Smallmouth Yellowfish (*Labeobarbus aeneus*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, January 2022
Revised, March 2022
Web Version, 4/11/2023

Organism Type: Fish
Overall Risk Assessment Category: High

Photo: Mario Smit. Licensed under CC BY 3.0. Cropped from original. Available: https://www.fishbase.se/photos/ThumbnailsSummary.php?ID=4818# (January 2022).

1 Native Range and Status in the United States

Native Range

From Froese and Pauly (2022):

"Africa: originally endemic to the Orange-Vaal River system, South Africa."

Status in the United States

No records of *Labeobarbus aeneus* in trade or in the wild in the United States were found.

Means of Introductions in the United States

No records of *Labeobarbus aeneus* in the wild in the United States were found.

Remarks

From Bloomer et al. (2007):

"Over a period of nearly a year, 84 largemouth yellowfish [*Labeobarus kimberleyensis*] were collected from eight localities and 180 smallmouth yellowfish from approximately 12 sites. The analysis of mtDNA variation showed that it was not possible to clearly distinguish between *L. kimberleyensis* and *L. aeneus* based on the targeted mtDNA region. MtDNA only measure maternal inheritance patterns and the observed results therefore indicated that the two species either speciated very recently (with too few generations to ensure separation of their mtDNA lineages), that there is hybridisation between the two species, or that there is in fact only a single species with two morphotypes."

Labeobarbus aeneus may hybridize with the congeners *L. polylepis* (Roux 2007) and *L. natalensis* (Karssing 2007).

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to Fricke et al. (2022), *Labeobarbus aeneus* (Burchell 1822) is the current valid name for this species. It was originally described as *Cyprinus aeneus* Burchell 1822.

From ITIS (2022):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Ostariophysi
Order Cypriniformes
Superfamily Cyprinoidea
Family Cyprinidae
Genus *Labeobarbus*
Species *Labeobarbus aeneus* (Burchell, 1822)

Size, Weight, and Age Range

From Shelton et al. (2017):

"The abundant populations of *L. aeneus* in the Likalaneng, Senqunyane, Bokong and Bokoaneng inlets [Lesotho] comprised a range of size classes including a cohort of juvenile fish (20–100 mm TL), sub-adult fish (100–300 mm TL) which were somewhat less abundant, and sexually mature adults (>300 mm TL) […]."

From Froese and Pauly (2022):

“Max length : 50.0 cm FL [fork length] male/unsexed; [Skelton 1993]; max. published weight: 7.8 kg [Skelton 1993]; max. reported age: 12 years [de Moor and Bruton 1988]”

From Gerber et al. (2012):

“Males may live longer (maximum 19 years) than females (maximum 16 years). Fish matured relatively late in life, the males at 3 years and females at 5 years, corresponding to lengths of 254 and 375 mm FL, respectively. Growth was shown to be fairly slow, as asymptotic growth was reached only at 8 years.”

Environment

From Froese and Pauly (2022):

“Freshwater; benthopelagic; potamodromous [Riede 2004];”

From Jacobs et al. (2016):

“Eccles (1986) characterised *L. aeneus* as an omnivorous fish that predominantly inhabits shallow (<1 m) fast-flowing habitats (Eccles 1986); whereas O’Brien et al. (2013a) reported a broader range of habitat types used, including shallow fast-flowing riffles and runs, as well as deep slow-flowing pools.”

Climate

From Froese and Pauly (202):

“Subtropical; […] 24°S - 33°S”

From Cambray et al. (1986):

“The [Orange-Vaal] system is the only one in southern Africa to rise on the edge of the African Plateau and flow W (Wellington 1955). In doing so, it passes from cool-temperate and moist alpine regions […] to progressively more arid terrain of the W Atlantic coast.”

Distribution Outside the United States

Native

From Froese and Pauly (2022):

“Africa: originally endemic to the Orange-Vaal River system, South Africa.”

Introduced
From Froese and Pauly (2022):

"Has been introduced into the Gouritz River, South Cape and the Olifants River, Limpopo River system [South Africa] where it is now established."

From Impson (2020):

"[…] it has also been translocated widely for angling purposes and through inter-basin water transfers in South Africa to the Gourits, Great Fish, Kei and Limpopo River systems and even to the Matirikwe Dam in Zimbabwe (De Moor and Bruton 1988, Skelton 2001, de Villiers and Ellender 2007)."

From Shelton et al. (2017):

"The most widespread species recorded from river sites in the Mohale catchment [Lesotho] was the non-native *L. aeneus*, which was found in all three fish-supporting rivers, and was present at 10 of the 13 sites where fish were recorded […]."

"Fish assemblages in the Likalaneng, Bokoaneng, Bokong and Senqunyane river inlets into Mohale Reservoir were all dominated by *L. aeneus*, which is consistent with the reported presence of the species in the reservoir in 2006 (Rall and Sephaka, 2008)."

Means of Introduction Outside the United States

From Shelton et al. (2017):

"In 2006, *L. aeneus* was recorded in Mohale Reservoir [Lesotho] (Rall and Sephaka, 2008), suggesting that they had dispersed from Katse Reservoir through the IBT [inter-basin transfer] tunnel. At that stage, *L. aeneus* was not recorded in any of the rivers flowing into Mohale Reservoir; however, it was suspected that such an invasion may be imminent (Rall and Sephaka, 2008)."

"In that system [Matsoku River, Lesotho], *L. aeneus* was introduced via the Matsoku Diversion – a 5.6 km IBT tunnel that connects the river to Katse Reservoir […]."

From Ellender et al. (2016):

"Lake Gariep is the source population for the Great Fish River invasion of *L. aeneus* through an interbasin water transfer scheme (Laurenson et al. 1989)."

Short Description

From Froese and Pauly (2022):

"Dorsal spines (total): 4; Dorsal soft rays (total): 7-9; Anal spines: 3; Anal soft rays: 5"

From de Villiers and Ellender (2007):

"Skelton (1993) has described the general morphology of *L. aeneus*. The juveniles have a white belly and an olive-green dorsal side with black spots that create a camouflage effect. With increasing age the colour changes to olive green or golden yellow sprinkled with small black flecks but it varies throughout the distribution range. *Labeobarbus aeneus* tends to be more yellow than *L. kimberleyensis* which also lacks the dorsal spots. *Labeobarbus aeneus* has two pairs of barbels lateral of the sub-terminal mouth. There are three variations of the mouth form (Jubb, 1966). The first is called "rubber-lipped" due to very thick lips […]. The second or "normal" form shows continuous lips with the tip of the mouth slightly more pointed. The third form has lips suitable for scraping food off rocks. The different types of lips are associated with different feeding habits. Mouth morphology is plastic and rubber-lipped fish are able to change their mouth form in captivity to the "normal" form according to feeding conditions and food availability (Jubb, 1966). There is also variation in body form, with longer finned and deeper fishes found in the lower Orange River compared with elsewhere in the system […]"

From Bloomer et al. (2007):

"[…] *L. aeneus* from both sites had greater interorbital widths compared to *L. kimberleyensis*. This is probably due to *L. aeneus* having eyes more laterally positioned for foraging in the substrate compared to *L. kimberleyensis* which is more piscivorous catching it prey directly ahead of itself."

"Posterior orbit to preopercular groove distance (PO-PG) […] – this feature is one of the key characterisics used to distinguish between *L. aeneus* and *L. kimberleyensis* in Skelton's (2001) identification key. The PO-PG distance is greater in *L. kimberleyensis* than *L. aeneus* certainly associated with the overall elongation of the head in the more predatory *L. kimberleyensis*."

Biology

From Ellender et al. (2016):

"*Labeobarbus aeneus* is omnivorous, feeding on aquatic and terrestrial invertebrates, zooplankton, molluscs, algae and vegetation (Eccles 1986; Dorgeloh 1994). Its life history is characterised by slow growth, medium longevity (19 years), late maturity and moderate fecundity (Tómasson 1983; Weyl et al. 2009; Gerber et al. 2012). *Labeobarbus aeneus* is considered a rheophilic lithophil and exhibits preference for areas of fast flow over rocky or sandy substrate, and this species is reported to spawn on gravel substrates during the Austral summer (Mulder 1973)."

"Although riverine populations of *L. aeneus* are known to have an omnivorous diet, which includes algae, macrophytes, aquatic and terrestrial invertebrates, there is strong empirical evidence that populations of this species occurring in impoundments can adapt to forage primarily on zooplankton (Bruton 1985; Tómasson et al. 1985; Eccles 1986)."

Human Uses

From O'Brien et al. (2013):

"The Orange-Vaal largemouth yellowfish *Labeobarbus kimberleyensis* (Gilchrist and Thompson, 1913), and the Orange-Vaal smallmouth yellowfish *L. aeneus* (Burchell, 1822) are charismatic fishes that have both social and economic value in the Orange-Vaal River system in southern Africa [De Villiers and Ellender 2008, Brand et al. 2009]. Both species are actively targeted by angling and subsistence fishing communities for food, and are used as indicator species in regional management and conservation plans [Brand et al. 2009, Skelton 2001, Wepener et al. 2011]."

From Impson (2020):

"It is the most commonly caught yellowfish in South Africa. It is also a popular subsistence species, with large numbers of fish caught by poor rural people. Of concern, are increasing reports of fish being caught in rivers and dams using gill nets by subsistence fishers. This is illegal in South Africa, unless permits from provincial conservation authorities are issued."

Diseases

No records of OIE-reportable diseases (OIE 2022) were found for *Labeobarbus aeneus*.

From Bertasso and Avenant-Oldewage (2005):

"Seasonal surveys were conducted at the Vaal Dam between April 2000 and January 2001. Twenty smallmouth yellowfish (*Labeobarbus aeneus*) and 20 largemouth yellowfish (*Labeobarbus kimberleyensis*) were collected with the aid of gill nets. […] The cestodes were identified as either *Bothriocephalus acheilognathi* Yamaguti, 1934 or "other cestode spp.". The majority (99.8 %) of the cestodes found in both yellowfish species were identified as *B. acheilognathi* (Asian tapeworm). […] In this study, *B. acheilognathi* preferred *L. kimberleyensis* over *L. aeneus* although a low intensity was observed in smallmouth yellowfish."

Threat to Humans

From Froese and Pauly (2022):

"Harmless"

3 Impacts of Introductions

From Shelton et al. (2017):

"Given that there has been no obvious habitat deterioration in the river systems where [*Pseudobarbus*] *quathlambae* were formerly abundant (particularly in higher-lying areas), the translocation (via the IBT [inter-basin transfer]) and subsequent invasion by non-native *L. aeneus* into the Bokong, Jorodane and Senqunyane rivers is therefore the most likely factor

explaining the dramatic declines in the *P. quathlambae* populations documented in this study. An invasion by *L. aeneus* has been implicated also in the decline of *P. quathlambae* ('eastern' ESU [evolutionarily significant unit]) in the Matsoku River, a tributary of the Senqu River north east of the Mohale catchment (Paxton, 2011). In that system, *L. aeneus* was introduced via the Matsoku Diversion – a 5.6 km IBT tunnel that connects the river to Katse Reservoir – which apparently resulted in the extirpation of a previously abundant population of *P. quathlambae*. Indeed, *L. aeneus* was identified by Swartz (2008) as the most widely introduced South African cyprinid, with introductions throughout South Africa and Lesotho often facilitated by IBTs."

"*Labeobarbus aeneus* could potentially displace *P. quathlambae* from streams through predation, as well as competition for space or food. Adult *L. aeneus* is an opportunistic omnivore (Skelton, 2001) and is probably capable of consuming smallbodied fish (especially the early life stages) such as *P. quathlambae*. […] The absence of small size-classes of *P. quathlambae* in the Mohale catchment in 2013 suggests that *L. aeneus* may prey selectively on juvenile *P. quathlambae*, as might be expected for a gape-limited predator. It may be that the *L. aeneus* have depleted *P. quathlambae* populations by consuming most of the annual recruitment over the last seven years (time since the previous survey), thereby ultimately usurping the supply of new adults into the breeding population. Both species are known to inhabit pools and riffles in clear headwater streams and breed over gravel beds (and in crevices in the case of *P. quathlambae*), during summer high flow (Cambray, 1996; Rall, 1999; Skelton, 2001; de Villiers and Ellender, 2008) and it is therefore likely that the larger-bodied, more aggressive *L. aeneus* could out-compete smallerbodied *P. quathlambae* for habitat. Moreover, the primary food source of both *P. quathlambae* and juvenile *L. aeneus* is aquatic benthic invertebrates (Cambray, 1996; Rall, 1999; de Villiers and Ellender, 2008) and thus there is potential for competition for food between these two species. We recommend that future studies should quantify predatory and competitive interactions between *P. quathlambae* and *L. aeneus* in the Mohale catchment."

"The results from the present study show that the Mohale *P. quathlambae* ESU is on the verge of extinction in its natural range."

From Karssing (2007):

"*Labeobarbus aeneus* has the potential of naturalising in the Thukela primary catchment as well as hybridising with the endemic *L. natalensis*."

From Roux (2007):

"Recent genetic studies (Mulder et al., 1997) confirmed that there are significant differences among four populations of *L. polylepis* in different parts of their three native-river systems. The highest genetic diversity was present in the Spekboom population (Limpopo) and some alleles suggested that there might be hybridisation with *L. aeneus*. This probably occurred when both species were kept at the Lydenburg Fish Hatchery in the 1960s but also through direct introduction of Orange-Vaal smallmouth yellowfish *L. aeneus* (Burchell, 1822) into rivers in the Limpopo catchment."

4 History of Invasiveness

Labeobarbus aeneus is a fish species in South Africa that has high cultural and economic significance. It supports both commercial and subsistence fisheries and is also targeted by recreational anglers. It has been introduced widely outside of its native range, the Orange-Vaal River system in South Africa, via manmade inter-basin water transfer systems. It is established in both riverine and lacustrine (impoundment) habitats. Impacts of its introduction include displacement and predation of a small, endangered fish species, *Pseudobarbus quathlambae,* resulting in its extirpation from its range where it now co-occurs with *L. aeneus*. There are also concerns that introduced populations of *L. aeneus* may hybridize with other *Labeobarbus* species. Because of these negative impacts of introduction of *L. aeneus*, the history of invasiveness is High.

5 Global Distribution

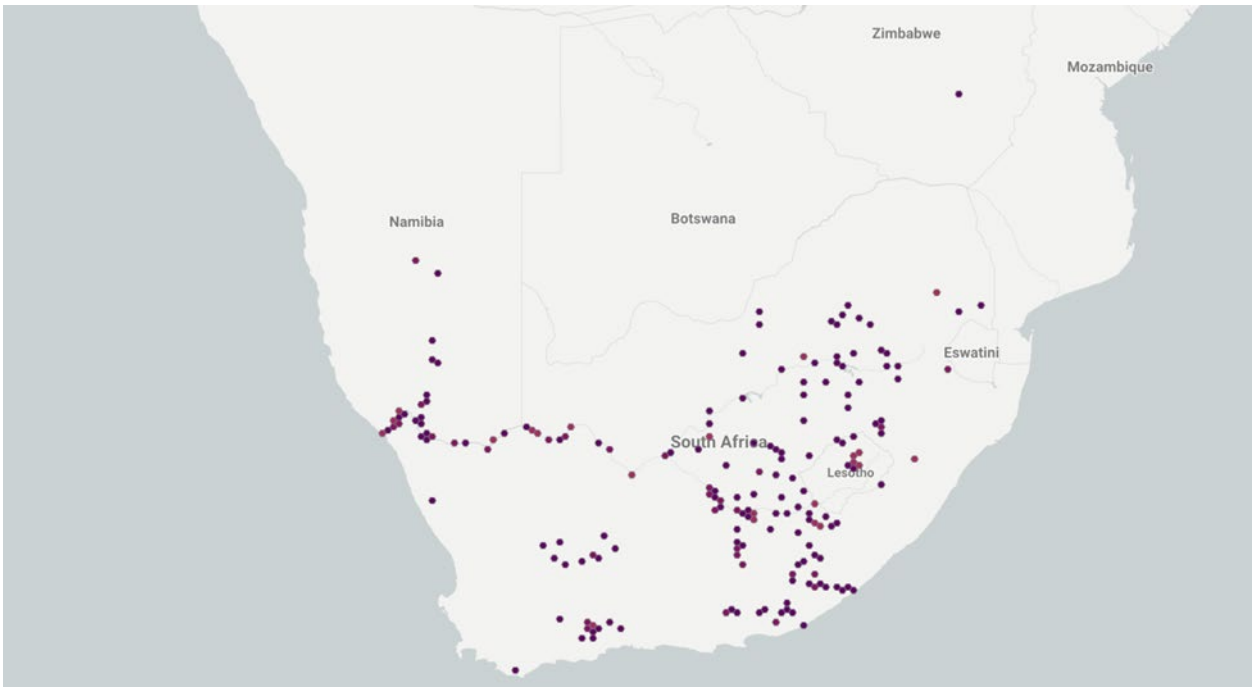

Figure 1. Known global distribution of *Labeobarbus aeneus*. Observations are reported from the native range of *L. aeneus* in the Orange-Vaal River Basin in South Africa, and outside of its native range in South Africa, Lesotho, Namibia, and Zimbabwe. Map from GBIF Secretariat (2022).

6 Distribution Within the United States

No records of *Labeobarbus aeneus* in the wild in the United States were found.

7 Climate Matching

Summary of Climate Matching Analysis

The area of highest climate match for *Labeobarbus aeneus* with the contiguous United States was in western Texas, southeastern Arizona, and southern New Mexico. The climate match in the eastern United States ranged from low to medium-low, except in southern Florida, where it was medium. The climate match in the western United States was medium overall, except in the Sierra Nevada Mountains and along the northern Pacific Coast, where it was low. The overall Climate 6 score (Sanders et al. 2021; 16 climate variables; Euclidean distance) for the contiguous United States was 0.414, High (scores of 0.103 and greater are classified as high). The following States had high individual Climate 6 scores: Arizona, California, Colorado, Florida, Iowa, Idaho, Kansas, Missouri, Montana, Nebraska, New Mexico, Nevada, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, Wisconsin, and Wyoming. Illinois, Michigan, Minnesota, North Dakota, Virginia, and West Virginia had medium individual Climate 6 scores. The rest of the states had low individual Climate 6 scores.

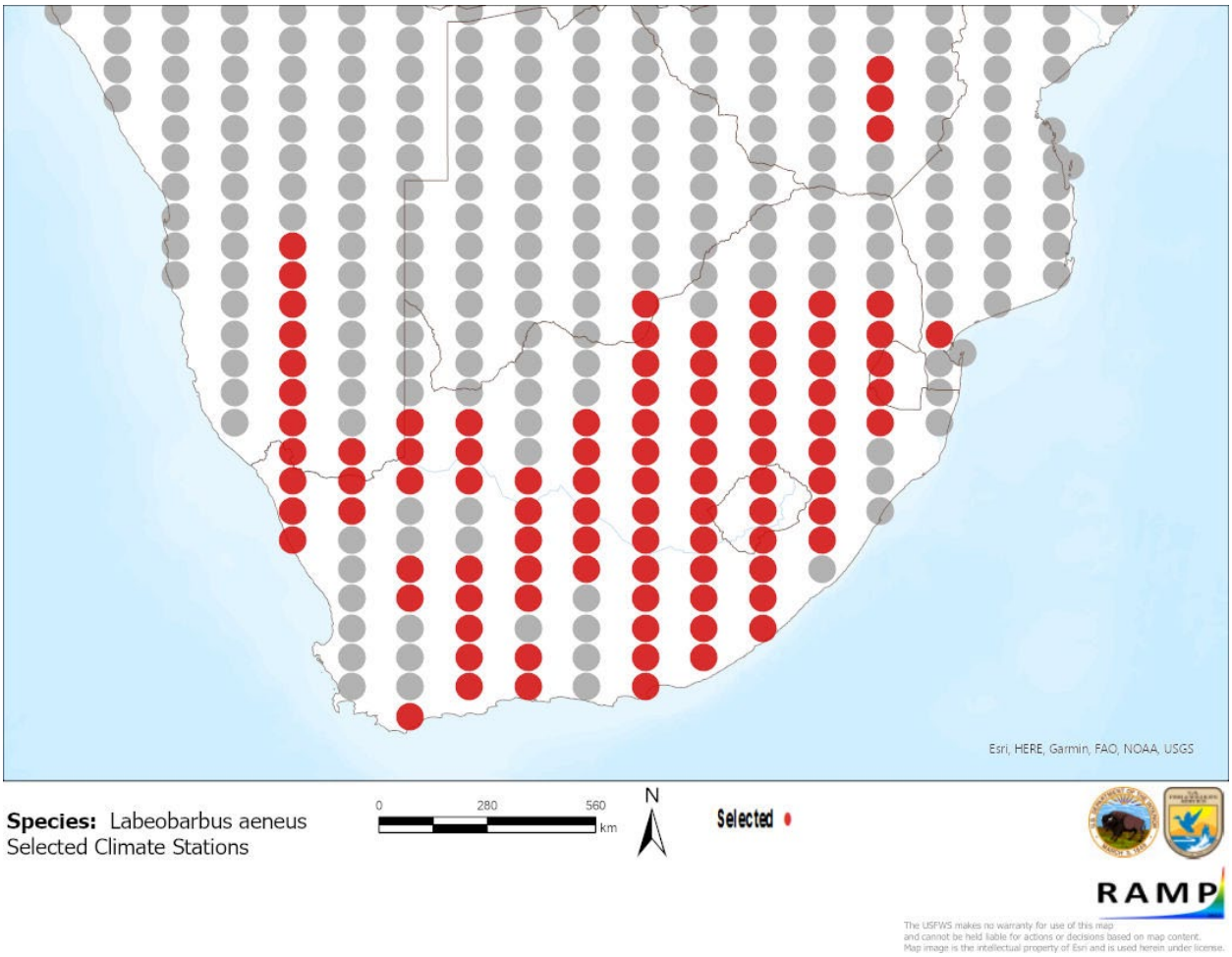

Figure 2. RAMP (Sanders et al. 2021) source map showing weather stations in southern Africa selected as source locations (red; South Africa, Botswana, Eswatini, Lesotho, Mozambique, Namibia, Zimbabwe) and non-source locations (gray) for *Labeobarbus aeneus* climate matching. Source locations from GBIF Secretariat (2022). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

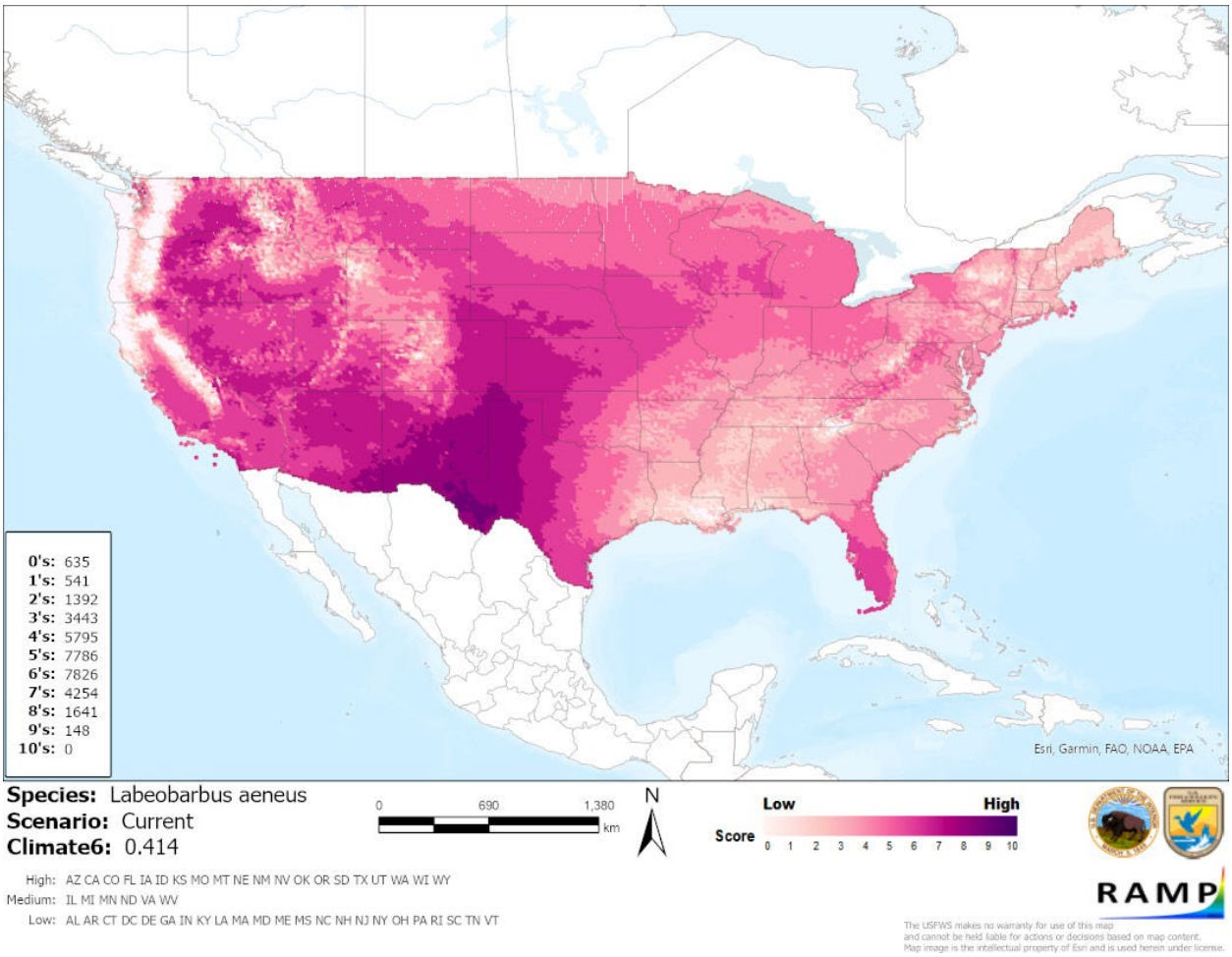

Figure 3. Map of RAMP (Sanders et al. 2021) climate matches for *Labeobarbus aeneus* in the contiguous United States based on source locations reported by GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

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

There was ample information available about the ecology and distribution of *Labeobarbus aeneus* in the scientific literature. Its establishment outside of its native range has been well-documented, and the means of its translocation outside of its native range is known. One study

credibly documents the negative impact *L. aeneus* has had on an endangered native minnow species where introduced. Certainty of this assessment is High.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Labeobarbus aeneus, the Smallmouth Yellowfish, is a freshwater cyprinid fish species native to the Orange-Vaal River system, which covers a large portion of South Africa. It is an important species to commercial, subsistence, and recreational fisheries. It has been translocated outside of its range by multiple inter-basin water transfer systems. Negative impacts of its translocation include predation of a range-restricted endangered small fish species and hybridization with other *Labeobarbus* species. *L. aeneus* has a high climate match with the contiguous United States, especially in the Southwest. The certainty of this assessment is High because negative impacts of this species' introduction have been credibly reported on in scientific literature. Overall risk assessment category is High.

Assessment Elements

- **History of Invasiveness (Sec. 4): High**
- **Overall Climate Match Category (Sec. 7): High**
- **Certainty of Assessment (Sec. 8): High**
- **Remarks, Important additional information: No additional remarks.**
- **Overall Risk Assessment Category: High**

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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