U.S. Fish & Wildlife Service

Rosy Bitterling (*Rhodeus ocellatus*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, September 2016
Revised, June 2019, September 2019, March 2020
Web Version, 5/1/2020

Organism Type: Fish
Overall Risk Assessment Category: Uncertain

Photo: Seotaro. Licensed under CC BY-SA 3.0. Available: https://www.cabi.org/isc/datasheet/66070. (July 2019).

1 Native Range, and Status in the United States

Native Range

Conflicting information is available on the native range of this species. The most recent phylogeographic research (Tsao et al. 2016) indicates that, at minimum, mainland China is part of the native range. Unless otherwise indicated, information pertains to the species as a whole (multiple subspecies).

From Huckstorf (2013):

"The species is thought to be native to Taiwan only […]"

From CABI (2014):

"The native range of *R. o. ocellatus* is Taiwan (Welcomme, 1988). *R. o. kurumeus* (/*smithii*) is considered as an indigenous endemic to Japan (Kimura and Nagata, 1992)."

Froese and Pauly (2019) report the species as native in China (Ye 1991), Japan (Kimura and Nagata 1992), Taiwan (Welcomme 1988), and Russia (Bogutskaya and Naseka 2004). In contrast, Novomodny et al. (2004) report the species as introduced in the Amur River basin of Russia.

From Tsao et al. (2016):

"Rose bitterling, *Rhodeus ocellatus*, is a small cyprinid fish distributed in East Asia. To infer its phylogeography and genetic structure, specimens from Taiwan, China, and Japan were collected, and complete mitochondrial cytochrome *b* (*cyt b*) DNA sequences were amplified and sequenced. Phylogenetic analyses identified seven mitochondrial lineages (A-G). Among them, three lineages (A, B, and C) distributed in mainland China. Lineages D, E, and F distributed in Japan, Korea, and Taiwan, respectively. Lineage G distributed in both China and Japan. The results of the Bayesian Binary MCMC analysis (BBM) suggested that the most recent common ancestor of *R. ocellatus* was from Lower Yangtze region. […] Lineage D in Japan was dispersed from the mainland China before the opening of the Sea of Japan, and lineage F in Taiwan was dispersed from the mainland China through the land bridge in the Pleistocene."

Status in the United States

This species has not been reported as introduced or established in the United States. There are no known trade restrictions targeting this species in the United States. This species may be in trade in the United States.

From Aquatic Arts (2019):

"ROSY BITTERLING (RHODEUS OCELLATUS OCELLATUS)"

"Sold Out"

Means of Introductions to the United States

This species has not been reported as introduced or established in the United States.

Remarks

A previous version of this ERSS was published in October 2012. Although there are two distinct subspecies of *R. ocellatus*, both this ERSS and the previous version pertain to the full species.

From Tsao et al. (2016):

"*Rhodeus ocellatus* (Kner, 1866), is a widespread species with high genetic diversity in East Asia (Chang et al. 2014; Kawamura et al. 2014). It consists of two subspecies: (1) *R. o. ocellatus* (Kner, 1866), which distributed [*sic*] in China, Korea, and Taiwan. (2) *R. o. kurumeus* Jordan and Thompson, 1914, which distributed [*sic*] only in western Japan. *R. o. ocellatus* was accidentally introduced from the Yangtze River basin of China into Japan and dispersed rapidly (Nakamura 1955). Hybridization between the two subspecies was detected in several populations in Japan that caused genetic introgression by *R. o. ocellatus* into *R. o. kurumeus* (Nagata et al. 1996; Kawamura et al. [2001]). *R. o. kurumeus* is now an endangered cyprinid species, however, its genetic distinctness has been spoiled by hybridization (Kawamura et al. [2001])."
From CABI (2014):

"Japanese rosy bitterling (*R. o. kurumeus*) and Chinese rosy bitterling (*R. o. ocellatus*) are morphologically very similar. *R. o. ocellatus* primarily differs from *R. o. kurumeus* by the presence of white colouration along the anterior margin of the pelvic fins (Kawamura et al., 2001)."

According to Fricke et al. (2020), the following are synonyms of *R. ocellatus*: *Pseudoperilampus ocellatus, Rhodeus hwanghoensis, Rhodeus kurumeus, Rhodeus maculatus, Rhodeus pingi,* and *Rhodeus wangkinfui*. All names were used in searching for information for this report.

Froese and Pauly (2019) report *R. ocellatus* as questionable in Vietnam (Nguyen et al. 2011).

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2016):

Kingdom Animalia
  Subkingdom Bilateria
    Infrakingdom Deuterostomia
      Phylum Chordata
        Subphylum Vertebrata
          Infraphylum Gnathostomata
            Superclass Osteichthyes
              Class Actinopterygii
                Subclass Neopterygii
                  Infraclass Teleostei
                    Superorder Ostariophysi
                      Order Cypriniformes
                        Superfamily Cyprinoidea
                          Family Cyprinidae
                            Genus *Rhodeus*
                              Species *Rhodeus ocellatus* (Kner, 1866)

From Fricke et al. (2020):

“Current status: Valid as *Rhodeus ocellatus* (Kner 1866). Acheilognathidae.”

Size, Weight, and Age Range

From Froese and Pauly (2019):

“Max length : 9.2 cm SL male/unsexed; [Yang et al. 2016]; common length : 5.2 cm SL male/unsexed; [Nichols 1943]”

From CABI (2014):

“Females mature at 24 mm SL.”

“The longevity of *R. o. ocellatus* is 3-4 years.”

Environment

From Froese and Pauly (2019):

“Freshwater; brackish; benthopelagic; pH range: ? - 7.0; dH range: 10 – 15. […] 18°C - 24°C [Baensch and Riehl 1985; assumed to represent recommended aquarium temperature range]”

Climate

From Froese and Pauly (2019):

“Subtropical; […]”

Distribution Outside the United States

Native

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From Huckstorf (2013):

“The species is thought to be native to Taiwan only […]”

From CABI (2014):

“The native range of *R. o. ocellatus* is Taiwan (Welcomme, 1988). *R. o. kurumeus* (/*smithii*) is considered as an indigenous endemic to Japan (Kimura and Nagata, 1992).”

Froese and Pauly (2019) report the species as native in China (Ye 1991), Japan (Kimura and Nagata 1992), Taiwan (Welcomme 1988), and Russia (Bogutskaya and Naseka 2004). In contrast, Novomodny et al. (2004) report the species as introduced in the Amur River basin of Russia.

From Tsao et al. (2016):

"Rose bitterling, *Rhodeus ocellatus*, is a small cyprinid fish distributed in East Asia. To infer its phylogeography and genetic structure, specimens from Taiwan, China, and Japan were collected, and complete mitochondrial cytochrome *b* (*cyt b*) DNA sequences were amplified and sequenced. Phylogenetic analyses identified seven mitochondrial lineages (A-G). Among them, three lineages (A, B, and C) distributed in mainland China. Lineages D, E, and F distributed in Japan, Korea, and Taiwan, respectively. Lineage G distributed in both China and Japan. The results of the Bayesian Binary MCMC analysis (BBM) suggested that the most recent common ancestor of *R. ocellatus* was from Lower Yangtze region. […] Lineage D in Japan was dispersed from the mainland China before the opening of the Sea of Japan, and lineage F in Taiwan was dispersed from the mainland China through the land bridge in the Pleistocene."

Introduced

A clear picture of *R. ocellatus* introductions is difficult to obtain due to the lack of consensus on the native range. Reported introduction locations are based on assumptions about where the species is native; these assumptions vary between authors particularly for China, Japan, Taiwan, Korea, and Russia.

From Huckstorf (2013):

"[…] widely introduced in mainland China from Taiwan in the 18th century and from China to Korea and Japan. In the 20th century, it was also introduced to Turkmenistan, Uzbekistan and Fiji."

According to Froese and Pauly (2019), *R. ocellatus* has been introduced and is established outside its native range in China, South Korea, Japan, and Fiji. It has been introduced in Uzbekistan as well, but its status there is unknown. No information is available on the introduction to Turkmenistan mentioned by Huckstorf (2013).

According to Kamilov et al. (2004), *R. ocellatus* is categorized as "accidental acclimatized not commercial" in Uzbekistan.

From Petr and Mitrofanov (1998):

"There has been an immigration of fish species to Turkmenistan from Uzbekistan reservoirs and lakes, including […] *Rhodeus ocellatus* (Kner) (Salnikov & Reshetnikov 1991)."

From Vanina et al. (2014):

"Alien fish species [in the Syr Darya River basin of Kazakhstan] are: […] ocellated bitterling *Rhodeus ocellatus* (Kner, 1865) […]"

According to Zhang and Jiang (2016), *R. ocellatus* is established in the Xinjiang Uyghur Autonomous Region in northwest China.

Novomodny et al. (2004) report *R. ocellatus* as introduced in the Amur River basin of Russia.

Means of Introduction Outside the United States

From CABI (2014):

"The main pathway is transfer of fish seed between fish farms. *R. o. ocellatus* escapes from fishponds and spreads in wild via irrigation canals. To prevent spread of this species all transported fish seed should be properly checked for the presence of *R. o. ocellatus* before release in ponds."

"Fish fry can be transferred within bivalves and *R. o. ocellatus*, in turn, can be a vector for bivalves as mussels use bitterlings as hosts for their larvae (glochidia)."

"Another pathway of introduction is releasing by aquarium hobbyists."

"In ancient times *R. o. ocellatus* was introduced into eastern China. From China was introduced into the Korean Peninsula and Japan as an ornamental species. For a long time those counties were considered as the native range (Welcomme, 1988). However, in Japan one of the subspecies, *R. o. kurumeus* (/*smithii*), is regarded as an indigenous endemic whereas another subspecies, *R. o. ocellatus*, is considered to have been introduced accidentally from mainland China, as contamination of seedlings of Asian carp in 1942 (Chiba et al., 1989; Kimura and Nagata, 1992; Kawamura et al., 2001; Sato et al., 2010)."

"In Central Asia *R. o. ocellatus* was unintentionally introduced along with Asian carp from the Yangtze River. It was first released into the Karametniyaz fish farm and the Kara-Kum Canal, Turkmenistan in 1958-1961. Then in 1961 it was introduced (again with larvae of Asian carp) to Uzbekistan into the Akkurgan (later Baliqchi) fish farm, in the Tashkent region."

Short Description

From CABI (2014):

"*R. o. ocellatus* is a small fish with a very deep, laterally compressed body. The female has an ovipositor which elongates in the spawning period. In the breeding season the male is brightly coloured and covered with tubercles. Female and juvenile bitterlings have a black blotch on the anterior part of dorsal fin. Pharyngeal teeth in 1 row. Lateral line is incomplete, 3-11 pored scales. In Uzbekistan: D II-III 9-12, A II-III 9-12 (Makeeva and Shubnikova, 1978)."

From Froese and Pauly (2019):

"Dorsal soft rays (total): 13-14; Anal soft rays: 13 - 14."

Biology

From CABI (2014):

"*R. o. ocellatus* is a lentic species found in rivers, lakes, reservoirs, canals, and marshes, preferring lakes and the stagnant parts of rivers. It keeps to the water surface in stagnant waters."

"*R. o. ocellatus*, as with other bitterlings, have a reproductive symbiosis with bivalves. The female lays its eggs inside the mantle cavity of the mussel. The mollusc, in turn, uses the bitterlings for the distribution of its own larvae (glochidias)."

"The breeding season extends from the middle of March to the middle of September in Japan. Spawning is fractional. The average individual fecundity is 17-69 eggs. *R. o. ocellatus* lays eggs inside bivalves. The larvae remain in the mantle cavity until they can swim (Asahina et al., 1980; Gultneh et al., 1984)."

"In the Shin Tone River, Japan, the diet of *R. o. ocellatus* consists mostly on [*sic*] diatoms, with a smaller proportion of crustaceans and green algae (Gultneh et al., 1985)"

Human Uses

From Froese and Pauly (2019):

"Aquarium: commercial"

This species may be in trade in the United States.

From Aquatic Arts (2019):

"ROSY BITTERLING (RHODEUS OCELLATUS OCELLATUS)"

"Sold Out"

Diseases

From Lilley et al. (1998):

"Species susceptible to EUS [epizootic ulcerative syndrome] […] *Rhodeus ocellatus*"

OIE (2019) lists "Infection with *Aphanomyces invadans* (epizootic ulcerative syndrome)" in its "OIE-Listed diseases, infections and infestations in force in 2019".

CABI (2014) lists the following as non-specific parasites of *Rhodeus ocellatus*: *Centrocestus armatus, Centrocestus taiwanense. Clinostomum complanatum, Clonorchis sinensis, Dactylogyrus chongqingensis. Dactylogyrus oblongus, Dactylogyrus rhodeusi, Echinochasmus fujianensis, Echinochasmus japonicas. Exorchis oviformis, Haplorchis pumilio, Liolope copulans, Metagonimus yokogawai*, and *Stamnosoma armatum*

Threat to Humans

From Froese and Pauly (2019):

"Potential pest [Chiba et al. 1989; no further details available]"

3 Impacts of Introductions

From NIES (2016):

"Impact: Competition, hybridization against native species."

"Regulation in Japan: Keeping and release of this species in Shiga and Saga Prefs. are controled [*sic*] by a prefectural ordinance."

From CABI (2014):

"*R. o. ocellatus* is considered as a pest in fish farms and competitor of juveniles of commercial species. It has been reported from fish farms and reservoirs that it feed on their eggs and fry of other fish."

"In Japan, *R. o. ocellatus* endangers the native subspecies *R. o. kurumeus* (/*smithii*) by ecological pressures and hybridization. The latter is now on the brink of extinction as a distinct subspecies (Kimura and Nagata, 1992; Kawamura et al., 2001; Sato et al., 2010)."

"Mollusc shells, transferred with *R. o. ocellatus*, become traumatic agents [presumably to human skin] in water bodies."

From Washitani (2004):

"*Rhodeus ocellatus ocellatus*, which was unintentionally introduced through intermingling with the fry of *Hypophthalmichthys molitrix* imported from China as a fishery resource, has become established in fresh aquatic ecosystems through range expansion facilitated by human activities of stocking lakes and rivers (Nagata 1980). *R. ocellatus ocellatus* has hybridized with *Rhodeus ocellatus kurumeus*, which was once widely distributed in western Japan but has now become endangered (Environment[al] Agency of Japan 1999). Hybridization with *R. ocellatus ocellatu*s is assumed as the main cause of the threat."

4 History of Invasiveness

Rhodeus ocellatus has a documented history of introduction into Central Asia and Fiji through contamination of stocks of carp larvae. The species is also moved intentionally as part of the ornamental trade. There are several indications that this species has negative impacts on aquaculture, native species, and humans, but these impacts have not been documented with sufficient scientific rigor. Without detailed and scientifically credible evidence of impacts to other species (not just subspecies of *R. ocellatus*) or to the economy within its introduced range, the history of invasiveness is categorized as "Data Deficient."

5 Global Distribution

Figure 1. Known global distribution of *R. ocellatus*. Map from GBIF Secretariat (2019). Lighter colors indicate a higher number of records from that area. An occurrence in Massachusetts was excluded from the extent of this map and the climate matching analysis because of erroneous identification. The occurrence in Vietnam was excluded from the climate matching analysis because presence of *R. ocellatus* in Vietnam is "questionable" (Froese and Pauly 2019). No georeferenced occurrences were available for portions of the established range in Russia, Central Asia or Fiji.

6 Distribution Within the United States

This species has not been reported as introduced or established in the United States.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2018; 16 climate variables; Euclidean Distance) was medium-high in the Southeast, Mid-Atlantic, Southern Appalachian, and parts of the Midwest regions. Climate match was medium throughout the remainder of the Midwest and into Texas. Low matches were predicted in the far Northeast, around Lake Superior, in the West, and in a patch of the South centered in Louisiana, Arkansas, and eastern Texas. The Climate 6 score for *Rhodeus ocellatus* in the contiguous United States was 0.131, indicating a high overall climate match. (Scores of 0.103 and greater are classified as high.) The following States had high individual Climate 6 scores: Florida, Georgia, Illinois, Indiana, Kansas, Maryland, Missouri, North Carolina, New Jersey, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, and West Virginia. Six additional States had medium individual Climate 6 scores: Alabama, Arkansas, Delaware, Kentucky, Michigan, and New York.

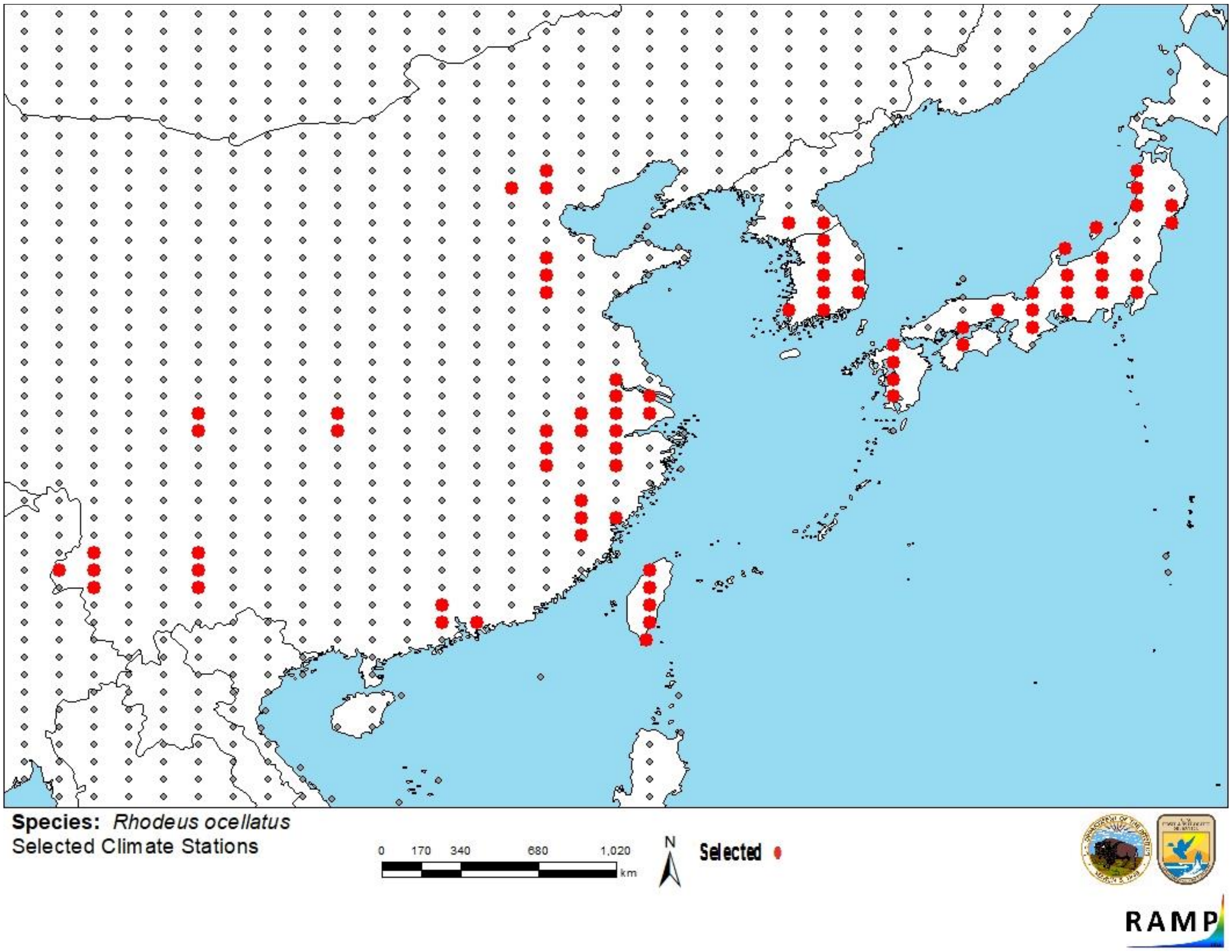

Figure 2. RAMP (Sanders et al. 2018) source map showing weather stations in East Asia selected as source locations (red; Japan, Taiwan, China, and the Korean Peninsula) and non-source locations (gray) for *Rhodeus ocellatus* climate matching. Source locations from GBIF Secretariat (2019). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

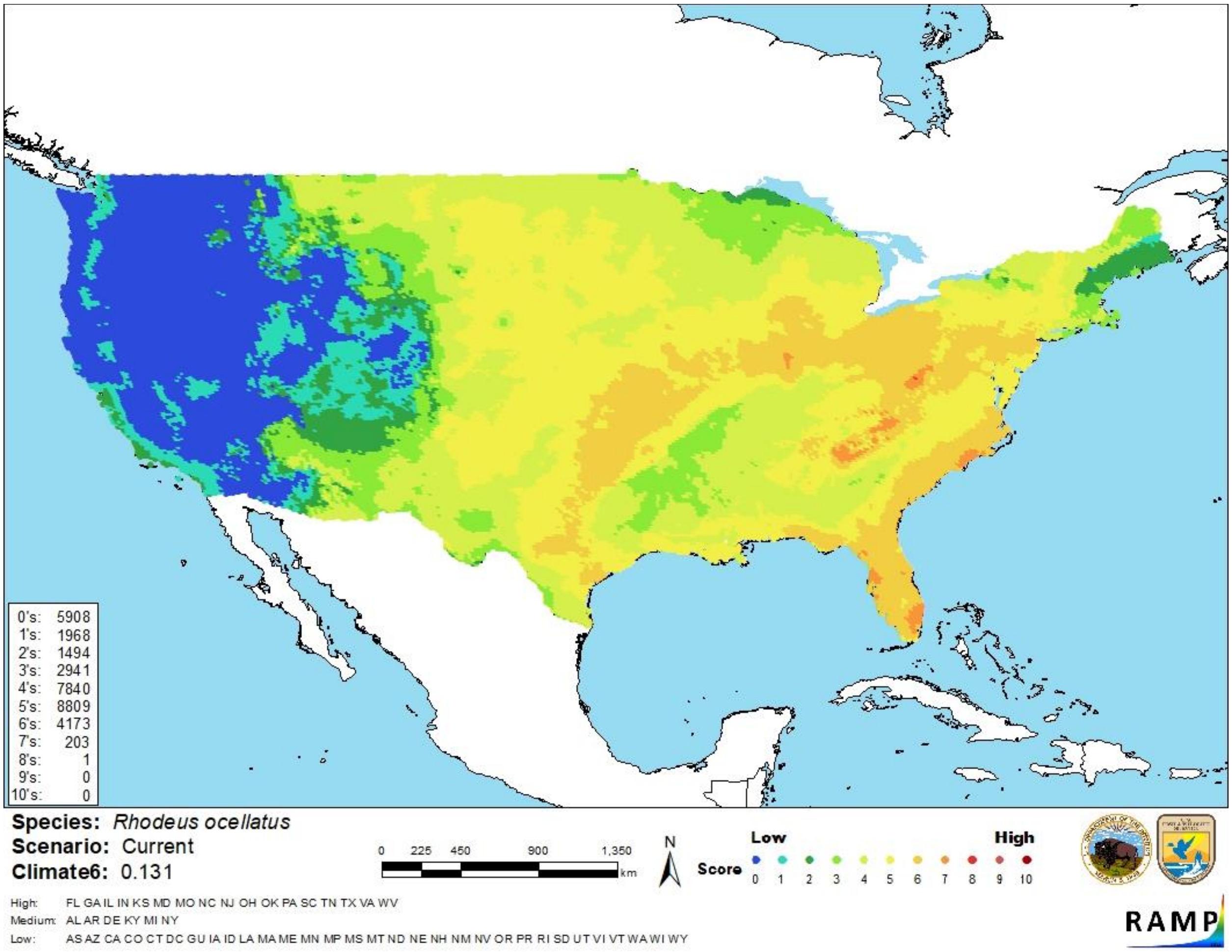

Figure 3. Map of RAMP (Sanders et al. 2018) climate matches for *Rhodeus ocellatus* in the contiguous United States based on source locations reported by GBIF Secretariat (2019). Counts of climate match scores are tabulated on the left. 0/Blue = Lowest match, 10/Red = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: (Count of target points with climate scores 6-10)/ (Count of all target points)	Overall Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

8 Certainty of Assessment

Information on the biology and ecology of this species is readily available. However, there is some uncertainty surrounding the distribution of this species, and which parts of the range in East Asia should be considered as “native range.” Further information on impacts of introductions of *R. ocellatus* would enhance the certainty of this assessment, particularly with respect to suggested impacts to native species that are not conspecifics and to local economies. Certainty of this assessment is low.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Rhodeus ocellatus, the Rosy Bitterling, is native to mainland China, Taiwan, Japan and possibly Russia. It has been introduced to Fiji, where it is established, and Central Asia, where its status is unknown. Introductions have been unintentionally through transfer of other aquatic organisms for aquaculture or intentionally through release of aquarium pets. *Rhodeus ocellatus* is reported to be a pest at fish farms where it preys on eggs and juveniles of commercial species and competes with them for food, but further research is needed on the extent and significance of such impacts. There is more scientific support for impacts of *R. ocellatus ocellatus* on *R. ocellatus kurumeus*, but impacts at the subspecies level are not considered in assessing history of invasiveness in this risk screen. History of invasiveness is classified as Data Deficient. *R. ocellatus* is also susceptible to epizootic ulcerative syndrome, an OIE-reportable disease. The climate match with the contiguous United States is high, especially in the Southeast. The certainty of assessment was low due to questions about the extent of the native range and the lack of detailed and scientifically credible information on impacts of introduction. The overall risk assessment category for *Rhodeus ocellatus* in the contiguous United States is Uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 4): Data Deficient**
- **Climate Match (Sec. 7): High**
- **Certainty of Assessment (Sec. 8): Low**
- **Important additional information: Susceptible to epizootic ulcerative syndrome, an OIE-reportable disease.**
- **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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