Paradisefish (*Macropodus opercularis*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, February 2011
Revised, April 2019
Web Version, 3/12/2020

Photo: Matthias Kloszczyk. Licensed under CC-BY-3.0. Available: https://commons.wikimedia.org/wiki/File:Macropodus_opercularis_fish.png. (March 2019).

1 Native Range and Status in the United States

Native Range

Froese and Pauly (2019), list the following locations as the native range of *Macropodus opercularis*: Cambodia, China, Hong Kong, Japan, South Korea, Laos, Malaysia, Taiwan, Viet Nam and Russia.

From Froese and Pauly (2019):

"Asia: China, from Yangtze basin to the south, on Hainan Island, in Taiwan, north Viet Nam; […]."

"[China] Recorded from Huanggang, Hanjiang, Xijiang, Beijiang river drainages and the Zhu Jiang delta [Murdy and Shibukawa 2001; Shiming et al. 2011]. Also known from Pingxiang,

Jiangxi Province and from Nanduhe river drainage and Linshui river drainage in Hainan Province [Murdy and Shibukawa 2001] and Bosten Lake [Walker and Yang 1999]."

"[Laos] Known from the Nam Ngum basin, a tributary to the Mekong and rivers Ma and Ca, draining to the Gulf of Tonkin in North Vietnam."

"[Malaysia] In Melaka."

"[Taiwan] Known from the Kinmen I. [Freyhof and Herder 2002]."

"[Viet Nam] Found in most coastal basins from Vinh to Thuy Hoa, except from the basins of the rivers Huong and Quang tri, which enter the sea at the city of Hue and Dong Ha, respectively. Also recorded in headwaters of the Dong Nai River, which enter the sea at Saigon, in headwaters of the Sesan River, a tributary of the Sekong River, itself a tributary of the Mekong River."

"[Russia] Known from the Amur River drainage [Bogutskaya and Naseka 2002]."

Status in the United States

From Nico (2019):

"Unconfirmed report of breeding population in the Everglades, Florida, prior to about 1940 (Myers 1940). Based on extensive sampling during the 1970s, established populations, if ever present, no longer exist (Courtenay and Hensley 1979; Courtenay and Stauffer 1990). Collected in Lake Worth Drainage District canal L-15, west of Atlantis and Lantana, adjacent to a fish farm in Palm Beach County, in 1969 and 1970 (Ogilvie 1969; Courtenay et al. 1974), but species not found in subsequent surveys (Courtenay and Hensley 1979a). Several specimens were taken from a marsh in Orleans Parish, Louisiana, in March 1997 (Cashner, personal communication)."

"There is no recent evidence of a breeding population in the Florida Everglades; more recent reports of fish represent non-established populations (Courtenay and Hensley 1979; Courtenay and Stauffer 1990). Reported from Louisiana but status is uncertain."

Means of Introductions in the United States

From Nico (2019):

"The Florida records probably result of aquarium releases or escapes from fish farms. Louisiana records are probably aquarium releases."

Remarks

No additional remarks.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to Fricke et al. (2019), *Macropodus opercularis* (Linnaeus 1758) is the current and valid name of this species.

From ITIS (2019):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Anabantoidei
Family Oshronemidae
Subfamily Macropodinae
Genus *Macropodus*
Species *Macropodus opercularis* (Linnaeus, 1758)

Size, Weight, and Age Range

From Froese and Pauly (2019):

"Max length : 6.7 cm SL male/unsexed; [Kottelat 2001]; common length : 5.5 cm TL male/unsexed; [Hugg, 1996]"

From Nico (2019):

"Size: 9 cm SL"

Environment

From Froese and Pauly (2019):

"Freshwater; brackish; pelagic; pH range: 6.0 - 8.0; dH range: 5 - 19. […] 16°C - 26°C [Riehl and Baensch 1991; assumed to be recommended aquarium temperature]; […]"

Climate/Range

From Froese and Pauly (2019):

"Tropical; […] 30°N - 20°N, 102°E - 122°E"

Distribution Outside the United States

Native

Froese and Pauly (2019), list the following locations as native range of *M. opercularis*: Cambodia, China, Hong Kong, Japan, South Korea, Laos, Malaysia, Taiwan, Viet Nam and Russia.

From Froese and Pauly (2019):

"Asia: China, from Yangtze basin to the south, on Hainan Island, in Taiwan, north Viet Nam; […]."

"[China] Recorded from Huanggang, Hanjiang, Xijiang, Beijiang river drainages and the Zhu Jiang delta [Murdy and Shibukawa 2001; Shiming et al. 2011]. Also known from Pingxiang, Jiangxi Province and from Nanduhe river drainage and Linshui river drainage in Hainan Province [Murdy and Shibukawa 2001] and Bosten Lake [Walker and Yang 1999]."

"[Laos] Known from the Nam Ngum basin, a tributary to the Mekong and rivers Ma and Ca, draining to the Gulf of Tonkin in North Vietnam."

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"[Russia] Known from the Amur River drainage [Bogutskaya and Naseka 2002]."

Introduced

According to Froese and Pauly (2019), *Macropodus opercularis* has been introduced and has become established in Madagascar and Japan. Occurrences have been documented in the Philippines and Russia, but it is unknown if the species is established in the wild.

From Froese and Pauly (2019):

"[Ryukyu Islands] Occurs in Okinawajima. Presumably introduced. Has been recognized to be established in the country or found in the wild [Japan Ministry of Environment 2005]."

From Kano et al. (2018):

"It has hitherto been unknown whether the paradise fish *Macropodus opercularis* that inhabits the Ryukyu Archipelago, Japan, is native to the region or was introduced. […] These results suggest a high likelihood that the fish in the Ryukyu Archipelago were artificially introduced from Taiwan. However, the possibility that the fish is indigenous to the Ryukyu Archipelago

cannot be completely ruled out, because some haplotypes and a clade from the Ryukyu Archipelago have not been found in the other areas."

From NIES (2019):

"[Range in Japan] Okinoerabujima Is. (Amami Islands) and Okinawajima Is. Whether the Okinawajima population is native or not remains unclear."

From Knight and Balasubramanian (2015):

"During recent (April to June 2014) surveys of the water bodies around Chennai [India], we recorded two species, […] *Macropodus opercularis* […]."

"[…] *M. opercularis*, has also established non native populations in Singapore and Japan (Wang et al. 1999)."

Means of Introduction Outside the United States

According to FAO (2019), the means of introduction in Russia, Madagascar, and Japan are unknown. According to Froese and Pauly (2019), *M opercularis* was introduced into the Philippines for ornamental reasons.

Short Description

From Froese and Pauly (2019):

"Dorsal spines (total): 11 - 17; Dorsal soft rays (total): 5-10; Anal spines: 7-22; Anal soft rays: 9 - 15; Vertebrae: 27 - 29. Caudal fin forked, both lobes elongate in males [Masuada et al. 1984], with filamentous extension in each lobe [Kottelat 2001]; lower margin of preorbital sharply serrated [Masuada et al. 1984]; conspicuous dark brown opercular spot with whitish posterior margin (margin red in life); body with 7-11 bold, dark bars on pale yellowish background in preserved specimens (blue bars on reddish background in life); dark stripe crossing eye connecting opercular spot with eye; top of head and predorsal body with dark spots; posterior tip or margin of scales on body not darker than scales [Freyhof and Herder 2002]."

Biology

From Froese and Pauly (2019):

"Adults inhabit any kind of lowland habitats from heterogeneous structured margins or backwaters of large rivers to small streams and irrigation channels on farmland [Freyhof and Herder 2002]. Can colonize stagnant water bodies with very low oxygen content (air breather). Found in streams, paddy fields and ditches [Man and Hodgkiss 1981]. Feed on small aquatic animals including small fish. First ornamental fish to be brought to Europe (France 1869, Germany 1876) after the goldfish [Riehl and Baensch 1996]. Males will fight each other [Riehl and Baensch 1991]."

"The species is a bubble-nest builder; the male swims to the surface, draws a little air into his mouth and envelops it in a film of saliva thereby forming bubbles; upon building the nest, the male drives the female towards it; female spawns then male follows; male picks up the fertilized eggs in his mouth and pushes one by one into each bubble of the nest; male guards eggs until hatching [Man and Hodgkiss 1981]. Produces up to 500 eggs [Riehl and Baensch 1991]."

Human Uses

From Froese and Pauly (2019):

"Fisheries: of no interest; aquarium: commercial

"Very popular with aquarists and has been widely transported around the world."

Diseases

No records of OIE-reportable diseases (OIE 2020) were found for *Macropodus opercularis*.

According to Froese and Pauly (2019), *M. opercularis* can have fin-rot disease, bacterial diseases and infections, icthyobodo infections and parasitic infections.

According to Poelen et al. (2014), *M. opercularis* is a host of *Heteronchocleidus buschkieli,* infectious spleen kidney necrosis virus*, Mycobacterium marinum, Heteronchocleidus bushkielli, Heteronchocleidus, Echinochasmus japonicas, Echinochasmus, Centrocestus, Haplorchis pumilio,* and *Clonorchis sinensis.*

Threat to Humans

From Froese and Pauly (2019):

"Harmless"

3 Impacts of Introductions

No impacts have been reported for the introductions of *Macropodus opercularis*.

From Knight and Balasubramanian (2015):

"Though the ecological impacts of neither […] or *Macropodus opercularis* have been documented, it is quite obvious […] they would also compete for niche space with native species […] *M. opercularis* are air-breathers and exhibit parental care, they will be able to ensure better survival of their young, even in stagnant and polluted water systems with high biological oxygen demand (BOD) where other fish species may not be able to survive and reproduce."

4 Global Distribution

Figure 1. Known global distribution of *Macropodus opercularis*. Map from GBIF Secretariat (2019). Locations in both South and North America were not included in the climate match. The collection in Florida does not represent an established population (Nico 2019). The location in Colombia is a single collection (GBIF Secretariat 2019) and there is no supporting documentation in the literature for an established population in the country. The location in India was not included due to limited information on whether that population has become established or if it was a single occurrence (Knight and Balasubramanian 2015).

5 Distribution Within the United States

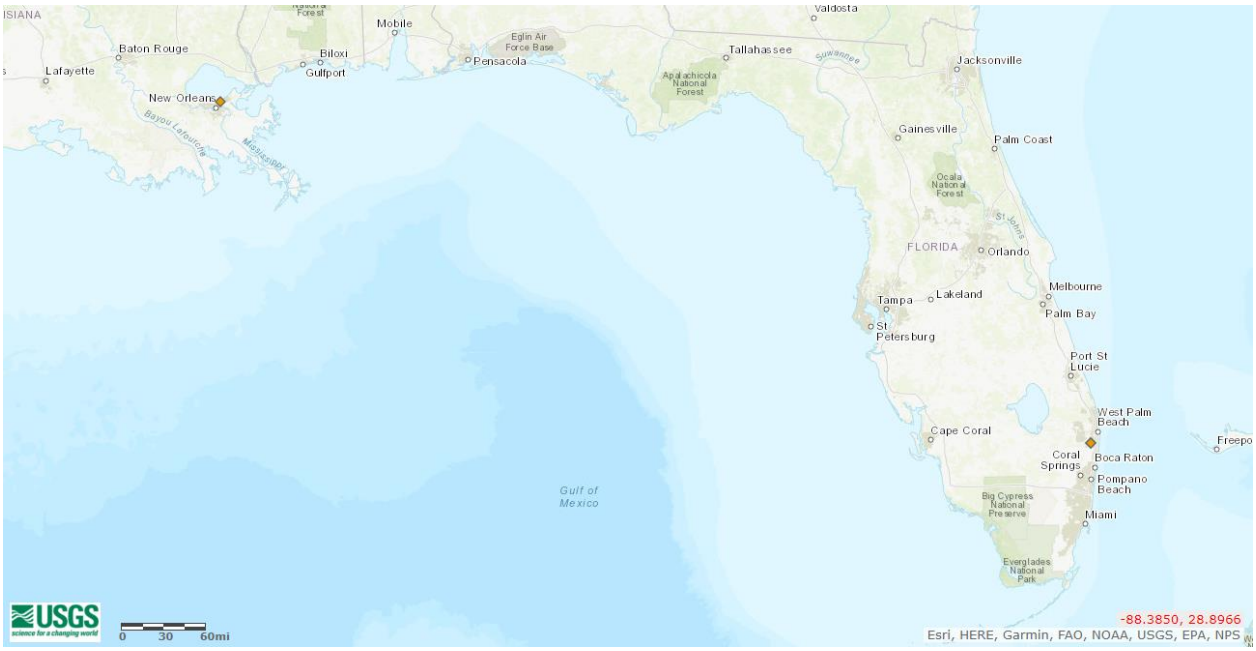

Figure 2. Known distribution of *Macropodus opercularis* in the United States. Map from Nico (2019). The location in Louisiana is near New Orleans and the location in Florida is near West Palm Beach. These locations were not used to select source points for the climate match. The observations do not represent currently established wild populations (Nico 2019).

6 Climate Matching

Summary of Climate Matching Analysis

A majority of the contiguous United States was a medium match. Western and northeastern States mostly had areas of low climate match, while central and southern States had medium to medium-high areas of climate match. The area of highest match was found in peninsular Florida. The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for contiguous United States was 0.053, medium (scores greater than 0.005, but less than 0.103, are classified as medium). The following States received high individual climate scores: Florida, Georgia, Kansas, North Carolina, Oklahoma, South Carolina, and Texas. Arizona and Missouri both received medium individual climate scores with the remaining States all receiving low individual climate scores.

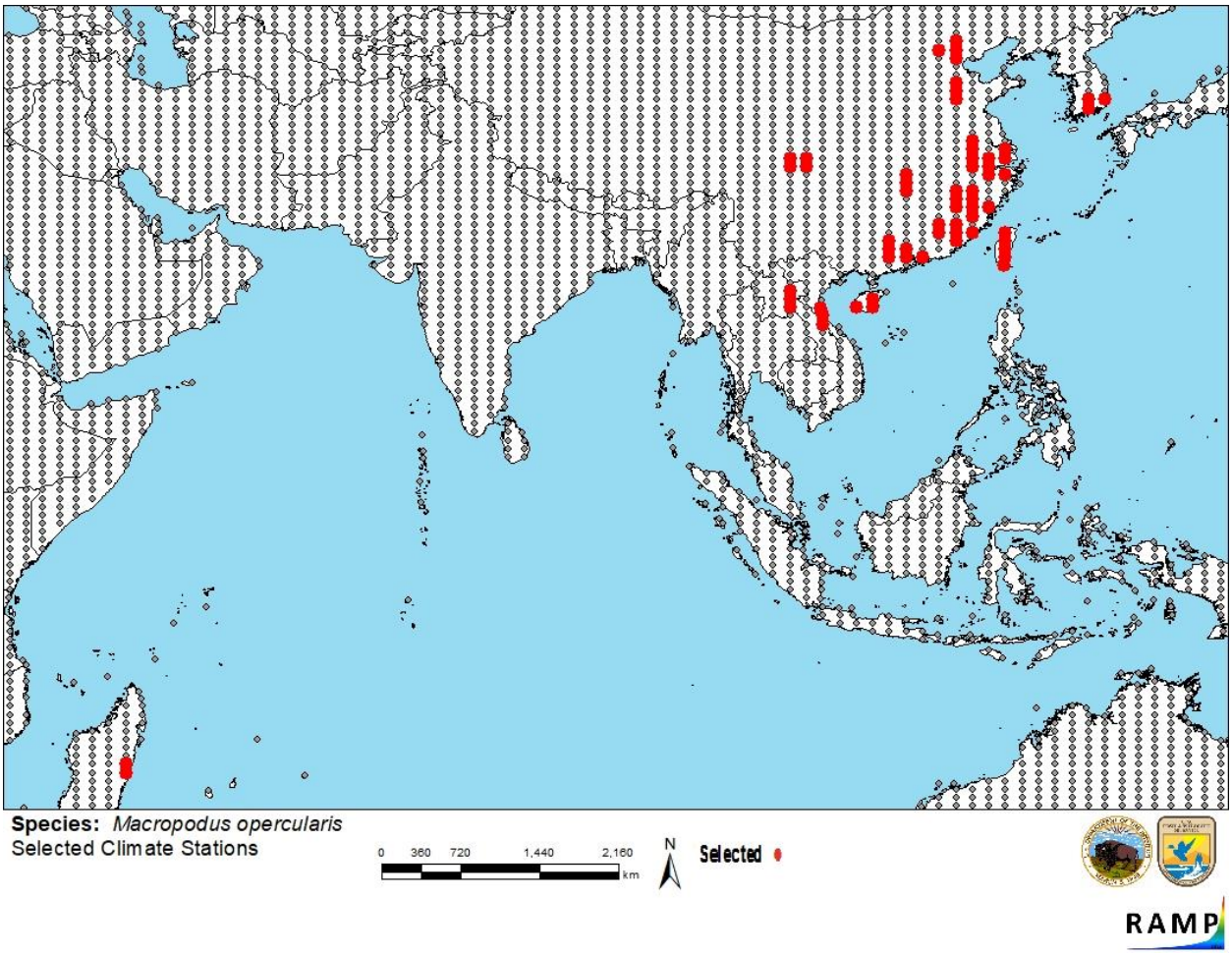

Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations in Asia and Madagascar selected as source locations (red; China, Laos, Madagascar, South Korea, Taiwan, and Vietnam) and non-source locations (gray) for *Macropodus opercularis* climate matching. Source locations from GBIF Secretariat (2019). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

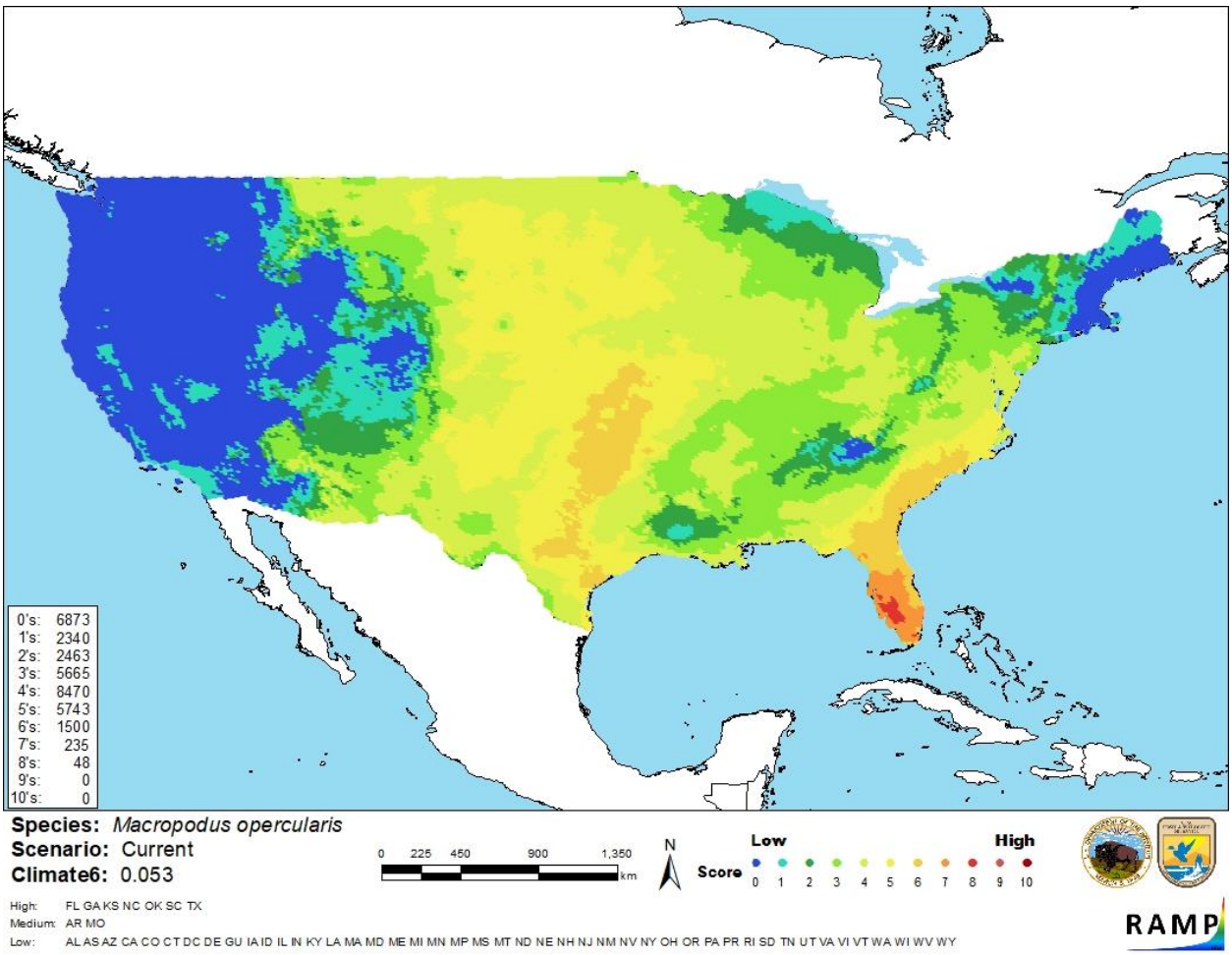

Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Macropodus opercularis* in the contiguous United States based on source locations reported by GBIF Secretariat (2019). Counts of climate match scores are tabulated on the left. 0 = Lowest match, 10 = Highest match.

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

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

7 Certainty of Assessment

The certainty of this assessment is low. There is information available on the biology and environmental preferences of *M. opercularis* but further research needs to be conducted on its range. This species has been introduced and established in other countries yet there is still uncertainty about its true native range and if other introductions have becomes established in the

wild. There is a speculative report of harm caused by the introduced populations but no scientifically defensible documentation of harm.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Macropodus opercularis, the Paradisefish, is a tropical freshwater fish native to eastern Asia. This air-breathing fish is popular in the aquarium trade and has been introduced outside of its native range. *M. opercularis* has been introduced and established in Madagascar and Japan; there is debate over whether Japan is actually part of its native range or if the population there was the result of an introduction. Observations of this species have been documented in other countries (Russia, Philippines, India, and Singapore) where it is unknown if the populations have becomes established. *M. opercularis* has been introduced in Florida and Louisiana but there are no established populations in those States. No recorded impacts of introduction could be found in locations where the species has becomes established. The climate match for the contiguous United States was medium with the following states receiving high individual scores: Florida, Georgia, Kansas, North Carolina, Oklahoma, South Carolina, and Texas. Arizona and Missouri both received individually medium climate scores with the remaining States all receiving individually low climate scores. The certainty of this assessment is low. The overall risk assessment category for *Macropodus opercularis* is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): None Documented**
- **Climate Match (Sec. 6): Medium**
- **Certainty of Assessment (Sec. 7): Low**
- **Remarks/Important additional information: No additional information.**
- **Overall Risk Assessment Category: Uncertain**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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10 References Quoted But Not Accessed

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