineages of speckled dace from the Owens River. The Owens and Amargosa River watersheds are internal drainages that were connected via a chain of large lakes during extended wet periods in the late Pleistocene. Given the results of their analyses and the relatively recent geographic separation and isolation, Su et al. (2022, p. 706) placed speckled dace from the Amargosa and Owens rivers as one sub-lineage. Although speckled dace from Long Valley are in the same watershed as the Owens Valley, dace from Long Valley are genetically distinct from dace in the Owens and Amargosa rivers. Mussmann et al. (2020, p. 11) observed a similar pattern in the phylogeny and FST estimates. This is probably the result of
genetic drift due to isolation of small dace populations in small streams flowing into the Long Valley Caldera. Climatic shifts and vulcanism in the southern Mono Lake basin subsequently isolated the Owens River basin from the Lahontan Basin. Su et al. (2022, p. 707) treat the Long Valley population as a sub-lineage under Lahontan Basin speckled dace.

Speckled dace from the Walker River, Humboldt River, eastern Sierra Nevada streams, and Death Valley system streams are one lineage: the Lahontan speckled dace (*Rhinichthys osculus robustus*), which is a widely recognized taxon (Deacon and Williams 1984, p. 109; Moyle 2002, p. 161). The historic habitat of Long Valley speckled dace was a series of hot spring outflows and connected marshes in the remnants of the Long Valley Caldera. The caldera was created by vulcanism approximately 767,000 years ago and then filled with water and sediment (Hildreth and Fierstein 2016, p. 2). The dace (and other fishes) presumably colonized these habitats in the late Pleistocene, when the Lahontan Basin was connected to the Owens River basin via outlets of large pluvial lakes. When the climate changed, the lakes dried up. Complex events then created the Owens River gorge, with high waterfalls, draining the caldera lake and isolating the fish that became Long Valley speckled dace about 100,000 years ago (Hildreth and Fierstein 2016, p. 11). Su et al. (2022, p. 699-701) consider Lahontan speckled dace to have given rise to two genetically distinct lineages in the Death Valley region: speckled dace in Death Valley (Amargosa and Owens River systems) and speckled dace in Long Valley.

Moyle et al. (2023, *entire*) describe how they determined species and subspecies, summarize the new genomic findings that support the revised taxonomy in their study (Su et al. 2022, *entire*), and present a revision of the taxonomy of dace populations in California. Moyle et al. (2023, *entire*) back up these designations by examining how well these lineages fit with the geologic history of the isolated basins they inhabit and with the presence of other endemic fishes. Moyle et al. (2023, p. 509) conclude that nine taxa can be recognized within the speckled dace complex in California:

- **Santa Ana Speckled Dace**, *Rhinichthys gabrielino* new species
- **Desert Speckled Dace**, *Rhinichthys nevadensis* (Gilbert) new combination
  - Lahontan Speckled Dace, *R. nevadensis robustus* (Gilbert) new combination
  - Amargosa Speckled Dace, *Rhinichthys nevadensis nevadensis* (Gilbert)
  - Long Valley Speckled Dace, *R. nevadensis caldera* new subspecies
- **Western Speckled Dace**, *Rhinichthys klamathensis* (Evermann and Meek)
  - Klamath Speckled Dace, *R. klamathensis klamathensis* new combination
  - Sacramento Speckled Dace, *R. klamathensis acomawii* new subspecies
  - Warner Speckled Dace, *R. klamathensis goyatoka* new subspecies

Speckled dace in the Great Basin are separated into Lahontan speckled dace and Amargosa speckled dace; Long Valley speckled dace are a distinct subspecies (Moyle et al. 2023, p. 509). Amargosa speckled dace (*R. nevadensis nevadensis*) is the subspecies occurring in Death Valley, Owens Valley, and the Amargosa River, with four Distinct Population Segments: (1) Owens speckled dace, (2) Oasis Valley speckled dace, (3) Ash Meadows speckled dace, and (4) Amargosa River speckled dace (Moyle et al. 2023, p. 522).

Moyle et al. (2023, p. 522) designate Amargosa speckled dace as a subspecies of desert speckled dace (*Rhinichthys nevadensis*), going back to Gilbert’s original description and name, based on the following lines of evidence:
**Taxonomy:** the Amargosa speckled dace has been a stable taxon since it was described, although it was mysteriously switched from being a species to a subspecies of *Rhinichthys osculus* in the 1940s, following the Great Basin studies of Hubbs and Miller (1948) and Miller (1946). Gilbert’s original description only encompassed dace in Ash Meadows, leaving as undescribed other dace populations in the Amargosa River, Oasis Valley, and Owens Valley. The undescribed forms have been variously lumped with Amargosa (Moyle 1976) or Lahontan speckled dace (Snyder 1917, 1918) or treated as undescribed subspecies of *R. osculus* (Miller 1973). Moyle et al. (2015) divided the Death/Owens Valley daces into Long Valley, Owens, and Amargosa populations. Su et al. (2022), however, show that the Owens Valley populations are best treated a part of the Amargosa subspecies, *R. nevadensis nevadensis*.

**Zoogeography:** during pluvial periods of the Pleistocene, the Death Valley and Lahontan regions supported many interconnected large lakes, with abundant fishes (Hubbs and Miller 1948). When the climate changed and frequent precipitation stopped, the lakes and rivers dried up or became small, disconnected remnants of what they once were. As a result, the Death Valley region became an endemism hot spot with numerous endemic plants and animals in springs and wetlands (Sada et al. 1995). The fish that survived became restricted to relatively small areas where permanent stream flows were created by springs, which is where we find them today. For speckled dace, this process resulted in numerous isolated populations with little opportunity for genetic exchange in the present landscape. In Death Valley proper, including Ash Meadows, the speckled dace shares spring systems with four species and eight subspecies of pupfish (*Cyprinodon* spp.). In the Owens Valley, other endemic fishes are Owens tui chub (*Siphatales bicolor snyderi*), the undescribed Toikona tui chub (Chen et al. 2007), Owens sucker (*Catostomus fumeiventris*) and Owens pupfish (*Cyprinodon radiosus*).

**Genomics:** the findings of Su et al. (2022) support Amargosa speckled dace as a distinct lineage within desert speckled dace. Thus, Oasis Valley speckled dace are genetically similar to Ash Meadows speckled dace, but both are distinct and separated population segments of Amargosa speckled dace (*R. nevadensis nevadensis*). Genetic analysis by Mussmann et al. (2018, p. 110; 2020, p. 7) indicates that speckled dace in Amargosa Canyon (also a DPS of Amargosa speckled dace) apparently originated as a recent hybrid between Ash Meadows and Owens Valley speckled dace; this makes sense since in extreme flood events, water from both Oasis Valley and Ash Meadows ultimately flows downstream into the Amargosa Canyon.

**Range**

Speckled dace in general are found in all major drainages in western North America. Amargosa speckled dace occurs in the Amargosa River Basin and Owens Valley, with four distinct populations in Oasis Valley, Ash Meadows, Amargosa Canyon, and Owens Valley. The Oasis Valley DPS of speckled dace is distributed throughout the perennial flow of the tributary springs of the Amargosa River within Oasis Valley and occurs in springs and spring outflows throughout the Amargosa Valley, Nevada (NDOW 2022b, p. 393). Speckled dace occur in highly isolated
populations throughout Oasis Valley with minimal connectivity (NDOW 2012, p. S-34; 2022b, p. 393). See Figure 1 for the known range of Oasis Valley speckled dace.

**Figure 1.** Range of Oasis Valley speckled dace, map by CBD using data from Westland 2023.
Life History

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

Feeding

Baltz et al. (1982, p. 1503) 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 p. 115, 118; Baltz and Moyle 1982, p. 1509; Hiss 1984, *entire*; Moyle et al. 1991, p. 269). Speckled dace can feed opportunistically on flying insects as well as zooplankton (NDOW 2012, p. S-34). 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, p. 163). Preference of forage items may also be influenced by presence of other fishes that share similar habitats (Johnson 1985, p. 8).

Reproduction and Growth

Speckled dace are short-lived fish with a life span of 3-4 years (NDOW 2022b, p. 393). Adult speckled dace attain a maximum size of 80 mm SL in inland basins (Moyle 2002, p. 163). Generally, speckled dace mature in their second season (*Ibid*), seeking out shallow areas where gravel is suitable for spawning, usually in late spring as water temperature increases. A high mortality is associated with spawning adults (Wydoski and Whitney 2003, p. 139). Peak spawning of Amargosa River speckled 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, p. 253) noted speckled dace reproduction occurring at temperatures between 17.5 and 24.0°C. Females produce 190-800 eggs, depending on size and location (Moyle 2002, p. 163). Females release eggs underneath rocks or near the gravel surface, while males release sperm (John 1963, p. 289). Eggs settle into interstices and adhere to gravels. Eggs remain in the gravel for 7-8 days before larval fish emerge (NDOW 2022b, p. 393). 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, p. 163), 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, p. 99-100). Slight changes in growth rates are also positively correlated with changes in temperature, as seen in the Colorado River (Robinson and Childs 2001, p. 811-813).

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, p. 163). 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, p. 163). Some speckled dace are active throughout the year, including the winter months (Moyle et al. 2015, p. 427).

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 may be able to recolonize or repopulate available habitats, if accessible (Sada 1990, p. 54, 86; Pearsons et al. 1992, p. 432). 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, entire). 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, p. 428).

However, Amargosa River speckled dace do not often move to new locations (Moyle et al. 2015, p. 429), and presumably, neither do Oasis Valley speckled dace. Genetic analysis by Sada et al. (1995, p. 357) indicated that dace populations within the Death Valley region rarely exchange genetic material. There is no sustained direct hydrologic or topographic connection between the Amargosa River and the Owens Valley/Long Valley areas, so it would be virtually impossible for individual dace to move between river basins. Within the Amargosa River Basin, there is no perennial hydrologic connection between Oasis Valley, Ash Meadows, and the Amargosa Canyon. Only during extreme flood events is there a surface water connection, and even then it is a one-way downstream connection. While some limited genetic exchange downstream to the Amargosa Canyon is possible (Mussmann et al. 2018, p. 110; 2020, p. 7), in general the DPSs can be thought of as isolated populations. This is especially true for the Oasis Valley speckled dace, which is at the top of the watershed, where individuals can only disperse away from the population but not ingress into the population.

**Habitat Requirements**

Speckled dace in general occupy a wide array of habitats including springs and outflows, streams, pools, ponds, and even intermittent streams (NDOW 2022b, p. 393). Speckled dace require clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water (NDOW 2022b, p. 393). Preferable habitats often include shallow riffles and sometimes channelized streams with reduced flow (NDOW 2022b, p. 393). Oasis Valley speckled dace occupy springs and their outflows in riparian wetlands (NDOW 2022b, p. 393).

**Associated Species of Interest**

The Oasis Valley speckled dace broadly co-occurs with the Amargosa toad (*Anaxyrus nelsoni*) and the Oasis Valley springsnail (*Pyrgulopsis micrococcus*). The speckled dace and the springsnail are endemic to Oasis Valley and the toad is endemic to a 14-mile stretch of the Amargosa River: the speckled dace and springsnails are ranked as critically imperiled (G1) by NatureServe (NatureServe 2024a, 2024b) while the toad is ranked as imperiled (G2) (NatureServe 2024c). Other species that are reported to occur along the Amargosa River in Oasis Valley include the federally protected Southwestern willow flycatcher and yellow-billed cuckoo (BLM 2023a, p. 2), as well as an unidentified species of *Tryonia* (NDOW 2023, p. 7).

**Hydrogeology of Oasis Valley**

Oasis Valley is a portion of the Upper Amargosa watershed, located at the headwaters of the Amargosa River. The valley forms part of the southern drainage of Pahute Mesa. Oasis Valley
is situated in Nye County near Beatty and is bounded on the west by the Bullfrog Hills, on the east by Bare Mountain and the mountains on the Nevada National Security site, on the south by the Beatty Narrows along the Amargosa River, and on the north by a low divide separating Oasis Valley from Sarcobatus Flat (Zdon 2021, p. 8). The Amargosa River, which runs through Oasis Valley, originates at 1,200 m on Pahute Mesa, about 20 km north of Beatty in Nye County. The river flows primarily underground southward, westward, and then northward over 290 km and reaches its terminus near Badwater in Death Valley, Inyo County, California (Bleich 2021, p. 9). See Figure 2.

Figure 2. The Amargosa River (from Williams et al. 1984 and Bleich 2021). Sections that do not support perennial surface flows in the absence of substantial rainfall events are shown with a broken line, and sections normally supporting surface water are shown with a solid line.
Although ephemeral for much of its length, the Amargosa River channel includes portions in Oasis Valley that have permanent surface water due to numerous springs and seeps (NDOW 2000, p. A-1; Soltz and Naiman 1978 cited therein). Many spring sources and seeps, some of which provide extensive wetted outflow systems, also occur in associated ephemeral tributary drainages. However, these only connect with the Amargosa River main channel during storm events or high precipitation years. Although upland benches and ephemeral river portions are typical of the surrounding transitional zone between Mojave desert scrub and Great Basin desert scrub ecotypes, Oasis Valley’s permanently wetted channel and extensive springs and seeps complex represent a unique ecological situation (NDOW 2000, p. A-1).

Oasis Valley is described as being part of the “Pahute Mesa-Oasis Valley Groundwater Basin” (Jackson et al. 2021, p. 3). See Figure 3. About half of the basin’s recharge comes from the eastern Pahute Mesa Area and the rest comes primarily from other highland areas including Timber Mountain, Belted and Kawich Ranges, and Black Mountain (Jackson et al. 2021, p. 1). Recharge is predominantly due to diffuse percolation of water greater than 1,000 years old. The other (minor) recharge component is episodic pulses of modern water, seen as a rise in water levels between 3 months and 1 year after a wet winter (Jackson et al. 2021, p. 54). Over 98% of natural groundwater flow in the Pahute Mesa-Oasis Valley basin is estimated to discharge from springs and seeps in Oasis Valley (Jackson et al. 2021, p. 52). Discharge is thought to be controlled by the general thinning of volcanic rocks toward Oasis Valley and their termination against siliciclastic rocks of low permeability cropping out near Oasis Valley. The siliciclastic rocks prevent southward flow and force groundwater to rise through faults in the Oasis Valley area (Jackson et al. 2021, p. 52 and references therein). It is estimated that 5,900 acre-feet/year (afy) of groundwater is discharged in Oasis Valley through springs, or by diffuse upward flow into shallow alluvium with phreatophytes subsequently evaporating or transpiring the water. The remaining natural discharge in the Pahute Mesa-Oasis Valley basin is through subsurface outflow in alluvium from Oasis Valley to the Amargosa Desert and is estimated to be about 80 afy (Jackson et al. 2021, p. 52; Reiner et al. 2002 p. 41). According to Jackson et al. (2021, p. 46), only minor amounts of surface and groundwater flow occur into and out of the Pahute Mesa-Oasis Valley basin.

However, there is uncertainty as to the amount of flow between Sarcobatus Flat and Oasis Valley. In the Death Valley regional groundwater flow system v. 2.0 model, the boundary between the two basins is not given an interbasin flow value, but the boundary is marked as having “high potential to transmit groundwater” (Belcher et al. 2017, p. 36). In developing their hydrologic model for the North Bullfrog Mine, HydroGeoLogica found “interpolated groundwater elevation contours show a component of flow from the Sarcobatus Flat South groundwater basin into the north end of the Bullfrog Hills groundwater basin and Oasis Valley, from the Sarcobatus Flat North groundwater basin into the PMOV groundwater basin, and from the Bullfrog Hills groundwater basin into Oasis Valley” (HydroGeoLogica 2023, p. 75, 86). The water budget developed for the North Bullfrog Mine model shows interbasin flow from both North and South Sarcobatus Flat into Oasis Valley (HydroGeoLogica 2023, p. 87).
Figure 3. Pahute Mesa-Oasis Valley groundwater basin (from Jackson et al. 2021, p. 47).
STATUS

Historic and Current Distribution and Abundance

Limited populations of Oasis Valley speckled dace exist in springs and outflows within Oasis Valley, Nevada, including portions of the Amargosa River (NDOW 2012, p. S-34). There is no historical survey data that the petitioners are aware of.

A long-term population monitoring program for the Amargosa toad was initiated by Nevada Department of Wildlife in 1998 (USFWS 2010a, p. 42041), and Oasis Valley speckled dace sightings and numbers are included in some of the annual toad monitoring reports. From 2015-2017, five locations of speckled dace occurrences were documented in the Oasis Valley, at Springdale, Parker Ranch, Torrance Ranch, Brackenbury Ranch (TNC 7J Ranch), and Roberts Field (NDOW 2015, entire; 2016, entire; 2017, p. 1-3; 2023, p. 6). Oasis Valley speckled dace relative abundance and occurrence surveys were conducted in 2015 at Torrance Ranch (NDOW 2015, entire); in 2016 at Parker Ranch (NDOW 2016, entire); and in 2017 at Springdale and TNC 7J Ranch (NDOW 2017, p. 1-3); speckled dace were also found extant in Roberts Field in 2017 (NDOW 2017, p. 1). During 2021 surveys related to the North Bullfrog Mine project, 13 springs with speckled dace were documented in the Oasis Valley (Westland 2023, entire). See Figure 7 below.

Springdale

Springdale is known to have 1 acre of suitable habitat for the Amargosa toad; it is unclear how much of this habitat is suitable for speckled dace. June 2017 speckled dace surveys by the Nevada Department of Wildlife (NDOW 2017, p. 2) captured 680 Oasis Valley speckled dace at Springdale above the bass pond, with an average catch per unit effort (CPUE) of 30.40; speckled dace averaged 32.54 mm in length (SD = 5.8 mm; range = 22 – 50 mm; n = 50). As of 2010, this site had undergone habitat improvements such as the removal of salt cedar (USFWS 2010a, p. 42043). The Springdale site was recently purchased by the mining company AngloGold Ashanti and will apparently be used for ecological and historical preservation (Pahrump Valley Times 2023a, p. 3). However, it seems reasonable to assume that, should the need arise, the company will use the site for its North Bullfrog Project mining operations located approximately 2 miles west (see below). Most importantly, as discussed below, AngloGold Ashanti has predicted that groundwater drawdown due to the North Bullfrog Project will be approximately 13 feet (4 meters) at Springdale Spring (see Gold Mining section in Threats, below).

TNC 7J Ranch

A ranch formerly called Coffer Ranch (USFWS 2010a, p. 42043) and then Brackenbury Ranch, was subsequently acquired by The Nature Conservancy (TNC) and became TNC 7J Ranch (NDOW 2023, p. 1), and then The Gary and Lajetta Atwood Preserve. However, for consistency with other recent reports, we use the name 7J Ranch in this petition. This site covers 900 acres (USFWS 2010a, p. 42043). At the Upper 7J Ranch, discharge from Suzie Kimball Spring was diverted into a pond constructed of native fill in the early 1900s. Annual discharge was approximately 1,090 afy prior to the impoundment, and less than 200 afy in the 1960s (DRI 2023, p. 26). June 2017 speckled dace surveys by NDOW (2017, p. 2-3) captured 1,730 Oasis Valley speckled dace in Brackenbury Ranch, at Brackenbury Spring (which is a fenced-off spring); with an average CPUE of 56.24, and average length of 44.82 mm (SD = 7.8 mm; range = 31 – 70 mm; n = 50). Surface water flow was recently observed in the area immediately downgradient of the pond, and along two braided swales, but the rate of discharge was not
reported. Following acquisition of the ranch by TNC in 2019, cattle grazing practices have been modified but cattle have not been eliminated (DRI 2023, p. 26). Invasive plants have also been removed but not eliminated (Ibid). At the Lower 7J Ranch, surface features include (but not may be limited to) diffuse seepage and several springs with discrete discharge points. Invasive plants occur at the site. Surveys at TNC 7J Ranch in 2017 also found invasive crayfish, gambusia, and bass.

Torrance Ranch
130-acre Torrance Ranch was purchased by TNC in 1999 to protect the Amargosa toad and to allow for experimental habitat management for the benefit of the toad. As of 2010, TNC was a conservation partner with the U.S. Fish and Wildlife Service and NDOW and had taken part in Amargosa toad habitat improvements projects (USFWS 2010a, p. 42043). May and June 2015 speckled dace surveys by NDOW (2015, entire) documented Oasis Valley speckled dace at Torrance Ranch. On May 20, a total of 16 Oasis Valley speckled dace were captured and marked (CPUE = 0.71) in the lower spring; in the upper spring, a total of 118 Oasis Valley speckled dace were captured and 95 of those fish were marked (CPUE = 10.98). On June 11, a total of 28 Oasis Valley speckled dace were captured (CPUE =1.75) with six recaptures at the lower spring, producing a population estimate of 74 (34-203, p≤ 0.05). A total of 108 Oasis Valley speckled dace were captured (CPUE = 8.85) in the upper spring with 38 having marks. The population at the upper spring was estimated at 270 (196-382, p≤ 0.05). The mean total length was 44.2 mm in the lower spring and 51.3 mm in the upper spring. A total of 92 crayfish were removed from the lower spring and 122 were removed from the upper spring during trap events.

Restoration work at Torrance Ranch has included a prescribed burn, removal of invasive species, fencing to exclude cattle and burro grazing, restoration of natural topography, and planting of riparian trees (DRI 2023, p. 33). However, approximately 350 ft east of Torrance Ranch, is a site referred to by DRI 2023 as Torrance Ranch East, centered around an unnamed spring associated with the Goss spring complex. The ownership of the land is unclear, but the spring system has been the subject of repeated but unsuccessful efforts to restore historically degraded Amargosa toad habitat, and the site has clear evidence of extensive grazing and numerous invasive species. Nearby compacted road surfaces and other features appear to also be causing several localized areas of active head cut (DRI 2023, p. 35, 37).

Parker Ranch
This site covers 24 acres and was purchased by TNC in 2000 for the protection and restoration of unique biological resources, including Amargosa toad habitat. The site includes Ute Spring and is located approximately 4 miles (6.4 km) north of Beatty. Restoration efforts on the property centered around the construction of several ponds in 2003 to restore open water and aquatic habitat. What had previously been a single large man-made fishing pond was reconstructed into a series of smaller ponds with a network of engineered channels and swales extending downgradient towards the Amargosa River. Additional restoration work was also conducted by TNC in subsequent years. 2016 speckled dace surveys by NDOW (2016, entire) documented Oasis Valley speckled dace at Parker Ranch. On May 26 a total of 47 Oasis Valley speckled dace were captured and marked (CPUE = 1.68). On June 9 a total of 55 Oasis Valley speckled dace were captured (CPUE =1.96), with four recaptures, producing a population estimate of 537 (274-1,680, p≤ 0.05). The mean total length was 32.0 mm. Grazing impacts and invasive species were recently observed on-site Parker Ranch (DRI 2023, p. 45-46).
Roberts Field
Unspecified numbers of speckled dace were extant in Roberts Field in 2017 (NDOW 2017, p. 1).

Spring 51
NDOW surveys in 2023 located speckled dace at Spring 51.

Population Trends

As of 2012, NDOW reported that the Oasis Valley speckled dace population trend was stable (NDOW 2012, p. S-34). As of 2022, the population trend was reported as stable and improving, with the species benefitting from restoration actions associated with the Amargosa toad, including the removal of nonnative aquatic species and vegetation (NDOW 2022b, p. 393). However, all locales where Oasis Valley speckled dace are extant appear to be severely jeopardized by groundwater drawdown from proposed gold mining operations. While collaborative conservation efforts in Oasis Valley have resulted in tangible habitat improvements, all of the habitats are imminently jeopardized and will cease to have habitat value for the Oasis Valley speckled dace if dewatered by gold mining.
CRITERIA FOR ENDANGERED SPECIES ACT LISTING

Oasis Valley Speckled Dace is a DPS which qualifies as a Listable Entity 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, entire), 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, p. 4725).

Discreteness

The Oasis Valley speckled dace meets the discreteness requirement of a DPS due to the significant geographic distance between and isolation from other populations of Amargosa speckled dace, and the resultant genetic differentiation between the populations. See Figure 4.

It is 40 miles from the southern end of Oasis Valley to the northern end of Ash Meadows National Wildlife Refuge, across the sandy, mostly flat Amargosa Desert. There is no perennial hydrologic connection between these two speckled dace populations. While Oasis Valley is on the Amargosa River, Ash Meadows is technically a tributary of the river, higher in elevation and to the east of the riverbed. Thus, not only is there no perennial hydrologic connection between Oasis Valley and Ash Meadows, but there is also no connection even during periods of extreme flood. As a result, analyses show clear genetic differentiation between the two populations (Mussmann et al. 2018, p. 110; 2020, p. 7). These two populations are entirely discrete.

It is 80 miles from the southern end of Oasis Valley to the northern end of the Amargosa Canyon. While the trace of the Amargosa River runs between the two directly, it is completely dry across almost that entire length. There is no perennial hydrologic connection between the two habitats. And while flooding in the desert is a relatively commonplace occurrence, floods at such a level that sustain flowing water in the Amargosa River across the 80 miles from Beatty to the Canyon are exceedingly rare. There is genetic evidence that the Amargosa Canyon speckled dace is hybridized between the Ash Meadows and Oasis Valley populations (Mussmann et al. 2018, p. 110; 2020, p. 7). This would indicate some amount of gene flow. However, this gene flow only occurs one way. During extremely rare flood events, Oasis Valley becomes a source population for dispersing fishes and genetics; but it never receives immigration from other populations. Thus, it is entirely discrete from the Amargosa Canyon population.
Figure 4. Amargosa River and disjunct Amargosa speckled dace populations.

Oasis Valley is approximately 100 miles from Fish Slough in the Owens Valley. There has not been a hydrologic connection, or resultant genetic exchange, with the Amargosa speckled dace there since the Pleistocene. Thus, it is discrete from the Owens Valley population.

Significance

(1) Persistence of the discrete population segment in an ecological setting unusual or unique to the taxon;

Each of the four populations of Amargosa speckled dace occur in unique ecological settings. There are distinct patterns of hydrogeology and biogeography which define the habitats of each population of these fish.
Oasis Valley is a broad valley defined by the Bullfrog Hills to the west and the Bare Mountains to the east. It derives its name from the dozens of springs which emanate from the base of the hills on either side of the valley. The valley has a flat bottom, where discharge from the springs collects and feeds marshes and wetlands. While there are portions of the Oasis Valley that have perennial flow (in particular the Narrows in the town of Beatty), in general Oasis Valley does not have a surface river flowing through it. Most of the major springs in the valley have spring pools and water flowing out through channels toward the Amargosa River’s channel. But in the channel itself, it is mostly marsh and wetland habitat (DRI 2023, pp. 26, 29-30, 31-33, 35-37, 45-46). Thus, many of the Oasis Valley speckled dace habitats are isolated from one another even within Oasis Valley. All of the known occurrences of speckled dace in Oasis Valley are at or near spring heads (see Figure 7 below). And while during times of flood there is likely genetic communication between these occurrences, in general they are fairly isolated and discrete. By contrast, in Ash Meadows and the Amargosa Canyon the speckled dace occur primarily in linear stretches of water – channels and sloughs and the Amargosa River itself (Scoppettone 2012, p. 11-13; Stillwater Sciences 2021, p. 5, 8). The Oasis Valley speckled dace, living in springs and their immediate outflow, has a fundamentally different life history than the other Amargosa populations, whose habitat is more pluvial. This makes the Oasis Valley population significant in its uniqueness in relation to other habitats where the subspecies is found.

Oasis Valley is also higher elevation than the other two Amargosa populations, at 3,500 ft., compared to 2,000 ft. at Ash Meadows and ~1,200 ft. at the Amargosa Canyon. This means Oasis Valley has an appreciably different climate than the other two populations, with colder winters, cooler summers, and significantly higher precipitation, including snow.¹ These climactic differences likely result in different physiological adaptations to different temperature regimes – more research is needed to establish this. Nonetheless, they are clear indicators of the significance of the Oasis Valley habitat in relation to other habitats where the subspecies is found.

Oasis Valley’s waters are derived from a volcanic rock aquifer; whereas the other two Amargosa River Basin populations in Ash Meadows and Amargosa Canyon have water derived from a carbonate rock aquifer (Halford and Jackson 2020, p. 81). This means there are distinct geochemical signatures to the water discharging at the springs in Oasis Valley (Zdon et al. 2015, p. 353-354). We cannot know the exact effects that unique water geochemistry can have on the evolutionary patterns and life histories of the fish in those waters. However, there is evidence that water geochemistry does influence fish development – and geochemical signatures can be found in fish scales (Ramsay 2015, p. 17). The geochemistry of the spring discharge in Oasis Valley is unique among the four Amargosa speckled dace populations and thus contributes to its significance.

The Owens Valley speckled dace’s habitat is clearly unique and unusual for the taxon, being in a different watershed than the other 3 populations. On its own, this makes the Owens Valley speckled dace unique from the Amargosa River Basin populations, including the Oasis Valley population.

¹ For instance, Beatty, NV’s weather station average July daily maximum temperature is 99.4°F, compared to 103.5°F in Amargosa Valley, NV (site of Ash Meadows); average annual precipitation in Beatty is 6.26”, compared to 3.77” in Amargosa Valley. (Data per NOAA 2024, entire). Directly comparable data is not available however the Community Environmental Monitoring Project (2024, entire) station in Tecopa records shows average annual precipitation of 3.5” and average July daily maximum temperature of 109.5°F.
(2) Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon;

The Amargosa speckled dace lives in four discrete habitats. The loss of any one of these populations would significantly contract the range of the taxon, by eliminating one of four unique and discrete habitats. The Oasis Valley population is also significant because it is the population furthest upstream in the Amargosa River Basin. It is a source of genetic material for the downstream population in the Amargosa Canyon. The loss of the Oasis Valley population would eliminate crucial gene flow into an otherwise isolated population in the Amargosa Canyon. The loss of the Oasis Valley speckled dace would contract the known range of the subspecies within the Amargosa River Basin by 40 miles.

(3) Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historical range; or

N/A

(4) Evidence that the discrete population segment differs markedly from other populations of the taxon in its genetic characteristics.

There is substantial evidence that the Oasis Valley population has genetic differentiation from the other populations. The evidence (Mussman 2018, p. 110; Mussmann et al. 2020, p. 7; Su et al. 2022, p. 706-707; Moyle et al. 2023, p. 522) shows genetic distinction of Oasis Valley speckled dace from other DPS of Amargosa speckled dace, and from all other species and subspecies of speckled dace, as discussed in detail above in the section on taxonomy. 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.

Thus, because the Oasis Valley speckled dace is isolated and genetically discrete, it meets the discreteness requirement to qualify as a DPS, and due to genetic, ecological, and range criteria, it meets the significance requirements and is a listable entity under the Act. This DPS is at risk of extinction and qualifies for listing, as detailed in the following threats discussion.
THREATS

Factor 1: Destruction, Modification, or Curtailment of Habitat or Range

Gold Mining

There are currently seven gold mining projects in the vicinity of Oasis Valley speckled dace habitat in the Oasis Valley and along the Amargosa River. These include Zacapa’s South Bullfrog project, Augusta’s Bullfrog and Reward projects, and AngloGold Ashanti’s Expanded Silicon, North Bullfrog, Sterling and Mother Lode projects (Zacapa Resources 2023, p. 2-3). The Sterling project includes the Sterling, Daisy, Secret Pass and SNA deposits, the North Bullfrog project includes the Mayflower, Jolly Jane and Sierra Blanca Complex (not labelled) deposits, and the Bullfrog project includes the Bullfrog, Bonanza Mountain and Montgomery-Shoshone deposits. The red broken lines correspond to Zacapa’s South Bullfrog project exploration targets. The Silicon project and Merlin deposit form part of what is now known as the Expanded Silicon project. See Figure 5.

![Gold mining projects in the Beatty district](Zacapa Resources 2023, p. 3)

Figure 5. Gold mining projects in the Beatty district (Zacapa Resources 2023, p. 3)
The approximate locations of the 7 projects (North Bullfrog, Bullfrog, South Bullfrog, Reward, Mother Lode, Sterling and Expanded Silicon) relative to the Oasis Valley speckled dace range are shown in Figure 6. Open pit mining is anticipated to occur at most if not all projects, with devastating consequences for the scarce spring and riparian habitat for Oasis Valley speckled dace. The specifics of each project are described first, followed by a discussion of water resource impacts and other potential effects on Oasis Valley speckled dace.

Figure 6. Map of Oasis Valley speckled dace habitat and Beatty district gold mining projects. Map by CBD using data from Westland 2023

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2 The location of the projects is approximate and based on the following sources: (a) North Bullfrog (AngloGold Ashanti 2022, p. 197); (b) South Bullfrog (Zacapa Resources 2021, p. 1); (c) Bullfrog (Augusta Gold 2022a, p. 159); (d) Expanded Silicon (AngloGold Ashanti 2022, p. 201, 203); (e) Mother Lode (AngloGold Ashanti 2022, p. 210); (f) Reward (Augusta Gold 2022a, p. 15, 159); (g) Sterling (AngloGold Ashanti 2022, p. 210). The Sterling project is represented as two separate projects, “Secret Pass deposit (Sterling project)” and “Sterling deposits (Sterling project)” as individual deposits are spread over a distance of approximately 10 km and it seems likely that more than one mine could be built.
The South Bullfrog project is a gold exploration project acquired by Zacapa Resources in 2020 through claim staking (Zacapa Resources 2023, p. 2, 4). The property is located on BLM land, directly adjacent to the western and northern town boundaries of Beatty, and is centered on 36°56'46" N, 116°45'33" W (Zacapa Resources 2021, p. 1; Zacapa Resources 2023, p. 6). It comprises 488 contiguous unpatented mining claims covering an area of almost 10,000 ha (Zacapa Resources 2021; Zacapa Resources 2023, p. 2-3). The company completed the first phase of its initial exploration program in March 2022 (Zacapa Resources 2022, p. 3), and in February 2023, announced that it had received approval from the BLM for its Notice of Intent for proposed drilling activities at the project’s Longtail prospect. This together with a previously obtained permit for the Shingleback prospect was reported to complete permitting activities for an inaugural 3,000 meter drill program at the project (CNW Group 2023, p. 2). Little is known about prior exploration at the property but some has taken place (CNW Group 2023, p. 4).

The Reward project is an open-pit heap leach gold mining project acquired by Augusta Gold in 2022. Located 11.3 km (7 miles) south-southeast of Beatty (Augusta Gold 2022a, p. 2; Augusta Gold 2022b, p. 1; Augusta Gold 2023a, p. 4), at approximately 36°50'16" N, 116°42'02" W (Augusta Gold 2022a, p. 15, 159), the project encompasses 127 mining claims totaling approximately 944 ha, mostly on BLM land (Augusta Gold 2022a, p. 3). There are two deposits (Good Hope and Gold Ace), as well as additional exploration targets (Augusta Gold 2023b, p. 10). The company recently claimed to have “all major federal and state permits in place, sufficient water rights for construction and operation, and existing power supply to the project site” (Augusta Gold 2023a, p. 2). The project’s feasibility study was said to be scheduled for completion in Q4/2023, with production planned for late 2024 (Augusta Gold 2023a, p. 2). Prior to the Reward project’s acquisition by Augusta Gold, historical exploration of the project had been completed by several other companies (Augusta Gold 2022a, p. 5).

The Bullfrog project is another open pit heap leach gold mining project owned by Augusta Gold (Augusta Gold 2023b, p. 4), which began exploration in 2020 (Augusta Gold 2022c, p. 15). The project is located 4 miles west of Beatty (Augusta Gold 2022c, p. 11, 65), at approximately 36°53'53" N, 116°49'02" W (Augusta Gold 2022a, p. 159), and is anticipated to share infrastructure with the Reward project, located 7 miles away (Augusta Gold 2023b, p. 4). The project includes three deposits: Bonanza Mountain, Bullfrog and Montgomery-Shoshone (Augusta Gold 2023b, p. 15), and two additional exploration targets, with drill plans in place for one of the targets (Augusta Gold 2023b, p. 16, 18). According to the company, a mine plan of operation (POO) is expected for mid-2024 (Augusta Gold 2023a, p. 3-4). Historically, the Bullfrog project was open pit and underground mined from 1989-1999 (Augusta Gold 2022c, p. 24).

The Silicon project is an open-pit heap leach gold mining project acquired by AngloGold Ashanti in 2020. The project is located approximately 12 km east of Beatty, at approximately 36°57'26"N, 116°38'45"W, and currently comprises 950 mining claims on BLM lands (AngloGold Ashanti 2022, p. 201, 203). A plan of operations (POO) for exploration activities was submitted to BLM in 2019 (AngloGold Ashanti 2023a, p. 35) and a first-time mineral resource was reported for the Silicon deposit in 2021 (AngloGold Ashanti 2023b, p. 2). A prefeasibility study began in 2022 (AngloGold Ashanti 2023a, p. 36) but was rolled back to incorporate the Merlin deposit (also situated within the Silicon claim block), in a conceptual study for the so-called Expanded.
Silicon project (AngloGold Ashanti 2022, p. 205; AngloGold Ashanti 2023a, p. 36). Submission of a new mining POO is anticipated for late 2024 to early 2025 (AngloGold Ashanti 2023c, p. 20). In February 2024, it was reported that the Expanded Silicon project has a mineral resource of 13.3 million ounces, including a 9.1 million ounce inferred resource at Merlin. The latter is believed to represent the largest greenfield gold discovery in the US in more than a decade (Webb 2024, p. 3). Project infrastructure for the Expanded Silicon Project is anticipated to include 2 pits, a waste dump of around 16 km² and processing facilities, including a 3-stage crushed leach facility, run of mine ore leach extension and an adsorption desorption and recovery plant. Support infrastructure will include a fresh water supply system (including pipeline and pump stations), an electrical energy supply system, new roads and road upgrades, maintenance facilities, as well as a pit dewatering system (AngloGold Ashanti 2023a, p. 30).

Mother Lode
The Mother Lode project is an open-pit gold mining project acquired by AngloGold Ashanti in 2022. The property is located approximately 10 km east of Beatty, at 36°54′27″N, 116°39′10″W, and comprises 13 mining claims. The project was mined from 1989 to 1991, with further exploration in later years. A mineral resource estimate was reported by Corvus Gold in 2020 (AngloGold Ashanti 2022, p. 208, 210, 212), and updated by AngloGold Ashanti in 2022 (AngloGold Ashanti 2022, p. 209-208). The project area currently includes a reclaimed overburden facility and a small open pit. Future project infrastructure will include an expanded open pit, with mineralized material processed on a heap leach pad or in a mill using agitated tank bio-oxidation and cyanidation. Access roads will be upgraded (AngloGold Ashanti 2022, p. 209).

Sterling
The Sterling project is a past-producing open-pit and underground heap leach gold mine acquired by AngloGold Ashanti in 2022. The mine is currently in care and maintenance but has a valid mining permit with a permitted heap leach pad expansion area (AngloGold Ashanti 2022, p. 214). The mine is located 14 km southeast of Beatty (AngloGold Ashanti 2022, p. 194), at approximately 36°49′39″N, 116°38′36″W. The Sterling project also includes 3 deposits (Daisy, Secret Pass and SNA) suited to open-pit mining (AngloGold Ashanti 2022, p. 214), located 6-9 km east of Beatty (AngloGold Ashanti 2022, p. 194, 210), at approximately 36°53′26″N, 116°40′53″W. AngloGold Ashanti plans to process mineralized material from these deposits either on a heap leach pad or in a mill (AngloGold Ashanti 2022, p. 215). Both Daisy and Secret Pass were mined during the 1990’s (AngloGold Ashanti 2023c, p. 18). A mineral resource was inferred for the Daisy, Secret Pass and SNA deposits by AngloGold Ashanti in 2022 (AngloGold Ashanti 2022, p. 217).

North Bullfrog
The North Bullfrog project is an open-pit gold mining project acquired by AngloGold Ashanti in 2022 and the most advanced gold mining project in the vicinity of the Amargosa toad’s habitat. The project is located approximately 14 km northwest of Beatty, at 37°01′45″N, 116°47′59″W (AngloGold Ashanti 2022, p. 194-195, 197). The project area covers ~6,292 acres, with 5,396 acres (85%) on BLM land and 896 acres (15%) on private lands controlled by AngloGold Ashanti (EM Strategies 2023, p. 1). A first-time mineral resource was declared in 2022 (EM Strategies 2023, p. 194) and the BLM is currently seeking public comment to inform its EIS for the project (DOI-BLM-NV-B020-2024-0019-EIS) (BLM 2024a, p. 2).

According to the POO, the project will include among other major components: three open pits: the Mayflower, the Jolly Jane, and the Sierra Blanca (with the Sierra Blanca Open pit comprised of the Sierra Blanca, Yellow Jacket and Savage Valley areas); four overburden storage areas;
an ore-crushing and conveying system; a gravity mill with cyanide tank leaching; ore and growth media stockpiles; a power sub-station, solar field, and associated distribution system; a heap leach facility with solution channels, associated process solution tanks, and ponds; a water supply well-field and open pit dewatering system (wells, pipelines, and pipeline corridors); stormwater diversion channels and stormwater sediment basins; an ADR plant, refinery, and an assay laboratory; access and haul roads; continued surface exploration (EM Strategies 2023, p. 1-2). The proposed surface disturbance associated with the Project is 3,481.1 acres (EM Strategies 2023, p. 9). Approximately 238 million tons of heap leach ore and 227 million tons of overburden will be mined at the project site, for a total of 465 million tons of mined material (EM Strategies 2023, p. 2). Of the 238 million tons of ore, ten million tons will be processed in the gravity mill prior to recovery on the heap leach pad, with the heap leach ore. Both ore and waste will be extracted from the open pits using conventional open pit mining methods (drilling, blasting, loading, and hauling). After recovery on the heap leach pad, further processing will occur, including at the adsorption desorption and recovery plant (EM Strategies 2023). The total mine life will be 20 years: approximately one year of “pre-mining” and construction, followed by 12 years of active open pit mining, followed by 2-3 years of active gold recovery on the heap leach pad and mine reclamation activities, followed by 3-4 years of heap rinsing, reclamation and closure activities (EM Strategies 2023, p. 42).

The annual mine water supply demand is estimated to range from 450 to 1,600 gallons per minute (gpm) (726 to 2581 afy) over a period of approximately 16 years to support mine construction, operations and closure (EM Strategies 2023, p. 31). The main demands will come from: the gravity mill, the ADR plant, the heap leach facility, construction for heap leach pad expansions, the crushing and screening plant, mine facilities such as water for dust suppression, operational drilling water, a truck wash, fire water and potable water. However, most of the demand will be associated with make-up water supply to the HLF and associated processing (EM Strategies 2023, p. 32). The project’s primary water supply will be the mine’s dewatering operation, and specifically dewatering associated with the Sierra Blanca open pit (EM Strategies 2023, p. 31). Open pit dewatering is required when a pit extends below the water table to keep the mine dry, and is typically achieved using in-pit pumps or vertical dewatering wells installed around the perimeter of the mine pit (Bozan et al. 2022, p. 1). At the Sierra Blanca pit, groundwater level is estimated at approximately 3,890 feet above mean sea level (amsl) pre-mining and 3,610 feet amsl post-mining – a difference of 280 feet (85 m). Dewatering is also planned at the Jolly Jane pit as mining is anticipated to reach 85 feet (26 m) below the pre-mining water table of 3,890 feet amsl (EM Strategies 2023, p. 14). The mine dewatering system is anticipated to include up to seven pit perimeter wells and one in-pit sump, with fewer pumping wells operating at the start of the open pit development. Peak groundwater dewatering is expected to occur during the final year of mining at the Sierra Blanca Open Pit at a pumping rate of around 820 gpm (1323 afy) (EM Strategies 2023, p. 14).

The other main source of water for the mine will be groundwater obtained through a proposed wellfield in the northwest corner of the project area, in the Sarcobatus Flat hydrographic basin (EM Strategies 2023, p. 31). The project straddles the boundary between Sarcobatus Flat hydrographic area (Basin 146) and Oasis Valley hydrographic area (Basin 228) (HydroGeologia 2021, p. 32). The six planned wells have individual pumping capacities between 250 and 400 gpm (403-645 afy) and AngloGold Ashanti is currently permitted to withdraw 1,277 afy from Basin 146 (EM Strategies 2023, p. 31). Additional mine water will also be supplied from meteoritic waters from ponds downstream of project facilities: (i) meteoric water accumulating within lined pond downstream of the crusher, stacker, and conveyor; (ii) meteoric water accumulating onto the heap leach or processing facilities (EM Strategies 2023, p. 32).
Figure 7. North Bullfrog Project impact zones and special status species locations (Westland 2023)
For the North Bullfrog Mine, Westland (2023, entire) created a map showing 2021 species surveys overlaid with the North Bullfrog Mine project, and 12 springs with speckled dace have been documented within the mining groundwater drawdown area or nearby in the Oasis Valley. See Figure 7 above. Two locations are within the ten-foot drawdown contour of the mining project, and two more locations are within the one-mile buffer. The mining company behind the North Bullfrog Project (the most advanced gold mining project in Oasis Valley currently) has predicted there will be approximately 13 ft (4 m) of drawdown at Springdale Spring (which they recently acquired) and around 3 ft of drawdown at Lower 7J Ranch, both locations with speckled dace (Hydrogeologica 2023, p. 99-104).

**Groundwater Quantity Impacts**

The North Bullfrog project and other mining projects in Oasis Valley have the potential to impact groundwater availability in Oasis Valley speckled dace habitat due to three main processes: 1) groundwater pumping, 2) pit lake development, and 3) diversion and/or collection of surface water.

**Groundwater Pumping**

Gold mines require a significant amount of water for construction, operations and closure. The exact amount of water required largely depends on the processing method and the amount of material to be mined (University of Arizona 2024, p. 2), with water uses such as dust suppression common across mines. Another important factor is the extent of water reuse.

Based on our review of the gold mining projects near Beatty, most if not all will involve a heap leaching operation. Similar water use requirements as at the North Bullfrog project may therefore apply, per ton of material mined. Water at the various mines will also likely be supplied through a combination of production wells and dewatering wells (collectively “pumping wells”) as open pit mining is planned for most projects and a portion of the pits will likely extend below the water table.

With the onset of groundwater pumping, water levels around the mines will begin to decline, causing hydraulic gradients that induce radial flow towards the pumping wells. Cones of depression will develop around the wells and grow until the recharge rates are in balance with the pumping rates. The drawdown may intercept water that would otherwise be discharged at springs (Nye County 2004, p. 25), or support groundwater dependent vegetation. See Figure 8. Once the pumping ceases, water will continue to flow towards the wells but start to replenish the drawdown cones created by the pumping. The top of the cones will continue to expand even as the tip of the cones recover because gradients toward the wells are still required to drive the flows. Water levels at the wells initially recover quickly because there is little volume at the tip of the cones but in the long term, the remainder of the cones recover slowly because the flow gradients will have decreased so that fluxes toward the cones decrease (Myers 2011, p. 11). Thus, groundwater dependent ecosystems may continue to be affected by the mining projects long after mining has ceased.
Figure 8. Impact of groundwater withdrawal on springs: (A) Natural hydrologic system is in balance; (B) Water levels are lowered in the vicinity of the pumping wells; (C) The area of decline expands outward from the pumping wells; (D) Wells’ areas of influence reach groundwater feeding springs, causing a decline in discharge rates; (E) Springs dry up. Adapted from Nye County 2004, p. 25.

A hydrological analysis by Roux, Inc (2024, *entire*) further illustrates the risk from groundwater pumping for gold mining to aquatic river and spring habitats for the Amargosa toad, and for Oasis Valley speckled dace. This analysis is a preliminary conceptualization of the potential effects to groundwater-dependent ecosystems in the Beatty area from groundwater pumping associated with the North Bullfrog project and other gold mining projects in the Oasis Valley region. Included in the analysis are 4 of the 7 existing gold mining projects (including North Bullfrog)\(^3\), and three different groundwater pumping scenarios with a pumping period of 15 years and an equally long recovery period. In the first scenario, with total pumping equal to 1,000 afy (i.e. less than half the maximum annual mine water supply demand at the North Bullfrog Project), >1 feet of drawdown is observed along the Amargosa River between approximately the town of Beatty and Parker Ranch, and around the Springdale site (Roux 2024, p. 4). In the second scenario, with total pumping equal to 2,500 afy (i.e. approximately equal to the maximum annual mine water supply demand at the North Bullfrog Project), drawdown in the Beatty area has increased to ≥ 10 feet, with drawdown of 1-10 feet further north. See Figure 9. The footprint of the cone of depression continues to expand, primarily northeastward toward upper Oasis Valley hydrographic basin, after 15 years of recovery (Roux 2024, p. 5). For this scenario, it was also estimated that the integrated discharge to the Amargosa River in the Beatty area would be reduced by almost a fifth (17%) at the end of 15 years (Roux 2024, p. 7, 9). The third scenario assumes each mining project extracts 3,000 afy annually, resulting in a drawdown of 10-50 feet in the Beatty area and a more expansive cone of depression (Roux 2024, p.6). Residual drawdown in the amount of 10 feet or more also remains along significant reaches of the Amargosa River after 15 years of recovery (Roux 2024, p. 7).

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\(^3\) For an explanation of the mining project selection for the analysis, see Roux 2024, p. 3.
The principal concern related to the potential groundwater extraction pumping projects, due to existing and planned mining operations in the Beatty area, are impacts to springs and particularly the “gaining” reaches of the Amargosa River. As observed in each of the scenarios, groundwater drawdown is observed throughout much of Oasis Valley hydrographic basin, with substantial drawdown observed along the trace of the Amargosa River (Roux 2024). This indicates that reductions in spring flow and Amargosa River flow would likely be substantial under these scenarios, affecting the extent of surface water along the Amargosa River, and reducing spring flows (Roux 2024).

The Roux memorandum is intended to be illustrative rather than definitive. The exact amount of water to be abstracted for future gold mines around Beatty is unknown, and the pumping amounts given in Scenarios 1 and 2 are very conservative. Additionally, the simulated groundwater extraction at the North Bullfrog Mine was assumed to be either 250 or 3,000 afy (rather than ranging from 726 to 2,581 afy, as prescribed in the POO) and to occur in Oasis Valley only (rather than Oasis Valley and Sarcobatus Flat)4. Thus, while not perfectly mirroring the mines as they are developing, it is clear from this analysis that the combined impact from multiple mining projects to springs and groundwater dependent ecosystems (shown on Figure 10, and Figure 8 in the Roux analysis) will be substantial and will likely drawdown the River while degrading or eliminating Oasis Valley speckled dace habitat.

Figure 9. Drawdown scenario with 2,500 acre-feet of pumping. This is Scenario 2 from Roux 2024 (p. 5) (Appendix B) depicting cumulative drawdown in Oasis Valley due to pumping from four mines. Widespread drawdown of 5-10 feet is observable along the length of the Amargosa River. Actual pumping from these mines will be much higher.

4 The amount of interbasin flow from Sarcobatus Flat to Oasis Valley is uncertain, but pumping in Sarcobatus Flat could potentially significantly impact water levels in Oasis Valley.
The risk to these resources from groundwater extraction associated with the North Bullfrog Project specifically is also apparent to some degree from AngloGold Ashanti’s own hydrological modelling. The baseline hydrogeology report for the project (HydroGeoLogica 2023) describes the estimated changes in drain discharges (representing baseflow, spring flow, and evapotranspiration) due to pit dewatering and wellfield pumping. Discharge is reduced by 7%, or 408 afy, in the upper reach of the Amargosa River above the confluence with the unnamed drainage south of Springdale Spring (shown on Figure 11), and reduced by ~10%, or 28 afy, in
the unnamed drainage south of Springdale Spring, upgradient from the confluence with the Amargosa River (HydroGeoLogica 2023, p. 112-113).

Figure 11. Map showing “confluence” of the Amargosa River with the unnamed drainage south of Springdale Spring (unlabeled blue dot). Adapted from HydroGeoLogica 2023, p. 654.
While the maximum extent of drawdown is only delineated for 10 ft (3 m) (HydroGeoLogica 2023, p. 114), the analyses also show that drawdown will be approximately 13 ft (4 m) at Springdale Spring (HydroGeoLogica 2023, p. 114), and approximately 3 ft (0.9 m) and 3.3 ft (1 m) at points along the Amargosa River, approximately 3 km (1.9 mi) and 4 km (2.5 mi) respectively, upstream from the confluence with the unnamed drainage south of Springdale Spring (HydroGeoLogica 2023, p. 114 and 655) (Figures 12 and 13). The Amargosa River locations approximately correspond to the Lower 7J Ranch. Approximately 1 foot (0.3 m) of drawdown is estimated near Colson Pond (HydroGeoLogica 2023, p. 114), which is located on the Upper 7J Ranch. Even a small amount of drawdown may potentially dry up lower flowing springs or increase the amount of time a spring stays dry due to natural variability (Myers 2011, p. 7). As noted in Currell 2016a (p. 3):

> It is quite possible for a spring (or a gaining stream) to experience minimal drawdown, but for the flow of water from the aquifer to the surface to decrease or even cease entirely. For this reason, by the time 20cm of drawdown has been noticed at the Doongmabulla Springs – which are located about 8 kilometres from the mine site – it is likely that the flow directions and water budget will have been fundamentally changed, and possible that the springs may ultimately cease to flow, as has occurred in many other parts of the Great Artesian Basin.

Due to the Oasis Valley speckled dace’s rarity and dependence on springs and spring-fed habitat to fulfill its life history requirements, even a small reduction in spring discharge could be catastrophic for the species. A smaller amount of spring habitat would support fewer dace by offering fewer resources for the population. If the amount of surface water decreases, temperatures and the concentrations of pollutants may increase while oxygen levels decrease (USFWS 2010b, p. 35405). Further, loss of spring habitat reduces opportunities for habitat niche partitioning and the ability of different species to coexist, particularly in the presence of non-native species (USFWS 2010b, p. 35405).

Even modest amounts of drawdown could dry up Oasis Valley speckled dace habitats, especially over the long term. Capture is a term that refers to the loss of discharge from an aquifer, through surface expression or evapotranspiration, due to groundwater drawdown. While initial response to pumping occurs through depletions to aquifer storage, over the long term, up to 85% of groundwater depletion expresses through capture of surface discharge (Konikow and Leake 2014, p. 8). As pumping occurs, surface discharge and evapotranspiration are captured, resulting in the desiccation of moist soils and mortality of phreatophytic vegetation (Bredehoeft 2011, p. 809). Declines in groundwater levels of one foot would result in a linear reduction in evapotranspiration from phreatophytes (Bredehoeft and Durbin 2009, p. 4). During monitoring elsewhere in the Amargosa Basin, groundwater levels at a monitoring well in Chicago Valley decreased 1.6 feet over a 6-year period (Zdon 2020, p. 41), which coincided with the adjacent Twelvemile Spring going functionally dry (Personal obsv., P. Donnelly, 2020).
Figure 12. Location of the approximately 3 ft drawdown location along the Amargosa River 3 km upstream from the confluence with the unnamed drainage south of Springdale Spring. Adapted from HydroGeoLogica 2023, p. 655.
Figure 13. Location of the approximately 3.3 ft drawdown location along the Amargosa River 4 km upstream from the confluence with the unnamed drainage south of Springdale Spring. Also shown is Colson Pond. Adapted from HydroGeoLogica 2023, p. 656.
There is the additional issue of groundwater flux as it pertains to pumping or dewatering. In some cases, groundwater monitoring for drawdown is not necessarily a good indicator of the propensity of a pumping scenario to contribute to capture (Currell 2016b, p. 620). There can be a delay between pumping and the impacts of such pumping as drawdown propagates through a system (Bredehoeft 2011, p. 810). After pumping commences and reductions in aquifer storage result, it creates a cone of depression which will induce flow of groundwater towards its bottom (Currell 2016b, p. 620). This will in turn draw water away from discharging at springs and wetlands, even when groundwater levels at those springs and wetlands have only decreased minimally (Currell 2016b). “Only very minor drawdown need occur at this point for the flow direction to reverse, depriving springs or streams of flux,” (Currell 2016b; see Figure 14).

**Figure 14.** Conceptual model illustrating the impacts of groundwater pumping on flux as it pertains to (A) gaining streams and (B) springs. Pumping induces flow away from surface discharge and toward the cone of depression, even when groundwater levels at the source of discharge decrease minimally (Currell 2016b, p. 620).

Proposed adaptive management measures to mitigate the harms of groundwater pumping on Oasis Valley speckled dace habitat are unlikely to succeed in preventing groundwater drawdown and decreases in spring discharge. Groundwater drawdown can propagate slowly across the landscape, and there can be a significant delay between when pumping commences and when impacts of pumping materialize in nearby surface water sources (Barlow and Leake 2012, p. 73). It may take years for a drawdown signal to propagate to a spring or other surface water source; and due to this lag, even when adaptive management or other reasons cause pumping to decrease or cease, the drawdown can continue to increase as the cone of depression spreads outward (Bredehoeft 2011, p. 812). Even as pumping ceases, capture of surface discharge and evapotranspiration may persist “over a longer time period than the immediate (and often temporary) loss of storage,” (Currell 2016b, p. 620). Therefore, adaptive management regimes using triggers and other signals to manage pumping levels are unlikely to prevent degradation of Oasis Valley speckled dace habitats due to groundwater pumping.

**Pit Lake Development**

As discussed above, open pit mine dewatering is required when a mine’s pit extends below the water table in order to keep the mine dry. Once the dewatering ceases, groundwater around the mine will start to recover and as this happens, the mine pit will fill with water, creating a pit lake (Bozan et al. 2022, p. 1822, 1825-1826). Because the volume of the pit below the water table was mostly rock prior to mining, the pit lake represents a substantial water deficit. Evaporation
from the surface of the pit lake is another source of water loss (Myers 2014, p. 1). Whether or not a pit lake is backfilled, and the prevailing climate conditions, thus partly control the amount of water that is lost from the system, as well as the rate and extent of groundwater level recovery at the mine site (Bozan et al. 2022, p. 1826). Groundwater level recovery occurs until the net flux into the pit equals the evaporative loss from the pit lake (Bozan et al. 2022, p. 1826). In arid climates, evaporation can greatly exceed precipitation, causing unfilled mine pits to become terminal sinks for groundwater (Bozan et al. 2022). In the study by Bozan et al. (2022), equilibrium lake levels simulated for moderately transmissive aquifer conditions varied between 15–30 m below the premining groundwater table for net evaporation rates of 1,000 and 3,000 mm/year, respectively. The situation was exaggerated if less permeable aquifer conditions were assumed (Bozan et al. 2022, p. 1826, 1830). Based on technical comments submitted by Nevada’s Bureau of Mining Regulation and Reclamation, net evaporation rates at mines in Nevada range between 508 mm/year and 1,473 mm/year, although these are generally located at higher altitudes than the mining projects around Beatty (BMRR 2021, p. 1-3). For North Bullfrog, the project’s hydrogeology baseline work plan estimates a net evaporation of 2,439 mm/year (HydroGeoLogica 2021, p. 18).

According to the North Bullfrog project plan of operations, dewatered pits at the project site will be backfilled with overburden material to eliminate the formation of pit lakes at closure and the associated evaporative water losses (EM Strategies 2023, p. 15). However, it is not all obvious that this mine closure option will be chosen at other proposed mines as shown by the 22 mining projects for which net evaporation rates have been estimated and reported to NDEP (BMRR 2021, p. 3), or the 38 mines (44% of all mines in the state) in Nevada that are or are expected to become pit lakes according to recent reports (e.g. Nevada Independent 2023, p. 2). Backfilling of open pits can be cost-prohibitive, as exemplified by a recent mine expansion plan document for South Carolina’s Haile gold mine which referred to the unfeasibility of backfilling two proposed pits due to cost (OceanaGold 2019, p. 9).

Surface Water Diversion and/or Collection

Construction of mine facilities and roads, and diversion of surface (including meteoric) water to protect mine infrastructure has the potential to change infiltration, and therefore groundwater flow, patterns. Consumption of surface water during mining operations also directly reduces the amount of water available to recharge aquifers.

Groundwater Quality Impacts

There are various mine components, described in more detail below, that can become a source of contamination to surface and/or groundwater due to leaks and spills. Among the chemicals that may be released are cyanide, heavy metals and sulfuric acid (OceanaGold 2019, p. 5). The latter is formed when sulfide minerals present in the ore are exposed to air and water. The acid leaches minerals from the surrounding rock (Gestring and Hadder 2017, p. 5-6), forming a highly toxic solution.

1) Overburden storage areas. Overburden corresponds to all of the unwanted or low value material located between the surface and the targeted ore. It sometimes includes the first layer of soil and vegetation on the surface. Once removed, it is stored in heaps around the site, which can produce dust, and if dust is suppressed with watering, leachate (BTL Liners 2024a, b, p. 1). The latter may run off the waste rock pile, or percolate through the pile, infiltrating groundwater. Leachate may also be produced as a result of rain falling atop the overburden material.
2) Heap leach pads. These large, engineered structures are used to process lower grade ore using surface irrigation with a sodium cyanide solution. The latter infiltrates through the ore, picking up gold and other metals in the process (Gestring and Hadder 2017, p. 5).

3) Ponds and tanks used to collect, store and process solutions and mill tailings. Also liable to spills and leaks are pipelines and surface conveyors.

4) Trucks. The transport of chemicals to the mining site, and waste off-site is another potential source of contamination, as is the long-term storage of waste on-site. Spills associated with truck transport are particularly relevant in the case of the Bullfrog and Reward projects as these two projects are anticipated to share infrastructure but occur on opposite sides of the Amargosa river.

A final source of contamination is pit lakes formed by groundwater seeping back into open pits after mining ceases. Since most open pit gold mines occur in areas of high evaporation, the flow of water is typically into the open pit. However, if outflow occurs, the surrounding groundwater may be contaminated as the outflowing pit lake water is usually of poorer quality (Gestring and Hadder 2017, p. 6). The backfilling of open pits, although preferable from a groundwater recovery standpoint, also poses a risk to groundwater quality. Unlike in the presence of a pit lake, there will be no evaporation once the pit is backfilled, which means groundwater will flow into the backfill and out. As the groundwater infiltrates into the backfill, potential toxins can be leached and transported out of the pit, into surrounding groundwater (Great Basin Resource Watch 2023, p. 8).

There are numerous examples of leaks and spills associated with gold mines. Gestring and Hadder (2017, p. 7-8) found that 27 out of the 27 (i.e. 100%) mining operations reviewed in their report (representing 93% of U.S. gold output in 2013) had experienced at least one pipeline spill or other accidental release, including cyanide solution, mine tailings, diesel fuel and ore concentrate. Meanwhile, 20 out of the 27 (i.e. 74%) mining operations were reported to have failed to capture or control contaminated mine seepage. The seepage of cyanide solution was one of the more common impacts (Gestring and Hadder 2017, p. 8). The potential for groundwater contamination depends in part on the local climate (Gestring and Hadder 2017), with the aridity of Oasis Valley (6 inches per year in the lowlands and 8-13 inches in higher elevation areas) (DRI 2023, p. 3) limiting vertical and horizontal flow of meteoritic water. However, ephemeral flows do still occur, and contaminated meteoritic water and/or mine chemicals may percolate into groundwater. At the North Bullfrog Project site, depth to groundwater is relatively deep, varying between less than 165 ft and more than 490 ft (HydroGeoLogica 2021, p. 21), which means that contamination of surface discharge may occur slowly, possibly after the mine has closed. Identifying failures prior to groundwater contamination can also be challenging, even in the presence of leak detection systems, as failures can and have occurred in parts of a mining facility that are unmonitored or difficult to monitor (Gestring and Hadder 2017, p. 8).

Spent ore from gold mining can be a source of acid drainage and/or of heavy metals. Residual cyanide leaching solutions may also be present in spent ore. Gold mining is a key contributor of hazardous selenium releases into aquatic ecosystems and is responsible for both acute and chronic impacts on living organisms (Khamkhash et al. 2017, p. 2). Numerous studies have shown severe effects of selenium on fish reproduction in the field as well as in the laboratory (USEPA 2011, p. 54). Cyanide is a rapidly acting, highly toxic, potentially deadly chemical that can result in substantial environmental impacts if released into the environment (Earthworks 2024, p. 2). Cyanide spills have resulted in major fish kills (Ibid). Cyanide spills into groundwater can persist for long periods of time and contaminate drinking water aquifers, and cyanide
contaminated groundwater can also pollute hydrologically connected neighboring streams (Earthworks 2024, p. 3). Cyanide may affect fishes through delayed mortality, pathology, impaired swimming ability and relative performance, susceptibility to predation, disrupted respiration, osmoregulatory disturbances, and altered growth patterns (Eisler 1991, p. 27). Heavy metals are stable, imperishable compounds that can accumulate in different fish organs when they reach aquatic regimes and affect the physiology of fishes (Kumar et al. 2023; Sharma et al. 2024). Multiple studies show that heavy metals cause severe damage to fish (Elbesht et al. 2018, p. 39). Accumulation of metals in fish organs can cause structural lesions and functional disturbances (Kumar et al. 2023; Sharma et al. 2024). Contamination of heavy metals induces oxidative stress, histopathological manifestations, and altered transcriptional gene regulation in exposed fishes (Kumar et al. 2023; Sharma et al. 2024). One of the main consequences of metal toxicity to fish is additional energy costs, and the metabolic load can lead to the disruption of oxidative metabolism and enhanced anaerobiosis (Gashkina 2024, p. 9).

Solar Energy Development

The BLM recently identified areas open for utility-scale solar energy development as part of its Western Solar Plan amendment (NEPA number: DOI-BLM-HQ-3000-2023-0001-RMP-EIS). The preferred alternative, Alternative 3, includes opening up a significant amount of land in and near Oasis Valley (as shown in Figure 15) to utility-scale solar development. This includes lands directly adjacent to, and possibly within, Oasis Valley speckled dace habitats.

Figure 15. Alternative 3 of the Western Solar Plan Programmatic Environmental Impact Statement Revision is shown in forest green (Map from Center for Biological Diversity based on data from BLM 2024b).
Under the previous (2012) solar plan, BLM established the Amargosa Valley Solar Energy Zone (SEZ), intended to fast track solar development projects, as well as variance and exclusion lands. Variance lands were identified as lower priority lands generally appropriate for solar development (Clarke 2023, p. 2). The Amargosa Valley SEZ and solar energy project applications received by the BLM, in the Amargosa Valley area, as of June 1, 2022 (BLM 2022, p. 12), are shown in Figure 16.

Figure 16. Solar energy projects in the Amargosa Valley area. The Ponderosa Solar application, received 6/2/2022, is not depicted (BLM 2022, p. 12).

Large solar installations are a threat to the Oasis Valley speckled dace, as construction (primarily dust suppression) and operation consumes water, with recent reports linking drying of local wells to solar plants in California’s Colorado Desert (Myskow 2023, entire; Wainwright 2023, entire). Recent solar plans for nearby Pahrump Valley cite requirements of 1,000 acre-feet or more of water for construction (Noble Solar 2022, p. 1-24; BLM 2020, p. 3-95). Future solar energy development is thus highly likely to increase pressure on the Death Valley Regional Flow System as a whole due to increased groundwater withdrawals and may result in increased groundwater demand in Oasis Valley itself, exacerbating the impact of other groundwater uses on the Oasis Valley speckled dace’s habitat.

Inasmuch as the Western Solar Plan revision may result in solar development directly adjacent to Oasis Valley speckled dace habitat, site-specific impacts must also be considered. Land clearing associated with solar development is also a concern as it may increase sedimentation and promote invasion of exotic plants (Glicksman 2011, p. 114).
Water Diversions

Springs and streams within the range of the Oasis Valley speckled dace continue to be impacted by surface water diversion and water abstraction (NDOW 2022b, p. 393). In the Stagecoach area of the Amargosa River, there is evidence of surface water diversion and water abstraction (DRI 2023, p. 51). At Parker Ranch, a large fishing pond was reconstructed into a series of small ponds but water there is insufficient (DRI 2023, p. 45-46). At Upper 7J Ranch, surface water flows downgradient of the ponded spring, but the spring’s discharge was an order of magnitude higher prior to the ponding (DRI 2023, p. 26). Water abstraction is a threat to the Oasis Valley speckled dace because it results in fewer population resources, inability to breed, inability to withstand deviations in water quality, and reduced ability to coexist with other species (including nonnatives).

Livestock Grazing

Livestock grazing is one of the most widespread land management practices in western North America and it has been associated with a wide range of negative impacts on habitat for freshwater aquatic species. Livestock grazing can increase soil compaction, decrease infiltration rates, increase runoff, decrease riparian vegetation, increase stream sedimentation and water temperature, contaminate water through excrement and promote invasive species, among other changes (Batchelor et al. 2015, p. 931; Kimball and Schiffman 2003, p. 1683; Filazzola et al. 2020, p. 1-2; USFWS 2022, p. 72 and references therein). These changes are significant as even small deviations in water quantity and quality could potentially negatively impact Oasis Valley speckled dace. The loss of riparian vegetation (and potentially the change in composition) may also affect the availability of prey items and dace’s ability to shelter from predators and the heat.

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, p. 336; Clary and Medin 1990, p. 1). Cattle prefer to browse young willow and cottonwood shoots, eventually eliminating these important woody species from streamside locations (Kauffman et al. 1983, p. 689; Kovalchik 1987, p. 75, 76; Case and Kauffman 1997, p. 116). Grazing in riparian areas can degrade habitat for native fish species (Kauffman and Krueger 1984, p. 432-433; Knapp and Matthews 1996, p. 805), alter stream morphology and hydrology, increase soil erosion and sediment deposition in streams, and degrade and contaminate water quality (Chaney et al. 1990, p. 3-5, entire; Belsky et al. 1999, p. 8-10).

Taylor et al. (1989, p. 494) 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 nitrates in the water, which are toxic to fish in chronic amounts. The increases in ammonia and nitrates 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, p. 494).
In addition to causing habitat degradation, livestock can trample speckled dace and their eggs. An indirect effect of grazing can include the development of water tanks for livestock. In some cases, stock-tanks are used for stocking nonnative fish for fishing, or they may support other nonnative aquatic species such as bullfrogs or crayfish (USFWS 2022, p. 72-73), all of which increase the likelihood of negative interactions with speckled dace.

Oasis Valley is co-located with BLM’s Razorback grazing allotment, which according to PEER, was failing Land Health Standard Evaluations as of 2020, with livestock grazing a significant causal factor (PEER 2020, p. 1). Recent field investigations found livestock grazing impacts at both the Upper and Lower 7J Ranch, Torrance Ranch East, Brian Spring and Beatty Narrows (DRI 2023, p. 25).

**Wild Burros**

Wild burros are an invasive species in North America. Invasive species are one of the most widespread and serious threats to the integrity of native wildlife populations due to the habitat degradation they cause in native ecosystems (Wildlife Society 2014, p. 1). While light to moderate disturbance by wild burros is sometimes purported to benefit speckled dace by preventing the overgrowth of vegetation (USFWS 2010a, p. 42047 and ATWG 2005 cited therein), intensive disturbance is likely to lead to significant habitat degradation. Large herbivores such as burros disturb landscapes by trampling soils and vegetation, selectively grazing palatable plants, and altering the distribution of nutrients in the ecosystem. Burros and horses ingest more forage per unit of body mass than any other large-bodied grazer in western North America (Wildlife Society 2014, p. 1-2). Research in the Great Basin has also found that areas with feral horses have fewer plant species and less grass, shrub, and overall plant cover than areas without, and more invasive plant species and weeds such as cheatgrass, which degrades wildlife habitat. Riparian and wetland areas may furthermore be impacted by burros through soil compaction and increased erosion (Wildlife Society 2014, p. 1), as well as decreased water quality and accelerated drying and loss of pool habitats during spring and summer months (NDOW 2000, p. A-5). In addition to habitat degradation, burros can trample all life stages of dace, causing direct mortality; this effect is particularly a concern during key periods of the dace’s life history such as breeding, egg-laying, maturation and emergence of young of year fish (NDOW 2000, p. A-5).

Burro impacts on Amargosa toads, a more studied and monitored species co-occurring with speckled dace, can be viewed as a rough surrogate for potential impacts to Oasis Valley speckled dace. In 2010, the U.S. Fish and Wildlife Service reported that burro use in Amargosa toad habitat was “light to moderate” (USFWS 2010a, p. 42047) and that the BLM manages the feral burro population and conducts gathers whenever the population numbers exceed the appropriate management level for the area, in accordance with a 2000 Amargosa Toad Conservation Agreement and Strategy (CAS) (USFWS 2010a). In 2000, there were only about 30 wild burros in the Bullfrog Herd Management Area (HMA) as a result of past burro removals, and it was suggested that additional removal might occur if wild burros were determined to be negatively impacting Amargosa toads or their habitat (NDOW 2000, p. A-16). In 2012, the number of wild burros within and outside the HMA boundary was estimated to be 195 (although the real number was believed to be higher) (BLM 2012, p. 2), or approximately 214% of the high range of Appropriate Management Level (AML), 336% of the low range of AML (BLM 2012, p. 4-5) and 650% of the population size at the time of writing of the CAS. The BLM announced that it would implement phased burro gathers from 2012-2022 to achieve a post-gather population in the HMA of 58 wild burros (BLM 2012, p. 3). It argued that without the prompt removal of the excess wild burros, “habitat for the sensitive Amargosa toad […] would continue to be impacted
by the overpopulation of wild burros”, and there would be “potential degradation or loss of Amargosa toad […] habitat as wild burros increasingly concentrate at riparian areas” (BLM 2012, p. 5). It further stated that many of the riparian areas within the HMA are critical habitat for the toad and that many of the riparian areas within the HMA that are accessible to wild burros have been degraded by heavy and concentrated use by wild burros (BLM 2012, p. 5).

In 2019, the pre-gather population within and outside of the HMA was 828 (BLM 2019, p. 1), despite at least 3 previous gathers (BLM 2018, p. 1) since the BLM’s decision to implement the Bullfrog HMA Wild Burro Gather Plan (BLM 2012, p. 1). The 2019 population count was 425% of that in 2012, 909% of the established AML of 58-91 (BLM 2019, p. 1) and 2,760% of the burro population size in 2000. Thus, no overall reduction in burro population size was achieved in the lead up to the 2019 gather. The high number of burros was also noted by the BLM to have resulted in degradation of the landscape and negative impacts to other species sharing the habitat (BLM 2019, entire). The number of burros to be removed in 2019 was ~600, with the remaining ~282 burros set to remain in the HMA due to limited space in off-range holding facilities (BLM 2019, entire). Two hundred eighty-two burros is still 144% of the population in 2012, 310% of the high range of AML and 940% of the population in 2000. The burro population is also reported to have continued to increase since 2018, and that the Beatty Town Advisory Board has requested another gather (Pahrump Valley Times 2023b, p. 1). Recent field investigations found burro grazing-related impacts at Brian Spring and Beatty Narrows (DRI 2023, p. 25, 44).

The BLM’s Bullfrog HMA website suggests that the current AML is 55-91 burros and that it applies to just a portion of the HMA, with the decision to establish AML for the remainder of the HMA under appeal (BLM 2023b, p. 1). However, it is unclear how up to date this information is, and regardless, based on the information presented above, burros are not being managed in a manner consistent with Amargosa toad conservation nor protection of Oasis Valley speckled dace habitat.

**Factor 2: 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). Invasive fish, such as mosquitofish, as well as introduced crayfish and bullfrogs are known to predate on speckled dace – see the section below on invasive species.

**Factor 3: Overutilization for Commercial, Recreational, Scientific or Educational Purposes**

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

**Factor 4: Inadequacy of Existing Regulatory Mechanisms**

**Federal Protections**

*National Environmental Policy Act*

The National Environmental Policy Act (NEPA) provides some potential protection for Oasis Valley speckled dace. For activities undertaken, authorized, or funded by federal agencies,
NEPA requires that the potential impacts of projects on the human environment be analyzed prior to implementation (42 U.S.C 4371 et seq.). Federal agencies such as the U.S. Bureau of Land Management must fully and publicly disclose the potential environmental impacts of all proposed projects. 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. If significant environmental effects are predicted to occur, the federal agency must propose mitigations that could offset those effects (40 CFR 1502.16) (USFWS 2009, p. 16). However, the law only requires agencies to disclose the impacts of their actions; it does not prohibit federal agencies from choosing alternatives that may negatively affect imperiled species. Even if Oasis Valley 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. Moreover, actions taken by private landowners or state agencies do not generally need to comply with NEPA since only projects with a federal nexus (i.e. federal funding, authorization or permitting) fall under NEPA (USFWS 2009, p. 16). Most of the known habitat for Oasis Valley speckled dace is on private land.

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 could provide some protection for stream habitats used by speckled dace in Oasis Valley. However, The CWA contains no specific provisions to address the conservation needs of rare species. 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. 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 Oasis Valley speckled dace may receive no special consideration with regard to conservation or protection absent listing under the ESA.

The definition of jurisdictional waters, or the “Waters of the United States” (referred to as “WOTUS”) has changed numerous times over the past decade based on Supreme Court rulings, U.S. Environmental Protection Agency (EPA) interpretations of law and changing administrations. Under the definition of WOTUS promulgated by the Trump administration (the “Navigable Waters Protection Rule”), endorheic basins without perennial surface water connections to traditionally navigable waterways, such as Oasis Valley, were considered non-jurisdictional, and any water features within them were exempt from the Clean Water Act (CWA) (USEPA 2020, p. 22251). A new definition took effect under the Biden administration in March
2023 (USEPA 2023) and includes, among other water features, the following: interstate waters, certain tributaries to interstate waters, and wetlands adjacent to interstate waters (USEPA 2023, p. 3005-3006). The EPA further notes “Interstate waters thus include waters that cross or form a part of State boundaries with other States and with other countries (Canada and Mexico). Examples of such waters include portions of the Amargosa River, which flows from Nevada into a dry playa in Death Valley, California, and the Great Dismal Swamp, a wetland which crosses the border between Virginia and North Carolina. The Amargosa River is not a traditional navigable water and does not otherwise flow to a traditional navigable water or the territorial seas, but under the agencies’ pre-2015 regulations and the final rule, the portion of the Amargosa River that crosses the California/Nevada border is an interstate water. Tributaries to interstate waters like the Amargosa River and wetlands adjacent to interstate waters and their tributaries are critical sources of life in desert climates.” (USEPA 2023, p 3072). However, whether or not the Amargosa River in Oasis Valley and associated wetlands would be considered jurisdictional under this latest rule is unclear. Moreover, while the USFWS can review permit applications under section 404 of the CWA and provide recommendation for avoiding and minimizing impacts and implementing conservation measures for fish and wildlife resources, incorporation of these recommendations into permits is at discretion of the U.S. Army Corps of Engineers (USFWS 2014b, p. 51060).

**Overlap with ESA Listed Species**

The Oasis Valley speckled dace’s aquatic habitat does not directly overlap with any other ESA listed species habitat. The Oasis Valley in general has had documented occurrences of the southwestern willow flycatcher (*Empidonax traillii extimus*) and the yellow-billed cuckoo (*Coccyzus americanus*) (Audubon 2024, entire). The local populations of both birds are protected under the Endangered Species Act, the southwestern willow flycatcher as endangered, and the yellow billed cuckoo as threatened. However, Oasis Valley is not designated critical habitat for either bird. Additionally, their habitat does not directly intersect with the open water habitat of the Oasis Valley speckled dace. The mere presence of these listed birds does not provide substantial protection for the Oasis Valley speckled dace.

**State Protections**

The Nevada Department of Wildlife (NDOW) annually monitors springs and other aquatic habitats in Oasis Valley, primarily focused on Amargosa toads. NDOW conducts bi-annual surveys of known speckled dace populations, but continued efforts to inventory all potential waters that may contain speckled dace are needed (NDOW 2022a).

The Oasis Valley speckled dace is identified as a Species of Greatest Conservation Need in the Nevada Wildlife Action Plan (WAP) 2022 Revision (NDOW 2022a, p. 41). The WAP serves as a comprehensive, landscape level plan, identifying the species of greatest conservation need and the key habitats they rely on, with the intent to prevent wildlife species from becoming threatened or endangered. The WAP contains conservation actions to guide conservation of Nevada’s key habitats and priority species, and many of these actions are strategies identified in other existing conservation plans. However, the WAP’s recommended actions in no way represent a mandate or expectation for a given party to carry out or implement these actions (NDOW 2022a, p. 241). Conservation Agreements and Strategies identified in the WAP include the Amargosa toad CAS (NDOW 2022a, p. 7), which may confer some benefits to Oasis Valley speckled dace, and is described in more detail below.
The Oasis Valley speckled dace is also included on the Nevada Division of Natural Heritage (NDNH) At-Risk Plant and Animal Tracking List (NDNH 2023, p. 19). This list directs NDNH's data acquisition priorities and provides up to date information on the status of these taxa. Taxa considered at-risk and actively inventoried by NDNH usually include federal or other Nevada agency status species, as well as those with global and/or state ranks 1-3, indicating some level of imperilment (NDNH 2023, p. 1). The Oasis Valley speckled dace taxon has a global and state rank of 1 (critically imperiled) and is designated by the BLM and the state respectively as a Sensitive Species and a Sensitive Fish (NAC 503.067) (NDNH 2023). State protection is functionally a regulated take program, where the department must issue a permit to anyone wishing to “take” a state protected species. However, these state protections have never been used to prevent the destruction of protected species habitat. And indeed, these protections do not apply to actions undertaken by the federal government. For instance, despite the fact that the Moorman White River springfish (Crenichthys baileyi thermophilus) is on the list of fully protected species (NAC 503.065), BLM issued oil and gas leases within one mile of its habitat (BLM 2017, p. 10). State fully protected species status is inadequate to protect the Oasis Valley speckled dace from federal actions which could impact its habitat, such as permitting of gold mines that could dry up springs the dace depends on for its survival.

The state of Nevada also cannot be relied on for safeguarding groundwater resources. First, the state’s concept of “perennial yield” allows for the unmitigated destruction of all unallocated surface water resources. Perennial yield is notably not defined in statute, but a working definition is “[T]he maximum amount of groundwater that can be salvaged each year over the long term without depleting the groundwater reservoir. The perennial yield cannot be more than the natural recharge of the groundwater reservoir and is usually limited to the maximum amount of natural discharge.” (Nevada Department of Conservation and Natural Resources (NDOCR) n.d., p. 6). What this functionally means is that the state of Nevada makes available for appropriation an amount of water equivalent to that which is discharged within a basin through surface discharge and evapotranspiration through phreatophytic vegetation. As such, if a basin is fully appropriated and all of those water rights are being exercised, the long-term effect will be to cease all surface discharge and eliminate all phreatophytes (Bredehoeft and Durbin 2009, p. 4).

Private Lands

Conservation efforts to secure Amargosa toad habitat in the Oasis Valley indirectly provides some protections for speckled dace. The Amargosa Toad Working Group (ATWG) was established in 1996 to provide recommendations for the management and conservation of the Amargosa toad, and includes representatives of the USFWS, NDOW, TNC, BLM and other public and private stakeholders. The ATWG meets twice a year to present and exchange information on the toad, its habitat, ongoing habitat projects, potential threats, and to identify new conservation tasks (USFWS 2010a, p. 43043-42044). Many of the conservation actions implemented by the ATWG and its partners are due to commitments made in the CAS, completed in 2000. The goals of the CAS are to manage threats, maintain habitats, monitor populations, and test and evaluate habitat manipulations (USFWS 2010a, p. 42044).

As of 2010, progress had been made towards achieving CAS goals for Amargosa toads through monitoring and research, habitat protection and restoration, invasive vegetation removal, predator control, public education and outreach, and work with local community to achieve conservation such as an open space plan (USFWS 2010a, p. 42044). The ATWG was also in the process of updating the CAS, with the revised version anticipated to identify the conservation needs of the toad for the next 10 years and operate in a manner similar to the
previous CAS (USFWS 2010a, p. 42044). Revision of the CAS was still in progress as of June 2023 but conservation efforts by the ATWG have continued to occur. A recent example is Amargosa toad habitat enhancement/restoration at Beatty Narrows (ATWG 2021a, p. 2; ATWG 2021b, p. 7).

Other examples of conservation efforts in the last decade have included habitat restoration in the Stagecoach and Torrance Ranch areas (DRI 2023, p. 33, 49), habitat restoration at the Crystal Spring Complex (ongoing), and management actions by private and public partners such as STORM-OV (Wildlife Action Plan Team 2012, p. S-62). 7J Ranch was also acquired by TNC in 2019, with conservation efforts including invasive species removal and modification of grazing practices. Efforts have been successful and are ongoing to secure and protect dace habitat throughout Oasis Valley (NDOW 2022b, p. 393). The ATWG, Beatty Habitat Committee, and Storm-OV have contributed to multiple TNC properties which have ongoing restoration efforts. There are continuing efforts by USFWS and NDOW to obtain private lands for habitat enhancement and private landowner access.

Despite past and current conservation efforts, however, habitat for Oasis Valley speckled dace continues to be impacted by grazing, invasive species and other human disturbances such as water diversion. Continued crayfish, mosquitofish, and bullfrog eradication efforts are needed (NDOW 2022b, p. 393). Many occupied speckled dace habitats exist on private lands. Continued efforts to inventory all potential waters that may contain speckled dace are needed (NDOW 2022b, p. 393). Most importantly, the Oasis Valley speckled dace needs water to survive, and existing efforts do not adequately protect dace against the existential threat of declining groundwater levels due to gold mining.

**Factor 5: Other Natural or Anthropogenic Factors**

**Invasive Species**

Nonnative Louisiana red swamp crayfish (*Procambarus clarkia*), American bullfrog (*Rana catesbeiana*), and Western mosquitofish (*Gambusia affinis*) occupy aquatic habitats within the Oasis Valley, likely affecting natural distribution and acting as stressors to Oasis Valley speckled dace (NDOW 2015, p. 1). Mosquitofish likely aggressivly compete with speckled dace for food (Caiola and Sostoa 2005, p. 179; Mills et al. 2004, p. 719). Predation of all life stages of Oasis Valley speckled dace by bullfrogs and nonnative crayfish is also a threat. Introduced crayfish compete with, prey upon, and alter the behavior of native fishes (Light 2005, p. 364). 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 (Scoppettone et al. 2012, p. 2). Red swamp crayfish are a threat to Amargosa River speckled dace (Otahal 2015, p. 1). 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, p. 430). Competition and/or predation from bullfrogs could play a major role in the decline of Amargosa River speckled dace (Otahal 2015, p. 1; Moyle et al. 2015, p. 431). Continued crayfish, mosquitofish, and bullfrog eradication efforts are needed (NDOW 2022b, p. 393). Non-native centrarchid predators 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, p. 412). Largemouth bass (*Micropterus salmoides*) are being reported from 7J Ranch (ATWG 2021a, p. 2), posing a predation threat to Oasis Valley speckled dace populations.
Nonnative invasive plant species such as Russian olive and saltcedar have significantly altered riparian plant communities, directly impacting speckled dace and other aquatic species through increased transpiration and alteration of habitat structure (NDOW 2000, p. A-6). Efforts to remove nonnative invasive plants from the Amargosa River watershed have occurred since 2003 (USFWS 2010a, p. 42047) and are ongoing. However, recent field investigations found numerous invasive species in the Torrance Ranch East area (DRI 2023, p. 37), and invasive saltcedar at Beatty Narrows, despite repeated removal efforts (DRI 2023, p. 55). Invasive species were also observed at Parker Ranch, Brian Spring, the Upper 7J ranch and the Stagecoach area (DRI 2023, p. 26, 44, 45, 51). Efforts to control invasive plants are, moreover, likely to be hampered by threats such as reduced river flows and off-road vehicles, which may act to promote the spread of invasives (University of California and California Exotic Pest Plant Council 1996, p. 2).

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, p. 1). 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, p. 117-118; Kozlowski et al. 2010, p. 1505), but today, these same processes serve as agents for the spread of saltcedar (Wiesenborn 1996, p. 11). 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 (Id., p. 6). Saltcedar also shades river systems, decreasing food resources within the waterway (Otahal 2015, p. 2). Saltcedar increases fire risk (Drus et al. 2012, p. 1), can change stream morphology (Auerbach et al. 2013, p. 107-108), increases soil salinity (Wiesenborn 1996, p. 9) and causes other potentially detrimental ecosystem effects (El Waer et al. 2018, p. 48). Saltcedar is proliferating and altering aquatic habitats in Amargosa Canyon (Scoppettone et al. 2011, p. 14). Its spread threatens to form a saltcedar monoculture throughout the Amargosa River floodplain (Scoppettone et al. 2011, p. 15). Saltcedar is a significant threat to flow levels in the Amargosa River and to Amargosa River speckled dace (Zdon 2014, p. 40; Otahal 2015, p. 2), 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, p. 430). 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

The climate of Nevada is changing (State of Nevada Climate Initiative 2020, p. 1). Average temperatures have been increasing and 8 of the 10 warmest years since 1895 have occurred since 2000. In the near term, a warming of 4-6°F is projected throughout the state (State of Nevada Climate Initiative 2020, p. 5). Increased temperatures will also lead to increased evaporative demand, and consequently increased drying of vegetation and soils (State of Nevada Climate Initiative 2020, p. 11). These water losses may exacerbate temperature effects (Greenberg and Palen 2021, p. 7), in addition to degrading the wetland habitats the Oasis Valley speckled dace needs for breeding, shelter and food.

Increasing air temperatures are also projected to lead to a longer growing season, with plants likely demanding more water overall (State of Nevada Climate Initiative, 2020, p. 15), and hence reducing the amount available to wildlife. Moreover, decreased surface-water resources generally means more groundwater withdrawal and more requests for water-well construction.
permits. Water development usually takes priority over aquatic habitats when the availability of water is limited by climatic conditions (USFWS 2014b, p. 51056).

Climate change may additionally increase the fire risk. Winter precipitation is projected to increase throughout Nevada and evaporative demand in both spring and summer is projected to increase by 5-15% in the near term. These conditions will likely lead to more vegetation and fuels growth followed by faster drying of vegetation, resulting in an increased fire risk (State of Nevada Climate Initiative, 2020, p. 18 and McEvoy et al. 2020 cited therein). More severe burning may lead to direct mortality of dace as well as loss of dace habitat.

Finally, according to Nevada’s 2012 WAP, models have predicted that for Oasis Valley and Amargosa River species in particular, there will be an increased potential for summer monsoonal precipitation patterns. While this could increase and extend base flow conditions for associated stream habitats, it may also increase the frequency of stochastic rain events with increased potential for flood events, channel scouring and channelization (Wildlife Action Plan Team 2012, p. 232). The negative effects of increased flooding on Oasis Valley speckled dace could include displacement of individuals onto unsuitable habitat, destruction of habitat, and spread of non-native species (USFWS 2010a, p. 42042). Due to modelling uncertainty, the authors of the WAP predicted that the net effects of climate change on the Amargosa toad would be neutral through 2022 (Wildlife Action Plan Team 2012, p. 232). However, their assessment did not discuss in detail the impacts of precipitation-related threats, nor mention increasing evaporative demand or other potential threats associated with climate change. Over the past 30 years, the Mojave Desert climate has become hotter and drier, with longer periods of drought, and projections show that warming and drying will continue (TNC 2024b, p. 5).

Climate change is a direct and significant threat to Oasis Valley speckled dace, which exist in an exceptionally arid region and rely on habitat 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 region will likely receive less recharge as the region warms (Riggs and Deacon 2004, p. 33). 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. Moyle et al. (2013, as cited in Moyle et al. 2015, p. 431) rated the Amargosa River speckled 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 local populations of Oasis Valley speckled dace are especially vulnerable to habitat alteration and exotic species (NDOW 2012, p. S-34). 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). Small, local populations are also vulnerable to habitat alteration and interactions with introduced, nonnative species, particularly crayfish and bullfrogs (Minckley 1985; Moyle et al. 1989). If local extirpation of isolated, spring-dependent speckled dace occurs, there is little potential for natural recolonization (Meffe and Vrijenhoek 1988, p. 158).
REQUEST FOR CRITICAL HABITAT DESIGNATION

The Center for Biological Diversity formally requests the Service designate critical habitat for the Oasis Valley speckled dace concurrently with listing, as required by the ESA (16 U.S.C. 1533(a)(3A)). Critical habitat as defined by Section 3 of the ESA is: (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protections; and (ii) the specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species. 16 U.S.C. § 1532(5).

Critical habitat should include all existing known and potential habitat of the Oasis Valley speckled dace and areas with potential for recovery and determined to be important to the survival and recovery of the species.
CONCLUSION

The Oasis Valley speckled dace is a narrowly endemic distinct population segment of the Amargosa speckled dace (*Rhinichthys nevadensis nevadensis*), only known to occupy about a dozen isolated springs and their outflows in Oasis Valley, Nevada. It has long faced threats such as trampling by non-native ungulates, predation and competition from invasive species, and water abstraction and diversion leading to habitat degradation and destruction; and it now faces alteration of suitable habitat from climate change. Ongoing conservation efforts in Oasis Valley to protect the Amargosa toad have had some successes, but the Amargosa toad, Oasis Valley speckled dace, and other endemic aquatic species continue to remain in a highly precarious state and now face a new existential threat.

Seven gold mining projects have been proposed encircling speckled dace habitat in Oasis Valley, with most if not all anticipated to involve open pits. Groundwater pumping and dewatering for these gold mines could have severe impacts on the availability of groundwater to sustain suitable dace habitat. Just one of these gold mines is under environmental review right now, and it will withdraw up to 2,500 afy from Oasis Valley and a likely connected aquifer in Sarcobatus Flat via dewatering and production pumping. This water consumption is modeled to cause significant declines on the Amargosa River and in the Oasis Valley, and dace habitats therein. Simulated pumping scenarios examining cumulative water withdrawals from the development of four mines show widespread drawdown across the Oasis Valley. This could spell extinction for Oasis Valley speckled dace.

Oasis Valley is set to become the epicenter of a vast new gold mining district, with over half a dozen gold mines putting tremendous stress on the delicate aquifer which sustains the Amargosa River. The Oasis Valley speckled dace is entirely reliant on sustained discharge of groundwater for its life cycle. Despite well-intentioned conservation efforts by the local community and partners, the threat of groundwater drawdown due to gold mining poses an existential threat to Oasis Valley speckled dace. Only the Endangered Species Act can prevent its extinction.
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