OWENS SPECKLED DACE
***Rhinichthys osculus* ssp.**

Status: High Concern. The Owens speckled dace was extirpated from a majority of its historic range by the 1980s. Three populations remain, mostly isolated from one another, in Fish Slough, Round Valley, and in irrigation ditches in and near the town of Bishop.

Description: The following is a general description of speckled dace with additional information on the undescribed Owens subspecies. Speckled dace are small cyprinids, usually measuring less than 8 mm SL but occasionally reaching 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. At maturity, the dorsal fin usually has 8 rays and originates well behind the origin of the pelvic fins (Moyle 2002). The anal fin has 6-8 rays. Pharyngeal teeth (1,4-4,1 or 2,4-4,2) are significantly curved with a minor grinding surface. The maxilla usually has a small barbel at each end. The snout is connected to the upper lip (premaxilla) by a small bridge of skin (frenum). As their common name indicates, most fish larger than 3 cm have distinctive dark speckles on the dorsum and sides of the body, although some fish from highly turbid waters may lack speckles. Dark blotches present on the side can merge creating what looks like a dark lateral band. A stripe on the head, below the eye, extends to the snout, and there is a black 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 tubercles on the head and pectoral fins.

Owens speckled dace are highly variable. A morphometric comparison of all extant populations in the Owens basin found that, although populations differ significantly for many characteristics, there is also high morphological overlap between populations. The frenum was well developed only in the now extirpated Little Lake population. Maxillary barbels occurred in most populations, which separates Owens Valley fish from conspecific populations in the Walker River/Lahontan basin. Speckled dace in the northern Owens Valley have maxillary barbels on at least one side, a high lateral line scale count, a moderate lateral line pore count, and moderately sized fins. Benton Valley populations were described as having low lateral line scale and pore counts, maxillary barbels on at least one side, and comparatively long pelvic fins.

The following ranges in mean counts are for four populations in the Owens River drainage: lateral line scales 59.3-70.7; lateral line pores 11.6-61.7; dorsal rays 7.8-8.0; anal rays 7.0-7.1; pectoral rays 12.0-13.9; pelvic rays 7.0-7.6; total vertebrae 36.9-38.1.

Taxonomic Relationships: The speckled dace has long been considered the most widely distributed species in the western United States and isolated populations can be found in many small streams and springs. However, its taxonomy is complex because the species is naturally so variable and mobile. Small morphological differences among speckled dace populations isolated in different watersheds (especially in the endorheic valleys of the Great Basin) led early ichthyologists to describe 12 separate species (Jordan and Evermann 1896). Later, based on the flexible nature and plastic morphology of the species, all speckled dace were collapsed into a single species, *Rhinichthys osculus* (Hubbs 1974). Recently, however, genetic analysis has

supported a return to some of the original taxonomy. Today, a number of forms are recognized as separate taxa by ichthyologists due to their distinctive morphology, diverse habitats, isolation from other dace populations, and genetic differentiation. Five such forms appear to exist in the Death Valley system: the Owens speckled dace, the Long Valley speckled dace, the Amargosa Canyon speckled dace, the Ash Meadows speckled dace, and the Oasis Valley speckled dace.

Gilbert (1893) described *Rhinichthys nevadensis* from Ash Meadows, Nevada, but the subspecific name *R. o. nevadensis* has also been assigned to speckled dace in both the Amargosa River system and the Owens Valley (La Rivers 1962, Moyle 1976). However, since the 1980's, some investigators have placed speckled dace from Amargosa Canyon and the Owens Basin in separate undescribed subspecies (Williams et al. 1982, Deacon and Williams 1984). Sada et al. (1995) conducted a morphological and electrophoretic study of all extant speckled dace populations in the Death Valley region, which includes the Owens and Amargosa river systems, both of which were tributaries to pluvial Lake Manly during the Pleistocene (Miller 1946, Hubbs and Miller 1948). Their results suggest:

1. All the isolated populations in the Owens River hydrographic basin (Owens and Long valleys) show genetic and morphological differences from each other but, with one exception, not enough for them to be regarded as separate subspecies.
2. The exception is the Long Valley speckled dace population in Whitmore Hot Spring, which differs enough from other dace populations to be regarded as a separate subspecies (see account for Long Valley speckled dace).
3. Owens speckled dace are closely related to speckled dace found in the Amargosa River (*R. o. nevadensis*) of Death Valley and probably should be placed within the same subspecies, but each isolated population should be recognized as a distinct population segment for management purposes.
4. To date, studies of the Death Valley region's speckled dace complex indicate the Owens and Amargosa Canyon speckled dace should be treated as distinct population segments of a distinct taxon.

A comprehensive genetic study of *R. osculus* from throughout its entire range using mtDNA supports both the distinctive nature of the Long Valley speckled dace and the grouping of the other Owens basin dace populations with those of Amargosa and Ash Meadows (Oakey et al. 2004). The affinity between Amargosa and Owens Basin is likely the result of their occasional contact in pluvial Lake Manley (Hubbs and Miller 1948, Oakey et al. 2004).

Systematics for the five forms would thus be: Long Valley speckled dace (undescribed subspecies, *R. o. ssp.*); with Owens, Amargosa Canyon, Ash Meadows and Oasis Valley speckled dace representing distinct population segments within the subspecies *R. o. nevadensis.* Despite the fact that the Ash Meadows speckled dace was listed as a federally endangered species in 1984, the Owens and Amargosa Canyon populations remain unprotected, partially due to historic uncertainties about their taxonomic status.

Life History: Specific life-history adaptations of speckled dace from the Owens Basin are unknown. In general, speckled dace live three years and attain a maximum size of 80 mm SL in inland basins (Moyle 2002). Owens speckled dace, however, rarely exceed 50 mm SL in length. Because of the paucity of data on Owens populations, the following general description of speckled dace life history is based on data from other locations.

The subterminal mouth, pharyngeal tooth structure, and short intestine of the speckled dace are characteristic of small invertebrate feeders. 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 feed on filamentous algae (Li and Moyle 1976, Baltz et al. 1982, Hiss 1984, Moyle et al. 1991). Not surprisingly, diet varies according with prey availability and speckled dace, in general, prey opportunistically on the most abundant small invertebrates in their habitat, which may change with season (Moyle 2002). Preference of forage items may also be influenced by the presence of other fishes that share similar habitats.

Speckled dace are usually found in loose groups in appropriate habitats, although they avoid large shoals except while breeding. Their activity is mediated by stream temperatures, apparently staying active all year if water temperatures remain above 4°C (Moyle 2002). Slight changes in growth rates are positively correlated with changes in temperature, as seen in the Colorado River (Robinson and Childs 2001). Life expectancy is approximately 3 years where maximum sizes do not exceed 80 mm FL, but dace may reach 110 mm FL and live up to six years (Moyle 2002). By the end of their first summer, dace grow to 20-30 mm SL (Moyle 2002), growing an average of 10-15 mm/yr in each subsequent year. Females tend to grow faster than males. However, growth rates can decrease in the presence of extreme environmental conditions, high population densities, or limited food supply (Sada 1990). Dace reach maturity by their second summer, with females producing 190-800 eggs depending on size and location (Moyle 2002). Females release eggs underneath rocks or near the gravel surface while males release sperm (John 1963). Eggs settle into interstices and adhere to the gravel. At temperatures of 18-19°C, eggs hatch in 6 days but larvae remain in the gravel for another 7-8 days (John 1963). Fry in streams congregate in warm shallow areas, often in channels with rocks and emergent vegetation.

When extreme conditions such as floods, droughts or winter freezing eliminate local populations, speckled dace from nearby areas can readily recolonize or repopulate available habitats if accessible (Sada 1990, Pearsons et al. 1992, Gido et al. 1997).

Habitat Requirements: Speckled dace from the Owens Basin are known to occupy a variety of habitats, ranging from small coldwater streams to hot-spring systems, although they are rarely found in water exceeding 29˚C. They also have been found in irrigation ditches in and near Bishop. Despite the large variety of habitats apparently suitable to speckled dace in the Owens Basin, their disappearance from numerous localities since the 1930s and 1940s suggests they are vulnerable to habitat modifications and predation and or competition by alien fishes. Speckled dace in the Owens Valley appear to persist in periodically disturbed human-created habitats, and areas where alien predatory fishes are excluded by poor water quality or insufficient water depth (S. Parmenter, pers. comm. 2013).

Distribution: California Department of Fish and Wildlife (CDFW) files and museum records from the University of Michigan, Museum of Zoology and the California Academy of Sciences, dating back to the 1930s, indicate that speckled dace historically occupied most small streams and springs in the Owens Valley. In the most comprehensive survey of Owens Basin aquatic habitat to date (166 survey sites), dace were found to have been extirpated from 8 of the 17 sites from which they had been historically recorded. Dace were also discovered at two new

locations, from which they have since been extirpated (Sada 1989, S. Parmenter, CDFW, pers. comm. 2009).

Today, Owens speckled dace are only known to occupy three disjunct areas in the northern Owens Valley: Fish Slough, Round Valley, and areas around and in Bishop. Waterways within each of these areas are frequently or consistently interconnected. However, speckled dace dispersal among the three population areas appears to be largely severed by both the presence of alien brown trout in intervening waterways, and stream channelization.

Sada (1989) reported the extirpation of speckled dace from Benton Valley and the persistence of a single small population remaining in the East Fork Owens River drainage at Lower Marble Creek, near Benton. Subsequently, verbal accounts documented the Marble Creek population was eliminated during the Tri-Valley Flood of 1989 (S. Parmenter, CDFW, pers. comm. 2013).

Speckled dace no longer occupy irrigation ditches between Bishop and Big Pine or Little Lake (Inyo County). Nor were Dace found in Warm Springs, where CDFW biologists had planted 75 speckled dace in 1983 (Sada 1989).

Trends in Abundance: There are few data available on the historic abundance of this dace. Given its greatly diminished range, it is undoubtedly much less numerous than it once was. In the streams and irrigation ditches around Bishop, where they are widespread, speckled dace occur at low densities but quantitative abundance estimates are lacking (Sada 1989).

Nature and Degree of Threats: The causes of the decline of Owens speckled dace are complex, but the most significant threats are:

Alien species. Introduction of centrarchid predators (largemouth bass, bluegill, green sunfish and Sacramento perch) into springs and small streams can rapidly drive dace populations to extinction. Other introduced fishes that may be competitors or predators of speckled dace are western mosquitofish (*Gambusia affinis*), brown bullhead (*Ameiurus nebulosus*) and the various trouts. Spring populations can also be threatened by cattails, which can significantly reduce habitat by filling in shallow pools and marshes, alter food webs, and remove water through transpiration.

Isolation. As habitat is altered or otherwise made inaccessible to dace small, isolated, populations are created with no gene flow to other populations. These populations are particularly vulnerable to genetic drift or bottlenecking and to stochastic events which sharply increase probability of extirpation. For example, the Benton Valley populations occurred in small springs and stream segments that were "altered and occupied by introduced predators" (Sada 1989).

Diversions. Regulation of the Owens River has impacted floodplain habitat extent and quality.

Habitat alteration. Speckled dace are highly sensitive to impacts that simplify their habitat or reduce cover. In the Owens Valley, channelization and vegetation clearing may impact dace populations.

	Rating	Explanation
Major dams	Medium	Mainstem dams have likely reduced potential habitat by flow regulation and elimination of floodplain inundation
Groundwater extraction	High	Groundwater extraction has eliminated a majority of springs on the Owens Valley floor, which would have provided habitat for speckled dace
Agriculture	Low	Agricultural water demand may dry irrigation ditches which are important speckled dace habitat, particularly in the face of climate change
Grazing	Low	
Rural residential	Medium	Alteration of streams for diversion and landscaping in and around Bishop
Urbanization	Medium	Alteration of streams for diversion and flood control and conversion of ditches to covered pipelines in and around Bishop
Instream mining	N/A	
Mining	Low	Present in region but no known impacts
Transportation	Low	Roads presumably alter habitats in some areas
Logging	N/A	
Fire	Low	Grass and brush fires are rare in existing and historical dace habitat; prescribed fires are used to maintain dace habitat in Fish Slough
Recreation	Medium	Alteration to thermal spring habitats for swimming and other recreation has been, and continues to be, a substantial threat as is off-road vehicle use
Harvest	N/A	
Hatcheries	N/A	
Alien species	High	All populations are vulnerable

Table 1. Major anthropogenic factors limiting, or potentially limiting, viability of populations of Owens speckled dace in California. Factors were rated on a five-level ordinal scale where a factor rated "critical" could push a species to extinction in 3 generations or 10 years, whichever is less; a factor rated "high" could push the species to extinction in 10 generations or 50 years whichever is less; a factor rated "medium" is unlikely to drive a species to extinction by itself but contributes to increased extinction risk; a factor rated "low" may reduce populations but extinction is unlikely as a result. A factor rated "n/a" has no known negative impact. See methods section for descriptions of the factors and explanation of the rating protocol. Certainty of these judgments is intermediate.

Effects of Climate Change: The thermal spring systems which comprise a major portion of Owens speckled dace habitat are fed by aquifers dependent on snow melt for recharge. It is predicted that climate change will lead to a reduction in snow pack in the eastern Sierra Nevada due to warmer temperatures and a shift in precipitation toward rainfall in late winter and early spring months. However, the Owens Valley is at the base of the southernmost portion of the Sierra Nevada, where the range attains maximum elevations. Thus, the effects of climate change may be mitigated, at least to some extent, by retention of snow pack in this portion of the range. However, Moyle et al. (2013) score this 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. The predicted, hotter, drier future climate, paired with an ever-increasing human demand for water resources in the Owens Basin, strongly indicates that aquatic habitats must be protected if the Owens speckled dace is to persist.

Status Determination Score = 2.6 – High Concern (see Methods section, Table 2). The Owens speckled dace has been extirpated from many of its historic locations due to habitat alteration, alien species and water withdrawal. Only a handful of populations remain, mostly isolated from one another in the norther Owens Valley. The Owens speckled dace is listed as "Critically Imperiled", G5T1S1 by (Natureserve.org) and the American Fisheries Society lists it as "Threatened" (Jelks et al 2008).

Metric	Score	Justification
Area occupied	2	Few historic populations still extant in one watershed
Estimated adult abundance	3	Moderate fragmentation of existing populations today
Intervention dependence	3	Many populations depend on irrigation water for persistence, but no active management of natural populations is indicated
Tolerance	2	Relatively tolerant but vulnerable to habitat alteration and introduction of alien fishes and salamanders
Genetic risk	4	Moderate diversity but range fragmented into subpopulations with reduced connectivity
Climate change	2	Thermal pools provide relatively stable habitat for some populations but loss of water for irrigation could imperil other populations
Anthropogenic threats	2	See Table 1
Average	2.6	18/7
Certainty (1-4)	3	

Table 2. Metrics for determining the status of Owens speckled dace, where 1 is a major negative factor contributing to status, 5 is a factor with no or positive effects on status, and 2-4 are intermediate values. See methods section for further explanation.

Management Recommendations: The most critical needs for Owens speckled dace are:

1. Maintain existing, compatible land management practices and land uses on existing habitat. Consider creating special refuge areas and establishing additional populations, particularly in upstream areas from which larval drift could seed new areas or supplement existing populations.
2. Eliminate alien fishes from springs which historically supported speckled dace and reintroduce dace from local brood stock.
3. Establish Owens speckled dace at additional sites in the Owens Valley as recommended by Sada (1989) and by the Owens Basin Wetland and Aquatic Species Recovery Plan (USFWS 1998).

4. Establish an annual monitoring program for all populations. Isolated populations of dace are susceptible to habitat loss and alteration, effects of genetic drift, stochastic events, and to the establishment of alien fishes (Williams and Sada 1985).
5. Complete formal studies on taxonomic and genetic status and publish results in a peer-reviewed journal.
6. Initiate studies into both the specific life-history and habitat requirements of Owens populations of speckled dace.

FIGURE 35. Distribution of Owens speckled dace, *Rhinichthys osculus* ssp., in California.