Speckled Dace (*Rhinichthys osculus*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2023
Revised, March 2023
Web Version, 3/26/2024

Organism Type: Fish
Overall Risk Assessment Category: Uncertain

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1 Native Range and Status in the United States

Native Range

From NatureServe (2023):

"The most ubiquitous fish in the western U.S. (Page and Burr 1991), ranging from the Columbia River drainage (north to southern British Columbia) to the southern Gila River drainage of Arizona and Sonora, Mexico (Peden and Hughes 1981, Minckley et al. 1986, Varela-Romero 1990, Wallace 1980) […]"

From Nico and Fuller (2023):

"Western drainages (Pacific and endorheic) from Columbia River, British Columbia, to Colorado River, Arizona and New Mexico, and south into Sonora, Mexico (Page and Burr 1991)."

Status in the United States

From Nico and Fuller (2023):

"Native Range: Western drainages (Pacific and endorheic) from Columbia River, British Columbia, to Colorado River, Arizona and New Mexico, and south into Sonora, Mexico (Page and Burr 1991)."

According to Nico and Fuller (2023), nonindigenous occurrences of *Rhinichthys osculus* have been reported in the following States. Range of observation years, watersheds, and population status where reported (one or more watersheds) in parentheses.

- California (1939-1993; Central Coastal, Cuyama, Death Valley-Lower Amargosa (failed), Eureka-Saline Valleys (failed), Lower Eel, Mono Lake, Sacramento Headwaters, Santa Clara (failed), Santa Maria, Truckee; established)
- Nevada (1951-2005; Lake Mead, Long-Ruby Valleys; established)
- New Mexico (1975-1990; Mimbres; established)
- Oregon (1994; Lower Rouge; established)
- Utah (1952; San Rafael; unknown)

"Established [as nonnative populations] in San Luis Obispo Creek and Webber Lake, California (Moyle 1976), and in Ruby Marsh, Nevada (La Rivers 1962). Reported from New Mexico (Sublette et al. 1990). Fishes introduced into Willow Creek and the Old Borax Works of California failed to survive; however, the species was common at River Springs, California, in 1967, more than 25 years after its initial introduction (Miller 1968). Although Miller (1968) reported on its occurrence in the Santa Clara River system, California, Bell (1978) did not collect the species there."

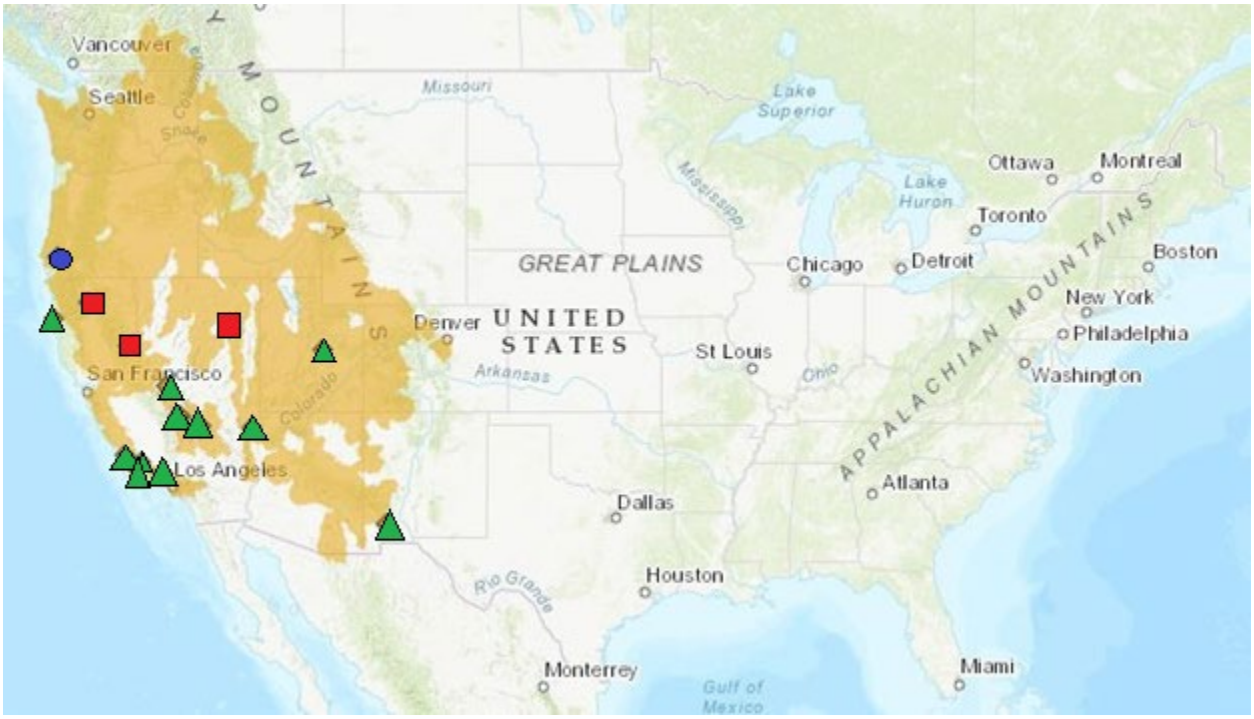

Figure 1. Non-native collection records (points) and native range (orange shading) for *Rhinichthys osculus* in the contiguous United States. Green triangles indicate nonnative records of *R.* osculus; the blue circle indicates a nonnative record for the subspecies *R. osculus klamathensis*; and the red squares indicate nonnative records for the subspecies *R. osculus robustus*. Map adapted from Nico and Fuller (2023).

No records of *Rhinichthys osculus* in live trade in the United States were found.

Regulations

Possession or importation of *Rhinichthys osculus* has been prohibited or regulated in three States (Colorado, Nevada, and Virginia). While every effort has been made to list all applicable State laws and regulations pertaining to this species, this list may not be comprehensive.

Rhinichthys osculus ssp. are listed as protected in Nevada (Nevada Board of Wildlife Commissioners 2022).

Rhinichthys osculus ssp. are listed as regulated in Virginia. A permit is required for importation, possession, and sale (Virginia Department of Wildlife Resources 2022).

Possession of *R. osculus* is restricted in Colorado (CPW 2022).

Means of Introductions within the United States

From Nico and Fuller (2023):

"Several transplants into parts of California during 1939 and 1940 were considered experiments to test the effects of changed environment on meristic and morphometric characters (Miller 1968). This species was intentionally stocked by Nevada Fish and Game officials in Ruby

Marsh-Ruby Lake complex as forage for introduced largemouth bass *Micropterus salmoides*; the first introduction, in 1950, involved *R. osculus robustus* from a headwater of the Humboldt River, and the second, in 1951, from nearby Diamond Valley, Eureka County (La Rivers 1962; Hubbs et al. 1974). Although La Rivers (1962) recognized that *R. osculus robustus* was native to the Truckee River system, he concluded that the high-altitude lake had no native fishes and that small fishes present in the lake had likely arrived as a result of being stocked along with trout. Introductions of this species in other areas were probably the result of bait bucket releases (e.g., Miller 1952; La Rivers 1962). For instance, Miller (1946) indicated that the presence of *Rhinichthys osculus* in the Santa Clara River system (California) was possibly the result of its introduction as bait by trout fishermen."

Remarks

From NatureServe (2023):

"The speckled dace is one of the most morphologically (and ecologically) variable fishes in western North America (Miller and Miller 1948, Minckley 1973). This variability is due to geologic events that have resulted in numerous isolated populations. This variability also reflects inadequate information on population interrelationships. Minckley (1985) referred to the 'speckled dace' complex, which reflects the view of many taxonomists that several species are now referred to as *Rhinichthys osculus*. Further taxonomic and systematic work is needed."

From Lyons (2019):

"*Rhinichthys osculus* exhibits high genetic diversity throughout much of its native range, under which several subspecies have been proposed or validated (Oakey et al. 2004, Billman et al. 2010, Hoekzema and Sidlaukis 2014, Wiesenfeld et al. 2018). Some studies suggest that many of these populations warrant consideration at the species level (Hoekzema and Sidlaukis 2014). Pending description of the high cryptic diversity within the *R. oculus* subspecies complex, non-genuine changes in the distribution or listing of *R. osculus* are likely."

From Moyle et al. (2023):

"Despite commonality of appearance across its vast range, the Speckled Dace is best referred to as the Speckled Dace complex, which is made up of multiple species and subspecies. One underlying reason for this is that these fishes occur in watersheds that have been isolated for long periods of time, sometimes millions of years, and support other endemic species, including fishes. This is especially true in California (Moyle 2002, Harrison 2013). Except in waters that also support anadromous fishes, Speckled Dace are often the only non-endemic native fish species listed for these watersheds. Smith *et al.* (2002, 2017) explain this phenomenon as the result of the dace's ability to colonize areas through headwater stream capture or similar routes not available to larger, less active fishes. If dace already occupy an invaded watershed, then a hybrid population emerges. Multiple events like this result in 'reticulate evolution' which presumably keeps populations from diverging at the species level. This process is assumed to prevent development of distinctive characteristics in dace populations, especially morphometric characters, even though the populations are currently isolated and may have been so for long periods of time (Smith *et al.* 2017, Bangs *et al.* 2020)."

According to ITIS (2023) and NatureServe (2023), the *Rhinichthys osculus* complex includes subspecies: *R. osculus adobe*, *R. osculus carringtonii, R. osculus klamathensis, R. osculus lariversi, R. osculus lethoporus, R. osculus moapae, R. osculus nevadensis, R. osculus nubilus, R. osculus oligoporus, R. osculus osculus, R. osculus religuus, R. osculus robustus, R. osculus thermalis, R. osculus velifer, R. osculus yarrow*, and other unnamed subspecies.

According to Nico and Fuller (2023), other common names include western dace, spring dace, dusky dace, and Pacific dace.

Because sources of information for this assessment frequently refer to only *Rhinichthys osculus* and/or *R. osculus* ssp., *Rhinichthys osculus* ssp. are grouped as part of the *R. osculus* complex and information found on *R. osculus* may encompass all subspecies for this assessment.

Rhinichthys osculus has been intentionally stocked outside its native range within the United States by State fishery managers to achieve fishery management objectives. State fish and wildlife management agencies are responsible for balancing multiple fish and wildlife management objectives. The potential for a species to become invasive is now one important consideration when balancing multiple management objectives and advancing sound, science-based management of fish and wildlife and their habitat in the public interest.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2023):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Ostariophysi
Order Cypriniformes
Suborder Cyprinoidea
Family Cyprinidae
Genus *Rhinichthys*
Species *Rhinichthys osculus* (Girard, 1856)

According to Fricke et al. (2023), *Rhinichthys osculus* is the current valid name for this species.

Size, Weight, and Age Range

From NatureServe (2023):

"Length: 8 centimeters"

"Maximum age of speckled dace in streams of the Chiricahua Mountains is 3 years (John 1964). Moyle et al. (1989) stated that some may live up to 5-6 years."

From Froese and Pauly (2023):

"Max length: 11.0 cm TL [total length] male/unsexed; [Page and Burr 2011]; common length: 6.3 cm TL male/unsexed; [Hugg 1996]"

Environment

From NatureServe (2023):

"Occurs in many kinds of habitats: riffles, runs, and pools of cool flowing headwaters, creeks, and small to medium rivers with mostly rocky substrates; large and small lakes (rarely); warm, permanent and intermittent streams; and outflows of desert springs (Moyle 1976); usually found in shallow water (averaging about 0.5 m deep or less); in streams, often congregates below riffles and eddies (Minckley 1973). Young tend to occupy edges of streams in slower, shallow water (Cross 1975). Larger adults generally are in relatively quiet water where cover (e.g., overhanging trees, deadfalls, boulders) is available (Minckley 1985)."

From Froese and Pauly (2023):

"Lowe et al. (1967) showed that speckled dace, collected from Sonoita Creek, Arizona, were intolerant to elevated temperatures and reduced oxygen levels."

Climate

From Froese and Pauly (2023):

"Temperate"

Distribution Outside the United States

Native

The native range for *Rhinichthys osculus* is within the United States, see section 1 for a full native range description.

From Nico and Fuller (2023):

"Western drainages (Pacific and endorheic) from Columbia River, British Columbia, […] and south into Sonora, Mexico (Page and Burr 1991)."

Introduced
No records were found for introduction of *Rhinichthys osculus* in the wild outside of the United States.

Means of Introduction Outside the United States
No records were found for introduction of *Rhinichthys osculus* in the wild outside of the United States.

Short Description
From Froese and Pauly (2023):

"Body elongate, greatest depth in front of dorsal fin. Head bluntly triangular, a small but distinct hump present behind the head. Mouth inferior, sucker-like, lower jaw with fleshy lip. Overall coloration gray or gray-brown with scattered and vague darker flecks, usually above midline of sides; lower sides and belly somewhat yellowish or creamy white. A faint lateral band present."

From Moyle et al. (2023):

"The morphology is variable (within limits) and the variability tends to be more related to habitat than to evolution in isolation. Thus, narrow caudal peduncles and large pectoral fins are found on fish in fast-moving streams and while thick caudal peduncles and smaller fins are found in quiet-water populations (Sada et al. 1995, Smith et al. 2002, 2017, Page and Burr 2011). Regardless, most forms are clearly recognizable as Speckled Dace (Figure 1[in source material])."

Biology
From NatureServe (2023):

"Stream populations spawn in swift water over rocky substrates. Lake populations spawn in shallow waters with gravel substrate or on gravel edge of riffles in inlet streams (Moyle 1976)."

"Mueller (1984) described spawning behavior of speckled dace in the San Francisco River, New Mexico. Spawning occurred in a 1-m square section of stream recently scoured by human activity. Spawning clusters formed, each with more than 25 fish. Dace thrashed violently (presumable at spawning) and eggs were found at depths to 5 cm. Most eggs were unexposed, attached to undersides of rocks or in interstices between rocks. Territoriality or spawning pairs were not observed."

"Females ranged from 45 to 75 mm SL [standard length] and numbers of eggs laid ranged from 174 to 514. Eggs hatched in 6 days at 18 to 19 C under laboratory conditions."

"An omnivorous benthic feeder, at times feeding on drift in mid-water or rarely at the surface (Schreiber and Minckley 1981). The diet consists mostly of benthic insects, also includes other invertebrates, algae, and detritus (little or no plant material or detritus in some areas) (Sublette et al. 1990, Woodbury 1933, Greger and Deacon 1988). Young feed mainly on zooplankton."

According to NatureServe (2023), spawning time is variable, likely dependent on location, and can range anytime from December to August. Spawning activity may also be triggered by flash floods.

Human Uses

From Nico and Fuller (2023):

"Widely used as a baitfish in certain parts of the western United States (Miller 1952; La Rivers 1962; Baxter and Simon 1970)."

Diseases

No information was found associating *Rhinichthys osculus* with any diseases listed by the World Organisation of Animal Health (2023).

According to Poelen et al. (2014), *Rhinichthys osculus* hosts the following parasites: *Bothriocephalus acheilognathi, Contracaecum, Dactylogyrus maculatus, Dactylogyrus osculus, Gyrodactylus osculus, Gyrodactylus rhinichthius, Gyrodactylus tahoensis, Hysterothylacium, Lernaea cyprinacea, Ornithodiplostomum, Posthodiplostomum, Rhabdochona, Yersinia ruckeri.*

According to CABI (2020), *Rhinichthys osculus* hosts the parasite *Trypanoplasma atraria*.

According to Foott et al. (2016), *Ichyophthirius multifiliis* were observed in *Rhinichthys osculus*.

Threat to Humans

From Froese and Pauly (2023):

"Harmless"

3 Impacts of Introductions

Although *Rhinichthys osculus* has been reported as introduced beyond its native range, no information on documented impacts of introduction (or lack of impacts) was found. The following information refers to *potential* impacts of introduction (or lack of impacts).

From Nico and Fuller (2023):

"Unknown in introduced areas. Speckled Dace are known to hybridize with least chubs *Iotichthys phlegethontis* (Sigler and Sigler 1987), a species under review for federal listing, and therefore present a threat to this rare species."

From Kinziger et al. (2011):

"We investigated genetic diversity in an introduced population of speckled dace (*Rhinichthys osculus*), […], which has had limited invasion success since their introduction to the Van Duzen River (northern California, USA) in the mid-1980s (Brown and Moyle 1997; Moyle 2002).

Initially suitable habitat conditions and low predation risk allowed establishment and rapid range expansion (Brown and Moyle 1997). However, despite the availability of suitable habitat, speckled dace have remained restricted to a 25-km stretch of the Van Duzen River."

"The key trait limiting the invasion success of speckled dace appears to be their inability to evade multiple predators (Harvey et al. 2004). Speckled dace contact sculpins (*Cottus aleuticus* and *C. asper*) and pikeminnow (*Ptychocheilus grandis*) at their downstream limit in the Van Duzen River. Competition for microhabitat and predation by benthic sculpins, combined with predation by the water-column-occupying pikeminnow, appear to prevent spread of speckled dace in this system (Harvey et al. 2004)."

The importation, possession, and/or trade of *Rhinichthys osculus* is regulated in the following States (see Section 1 for detailed information): Colorado (CPW 2022), Nevada (Nevada Board of Wildlife Commissioners 2022) and Virginia (Virginia Department of Wildlife Resources 2022).

4 History of Invasiveness

The History of Invasiveness for *Rhinichthys osculus* is classified as Data Deficient. *R. osculus* is recorded as being used for bait but no records of the species in trade were found. Established populations of *R. osculus* have been found outside of its native ranges, but the information available on impacts of introduction was sparse and inconsistent. One study observed limited spread of the species from an introduced location, potentially restricting its potential for impact, while another source warned of potential impacts to a rare species. More information is needed to draw conclusions about the invasiveness of this species where it has been introduced.

5 Global Distribution

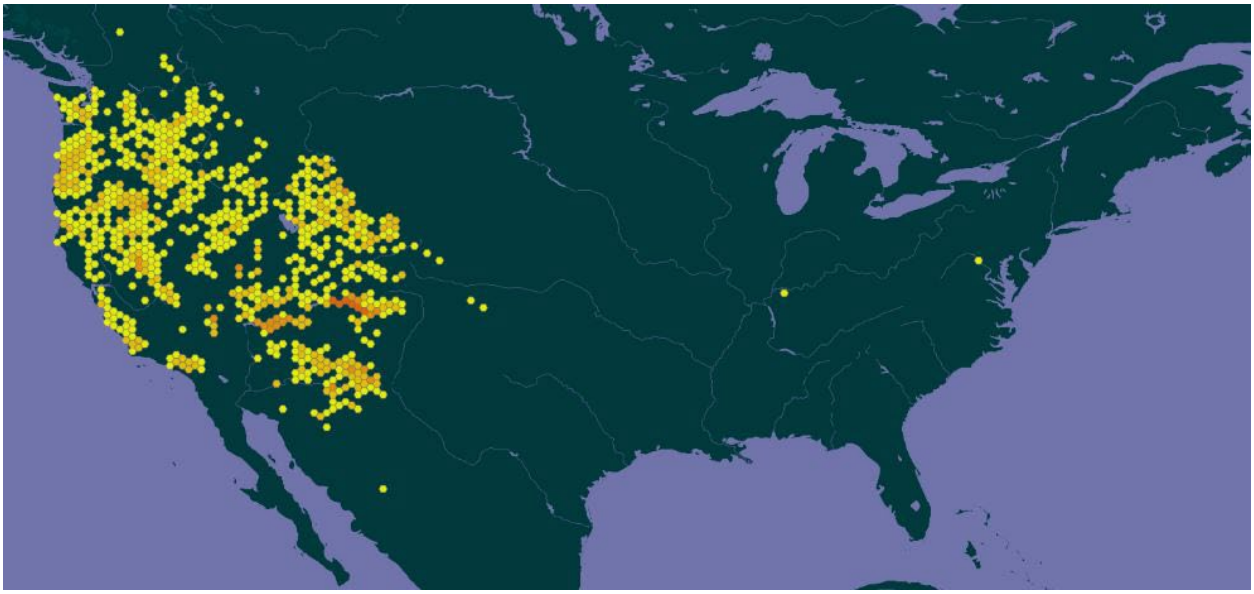

Figure 2. Known global distribution of *Rhinichthys osculus*. Observations are reported from Canada, the United States, and Mexico. Map from GBIF Secretariat (2023). A single point in China was not included in this figure because capture information was lacking; it was assumed to be an error and was excluded from the climate matching analysis. The points in southeast Colorado, northwest Oklahoma, and Kentucky had incorrect coordinates based on the record information and were not included in the climate matching analysis. The point in Maryland and the isolated point in Mexico were not found to be indicative of an established population and were excluded from the climate matching analysis.

6 Distribution Within the United States

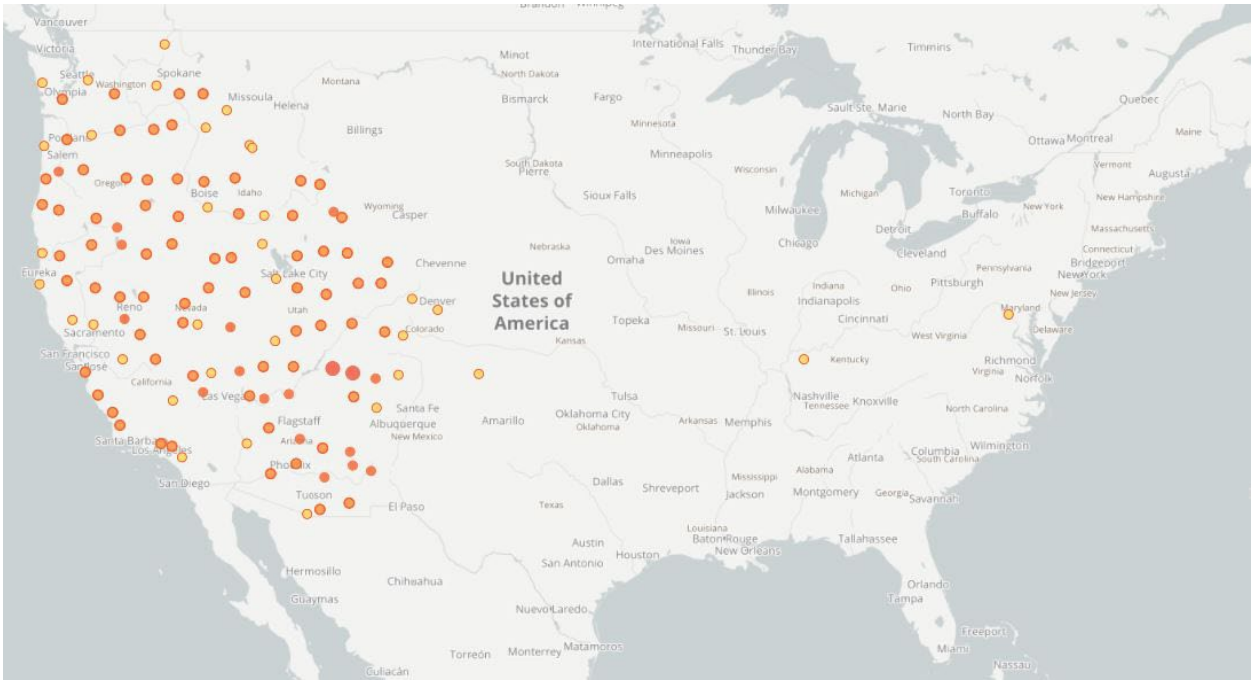

Figure 3. Reported distribution of *Rhinichthys osculus* in the United States. Map from GBIF-US (2023). The points in southeast Colorado, northwest Oklahoma, and Kentucky had incorrect coordinates according to the record information and were not included in the climate matching analysis. The point in Maryland was not found to be indicative of an established population and was excluded from the climate matching analysis.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Rhinichthys osculus* in the contiguous United States was generally high in the western United States where this species is native, and gradually decreased in match moving southeast towards the Gulf Coast States. An area of high match was also found in the northern Great Lakes. Medium matches were found in the southern Midwest, the Appalachian Range, and the Northeast. Low matches were found along the Gulf Coast and other coastal portions of the Southeast and Mid-Atlantic. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.730, indicating that Yes, there is establishment concern for this species outside its native range. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024).

Projected climate matches in the contiguous United States under future climate scenarios are available for *Rhinichthys osculus* (see Appendix). These projected climate matches are provided

as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category.

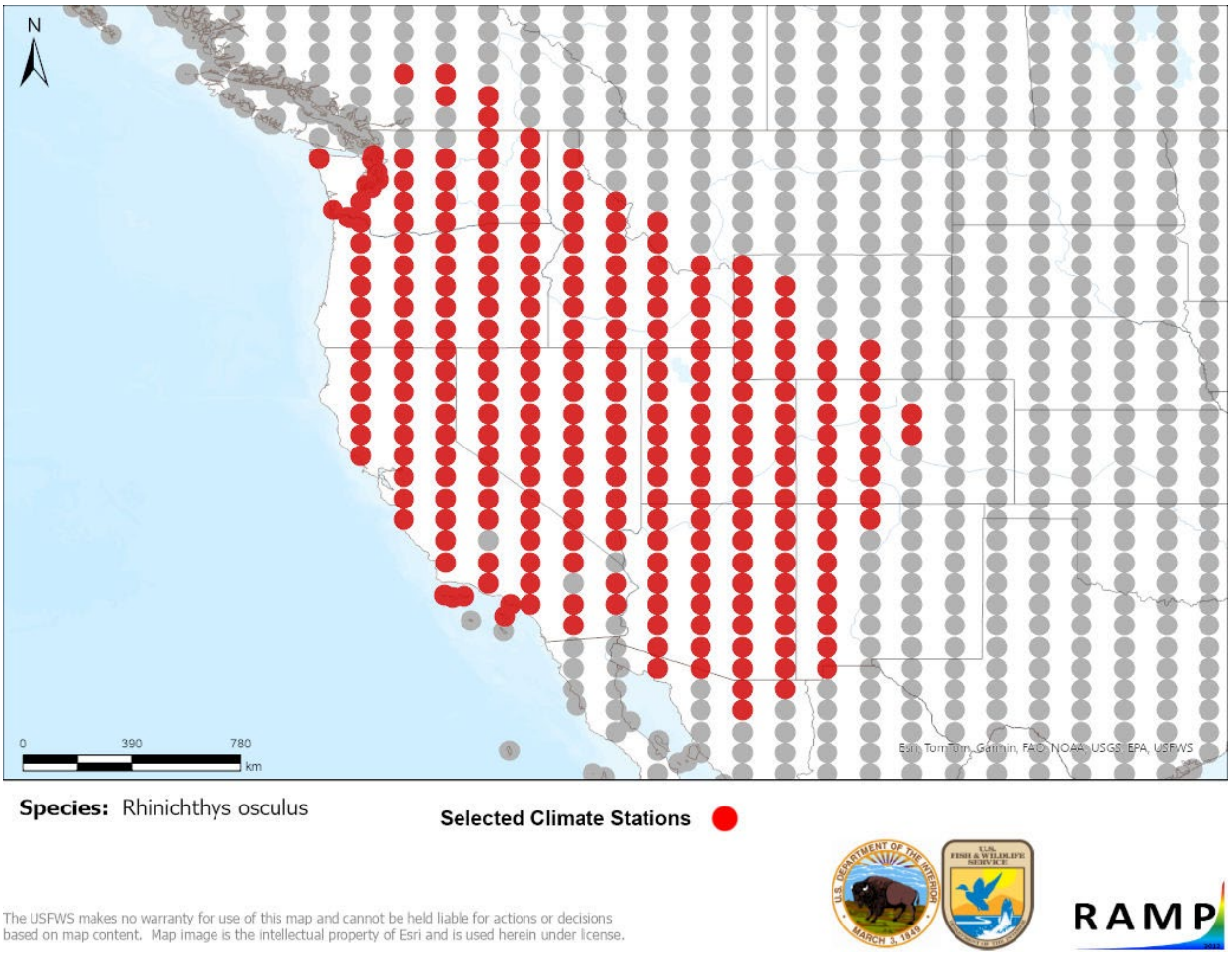

Figure 4. RAMP (Sanders et al. 2023) source map showing weather stations in western North America selected as source locations (red; United States [Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming], Canada [British Columbia], Mexico [Sonora]) and non-source locations (gray) for *Rhinichthys osculus* climate matching. Source locations are from GBIF Secretariat (2023). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

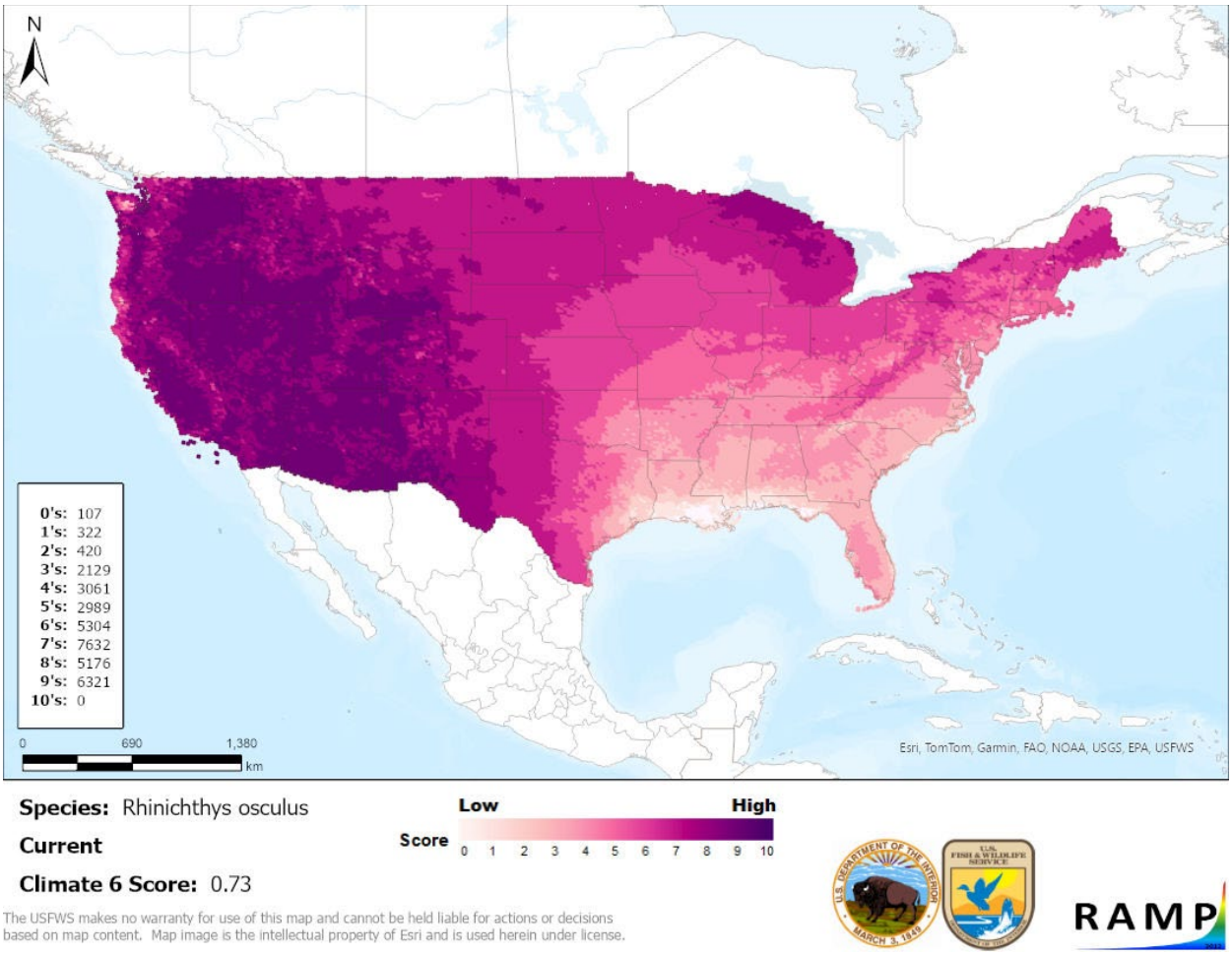

Figure 5. Map of RAMP (Sanders et al. 2023) climate matches for *Rhinichthys osculus* in the contiguous United States based on source locations reported by GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Rhinichthys osculus* is classified as Low. Information is available on the biology, ecology, and distribution of *R. osculus*. However, no information is available on actual impacts of introduction, and no information is available on *R. osculus* in trade. The taxonomic issues involved in the *R. osculus* species complex also contributed to increased uncertainty in this screening.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Rhinichthys osculus, the Speckled Dace, is a freshwater fish that is native to western North America from the Columbia River drainage in southern British Columbia, Canada to the Gila River in Arizona and portions of northern Sonora, Mexico. *R. osculus* is commonly found in rocky riffles, runs and pools of cool flowing water such as creeks, streams, and small to medium

rivers. This species is intolerant to high temperatures and low oxygenated waters. They are often used as bait by anglers but not found in-trade during this assessment. *R. osculus* has been introduced to areas adjacent to its native range. *R. osculus* has been intentionally stocked outside its native range for scientific or management purposes. The History of Invasiveness for *R. osculus* is classified as Data Deficient due to minimal information regarding impacts of introduction. The climate matching analysis for the contiguous United States indicates establishment concern for this species outside its native range. High climate matches were found for the entire western United States, which includes this species' native range, as well as the northern Great Lakes. The Certainty of Assessment for this ERSS is classified as Low due to lack of information regarding impacts of introduction and trade and the taxonomic complexity of the *R. osculus* species complex. The Overall Risk Assessment Category for *Rhinichthys osculus* in the contiguous United States is Uncertain.

Assessment Elements

- **History of Invasiveness (see section 4): Data Deficient**
- **Establishment Concern (see section 7): Yes**
- **Certainty of Assessment (see section 8): Low**
- **Remarks, Important additional information: Literature indicates a need for taxonomic revision of this species.**
- **Overall Risk Assessment Category: Uncertain**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in section 11.

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11 Literature Cited in Quoted Material

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

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Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by GBIF Secretariat (2023).

Under the future climate scenarios (figure A1), on average, high climate match for *Rhinichthys osculus* was projected to occur in California, the Colorado Plateau, Great Basin, Southwest, and Western Mountains regions of the contiguous United States. Areas of low climate match were projected to occur in generally in the Southeast. The areas of low match expanded northward with time and from SSP3 to SSP5. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.506 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.659 (model: MPI-ESM1-2-HR, SSP3, 2055). All future scenario Climate 6 scores were above the establishment concern threshold, indicating that Yes, there is establishment concern for this species under future scenarios. The Climate 6 score for the current climate match (0.730, figure 5) falls above the range of scores for future projections. The time step and climate scenario with the most change relative to current conditions was SSP5, 2085 (figure A3). Under all time step and climate scenarios minimal to no positive change in the climate match relative to the current match were observed. Under multiple time step and climate scenarios, particularly under SSP5, areas within the Appalachian Range, California, Great Lakes, Mid-Atlantic, Northeast, Northern Pacific Coast, and Southeast saw a large decrease in the climate match relative to current conditions. Additionally, areas within the Colorado Plateau, Great Basin, Gulf Coast, Northern Plains, Southern Atlantic Coast, Southern Plains, Southwest, and Western Mountains saw a moderate decrease in the climate match relative to current conditions. The degree of change increased with time and from SSP3 to SSP5.

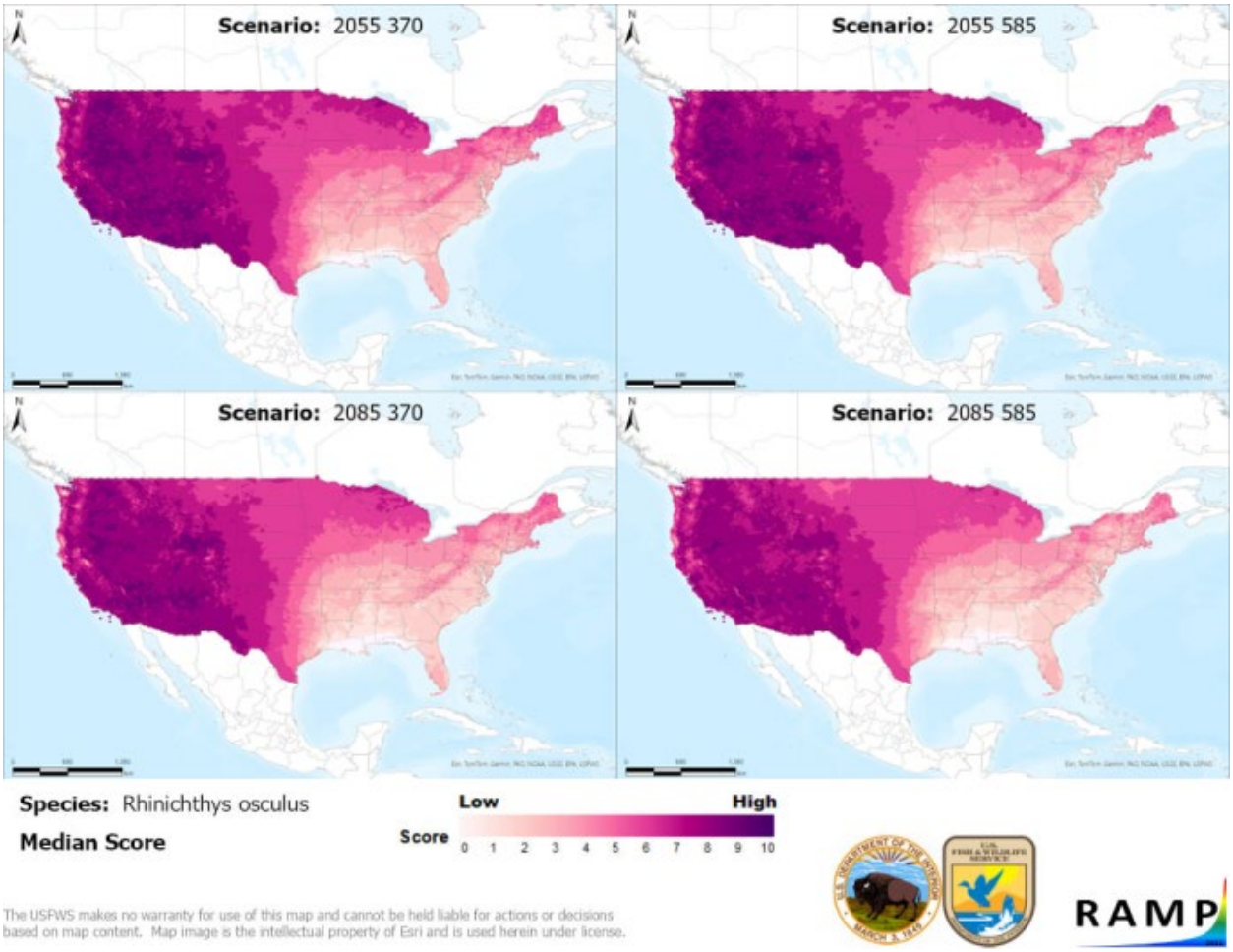

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Rhinichthys osculus* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

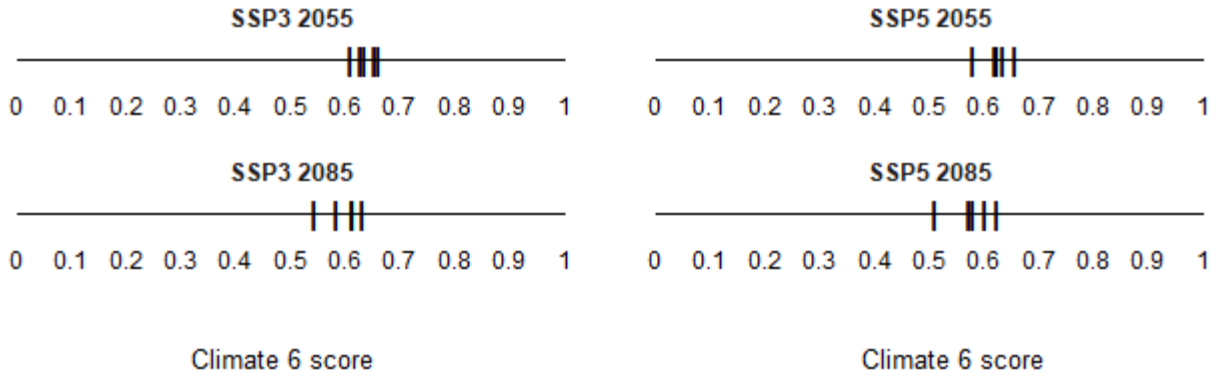

Figure A2. Comparison of projected future Climate 6 scores for *Rhinichthys osculus* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0.

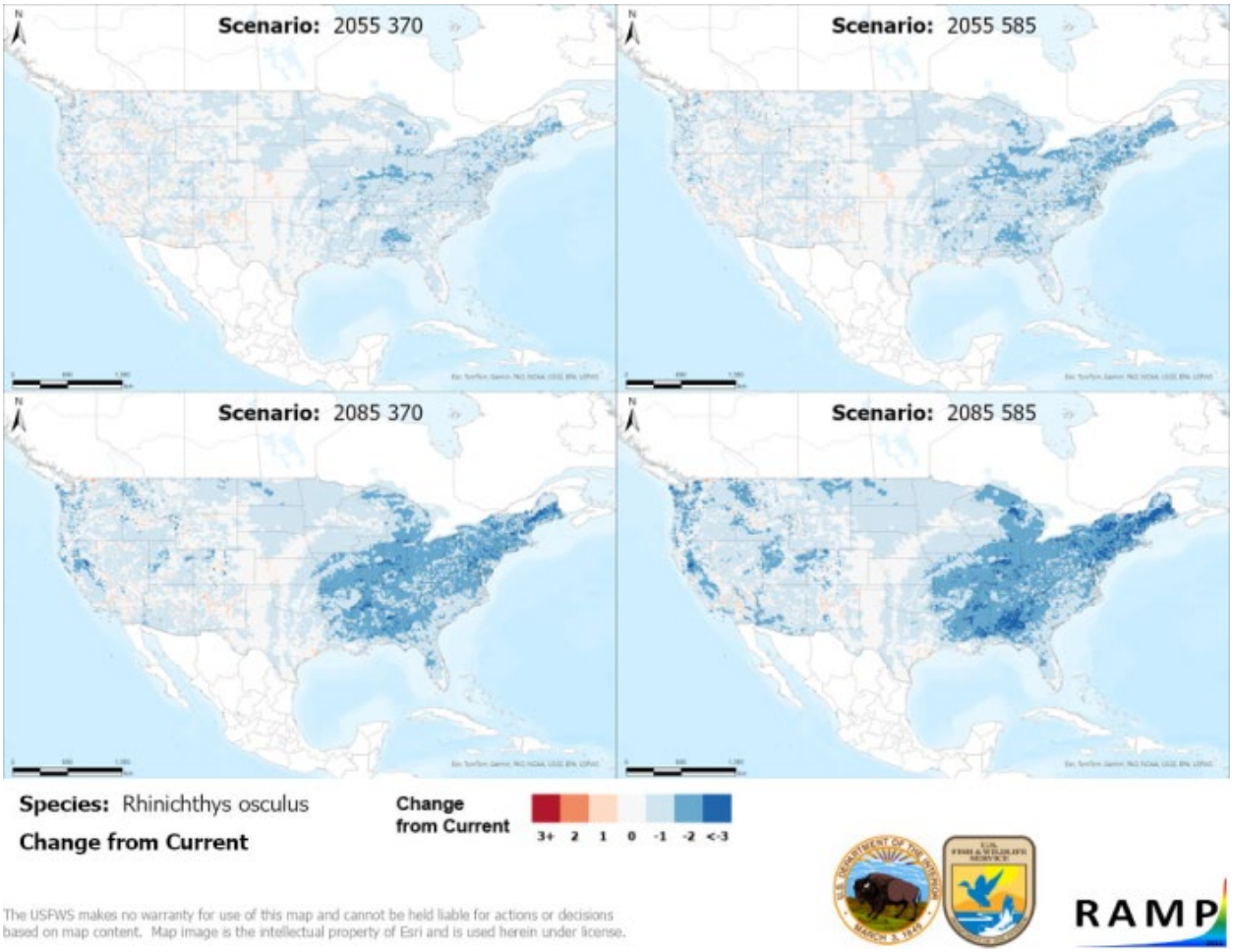

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Rhinichthys osculus* based on source locations reported by GBIF Secretariat (2023). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate greater change.

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