

Pike Killifish (*Belonesox belizanus*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, January 2024

Revised, April 2024

Web Version, 7/2/2025

Organism Type: Fish

Overall Risk Assessment Category: High



Photo: Kaitlin Kovacs, U.S. Geological Survey. Public domain. Available: <https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=843> (January 2024).

1 Native Range and Status in the United States

Native Range

From Schofield et al. (2025):

“The species is native to the Atlantic slope from Veracruz, Mexico south to the Yucatan, Guatemala and Belize, the Atlantic drainages of Honduras and Guatemala, and to Costa Rica (Rosen and Bailey 1963; Reis et al. 2003; Miller et al. 2005)”.

Status in the United States

From Greenwood (2017):

“Although the main invasive distribution of *B. belizanus* is in south Florida [...], a secondary introduction occurred in the Tampa Bay watershed (west central Florida), possibly as a result of escape from a tropical aquaculture facility [Schofield et al. 2013], [...].”

From Schofield et al. (2025):

“Established in southern Florida. The Key Largo, Florida, population apparently did not become established (Courtenay and Meffe 1989). A population was present and possibly established in the San Antonio area of Texas. However, the species was absent in later samples and the population was assumed to have been extirpated (Hubbs et al. 1978; Howells 1992).”

From Harms and Turingan (2012):

“After the introduction of 50 pike killifish into a ditch in Miami-Dade County, Florida, USA in 1957, this exotic population has continued to extend its distribution northward, becoming one of the most successful invasive-fish species in Florida (Belshe 1961; Miley 1978; Anderson 1980; Kerfoot et al. 2011; FWC 2012).”

This species is in trade in the United States (e.g., Wild Fish Tanks 2024).

Regulations

Belonesox belizanus is regulated in Arizona (Arizona Office of the Secretary of State 2013), California (CDFW 2019), Hawaii (HDOA 2006), Mississippi (Mississippi Secretary of State 2019), Nevada (State of Nevada 2018), Oklahoma (Oklahoma Secretary of State 2019), Texas (TPWD 2020), and Utah (Utah Office of Administrative Rules 2019). Please refer back to state agency regulatory documents for details on the regulations, including restrictions on activities involving this species. While effort was made to find all applicable regulations, this list may not be comprehensive. Notably, it does not include regulations that do not explicitly name this species or its genus or family, for example, when omitted from a list of authorized species with blanket regulation for all unnamed species.

Means of Introductions within the United States

From Schofield et al. (2025):

“This species was introduced into south Florida in 1957 when individuals reared for medical research purposes were released into a local canal (Belshe 1961). Those found in Hillsborough County in 1997 were escapees from a nearby ornamental fish farm (Nico, personal communication). The Texas introduction was probably an aquarium release (Howells 1992).”

From Greenwood (2012):

“The spread of pike killifish from an initially limited geographic area was facilitated by opening of water control structures, [...]”

Remarks

A previous version of this ERSS was published in August 2018. Revisions were done to incorporate new information and conform to updated standards.

Mention of commercial products in this Ecological Risk Screening Summary does not entail endorsement by the U.S. Federal Government.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2024):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Cyprinodontiformes
Suborder Cyprinodontoidae
Family Poeciliidae
Subfamily Poeciliinae
Genus *Belonesox*
Species *Belonesox belizanus* Kner, 1860

According to Fricke et al. (2024), *Belonesox belizanus* Kner, 1860 is the current valid name for this species.

Size, Weight, and Age Range

From Froese and Pauly (2024):

“Max length : 20.0 cm TL [total length] male/unsexed; [Lucinda 2003]; 15.0 cm TL (female); common length : 9.7 cm TL male/unsexed; [Hugg 1996]”

From Maddern (2015):

“*B. belizanus* is fast growing and may become reproductively mature within 6 to 12 months (Robins, 2014).”

“*B. belizanus* is ‘relatively short-lived’ (Robins, 2014). Other poeciliids, such as *Gambusia* sp., live a maximum of 1 to 2 years and it is likely that *B. belizanus* would live for a similar period.”

Environment

From Froese and Pauly (2024):

“Freshwater; brackish; demersal; pH range: 6.0 - 8.0; dH range: 9 - 19; [...] 25°C - 37°C [Bussing 1998];”

From Maddern (2015):

“*B. belizanus* is euryhaline and populations may occur and reproduce at salinities ranging from zero to at least 35 ppt (Turner and Snelson, 1984). As such the species will thrive in brackish habits such as lagoons, mangroves and estuaries as well as nearshore marine habitats with salinities as high as 40 ppt (Froese and Pauly, 2014; Robins, 2014). *B. belizanus* will live indefinitely in sea water and survives salinities of 40-50 ppt for limited periods (Belshe, 1961).”

“Hensley and Courtenay (1980) determined lower temperature tolerances of 10-13°C, whereas Shafland and Pestrak (1982) noted a lower lethal temperature of approximately 10°C.”

From Harms and Turingen (2012):

“[...] south Florida pike killifish raised in 9-30°C water survived, suggesting that they have the physiological potential to expand their invasive population into the colder regions of north Florida (Shafland and Pestrak 1982; Kerfoot 2012).”

Climate

From Froese and Pauly (2024):

“Tropical; [...] 29°N - 11°N, 100°W - 79°W [Florida Museum of Natural History 2005]”

Distribution Outside the United States

Native

From Schofield et al. (2025):

“The species is native to the Atlantic slope from Veracruz, Mexico south to the Yucatan, Guatemala and Belize, the Atlantic drainages of Honduras and Guatemala, and to Costa Rica (Rosen and Bailey 1963; Reis et al. 2003; Miller et al. 2005).”

Introduced

No records were found for introduction of *Belonesox belizanus* in the wild outside the United States.

Means of Introduction Outside the United States

No records were found for introduction of *Belonesox belizanus* in the wild outside the United States.

Short Description

From Maddern (2015):

“The body of *B. belizanus* is slender and elongated with large, conspicuous jaws forming a prominent pointed beak bearing long, cardiform teeth. *B. belizanus* is an obligate piscivore, and has evolved highly elongate jaws capable of a large gape (Ferry-Graham et al., 2010). The dorsal fin origin is well behind anal fin origin and males possess a prominent gonopodium. There are usually 52-63 lateral scales and 8-9 dorsal fin rays (Page and Burr, 1991).”

“*B. belizanus* is dark olive/grey dorsally and fades to white on the ventral surface. There are several longitudinal rows of small black spots on the lateral upper half of the body. A larger black spot on the mid caudal peduncle may be present. Young fish have a dark lateral stripe that is thought to aid their ability to mimic small floating twigs and plant matter at the water surface.”

Biology

From Harms and Turingen (2012):

“Functional morphologists and evolutionary ecologists have concluded that the pike killifish is a specialist piscivore, feeding exclusively on fish-prey (Greven and Brenner 2008; Ferry-Graham et al. 2002). It has evolved a unique feeding apparatus, equipped with elongated oral jaws and an independently mobile premaxilla (upper jaw), allowing it to achieve an unusually large gape to capture fish-prey (Ferry-Graham et al. 2002, 2010).”

“Results of the prey-selectivity experiment confirm the dietary flexibility of the Florida invasive pike killifish. When both fish- and shrimp-prey are available in the environment, the Florida invasive pike killifish shows no preference for fish prey and can switch to eat either fish- or shrimp-prey. Furthermore, pike killifish consume shrimp-prey when it is the only available prey in the invaded environment. [...] This prey-switching ability despite its stereotypical, specialized feeding mechanism may contribute to the success of the Florida invasive pike killifish in its non-native environment.”

From Maddern (2015):

“*B. belizanus* occurs in the surface waters of slow-flowing freshwater and brackish rivers, ponds, canals and lakes, and particularly habitats with abundant aquatic vegetation (Page and Burr, 1991; Froese and Pauly, 2014; Robins, 2014).”

“*B. belizanus* is ovoviviparous and fertilization is internal. Males inseminate females with a gonopodium. Females may store sperm and produce subsequent broods independently of male fish. Turner and Snelson (1984) found that the average brood size was approximately 99 embryos, and superfetation (simultaneous broods of embryos at different developmental stages) was absent. Mean interbrood interval of females was 42 days in the laboratory (Turner and Snelson, 1984). In naturalized populations in Dade County, reproduction occurred all year. *B. belizanus* is an obligate piscivore from birth, and Turner and Snelson (1984) noted that laboratory-born neonates were immediately piscivorous and exhibited predator-avoidance behaviour. Although the jaws of juveniles are proportionally shorter than that of adults, the dentition of neonates resembles that of adults in relative size, shape and arrangement of teeth (Greven and Brenner, 2008).”

Human Uses

From Fofonoff et al. (2018):

“As an aquarium fish, it has an interesting appearance, but quickly outwears its welcome by eating its tankmates, leading to numerous releases.”

This species is in trade in the United States (e.g., Wild Fish Tanks 2024).

Diseases

No information was found associating *Belonesox belizanus* with any diseases listed by the World Organisation for Animal Health (2024).

From Maddern (2015):

“*B. belizanus* has been found to host the parasites *Ascocotyle leighi* (Trematoda) (Hoffman, 1967) and *Salsuginus neotropicalis* (Mendoza-Franco and Vidal-Martínez, 2001).”

Threat to Humans

From Froese and Pauly (2024):

“Harmless”

3 Impacts of Introductions

From Greenwood (2012):

“The first study of pike killifish in South Florida, within a year of its initial introduction, documented an absence of eastern mosquitofish in a relatively closed canal system that contrasted with high abundance in a more open system with fewer pike killifish (Belshe 1961). The spread of pike killifish from an initially limited geographic area was facilitated by opening of water control structures, following which potential prey species apparently returned to normal or near-normal abundance (Belshe 1961). However, Miley (1978) sampled similar areas 15 years later and found that at two sites with pike killifish present, indigenous poeciliids and

cyprinodontids constituted 54% of individuals and 34% of biomass, whereas they made up 97% of individuals and 58% of biomass in an area isolated from pike killifish.”

“[...] the present study suggested that pike killifish was most likely to have affected three species (sailfin mollies [*Poecilia latipinna*], sheepshead minnow [*Cyprinodon variegatus*], and eastern mosquitofish [*Gambusia holbrooki*]) that are (1) resident (nonmigratory or potamodromous) within the systems that pike killifish occupies, (2) tend to be small-bodied (although may be able to exceed pike killifish’s gape at larger sizes [e.g., sailfin mollies]; Miley 1978), and (3) benthopelagic (occupying much of the water column). [...] There was good evidence for declines in abundance/frequency of occurrence but very little evidence for changes in size composition of the populations.”

“Pike killifish seems unlikely to extirpate any single species in the Tampa Bay watershed but apparently can cause appreciable population reductions in localized areas that it inhabits.”

From Maddern (2015):

“*B. belizanus* is a piscivore that has been reported to reduce populations of *Gambusia holbrooki* and other native poeciliid and cyprinodontoid populations, and well as decapod crustaceans (Belshe 1961; Greenwood 2012; Harms and Turingan, 2012; Texas State University 2014).”

“Hensley and Courtenay (1980) considered *B. belizanus* to be in trophic competition with native piscivores *Micropterus salmoides* (largemouth bass) and *Lepomis gulosus* (warmouth). Miley (1978) found an 84% dietary overlap between *B. belizanus* and the Florida largemouth bass, *Micropterus floridanus*, with the predominant diet taxa consisting of fish and decapod crustaceans.”

Belonesox belizanus is regulated in Arizona, California, Hawaii, Mississippi, Nevada, Oklahoma, Texas, and Utah. See section 1.

4 History of Invasiveness

The History of Invasiveness for *Belonesox belizanus* is classified as High. This species has become established outside of its native range; it has established two separate populations in peninsular Florida, although a third population was possibly established in Texas and has since been extirpated. *B. belizanus* introductions have caused declines in native small-bodied fish populations in Florida. Possession of this species is regulated in several States. The species is present in trade but specific information on duration or volume was not found.

5 Global Distribution

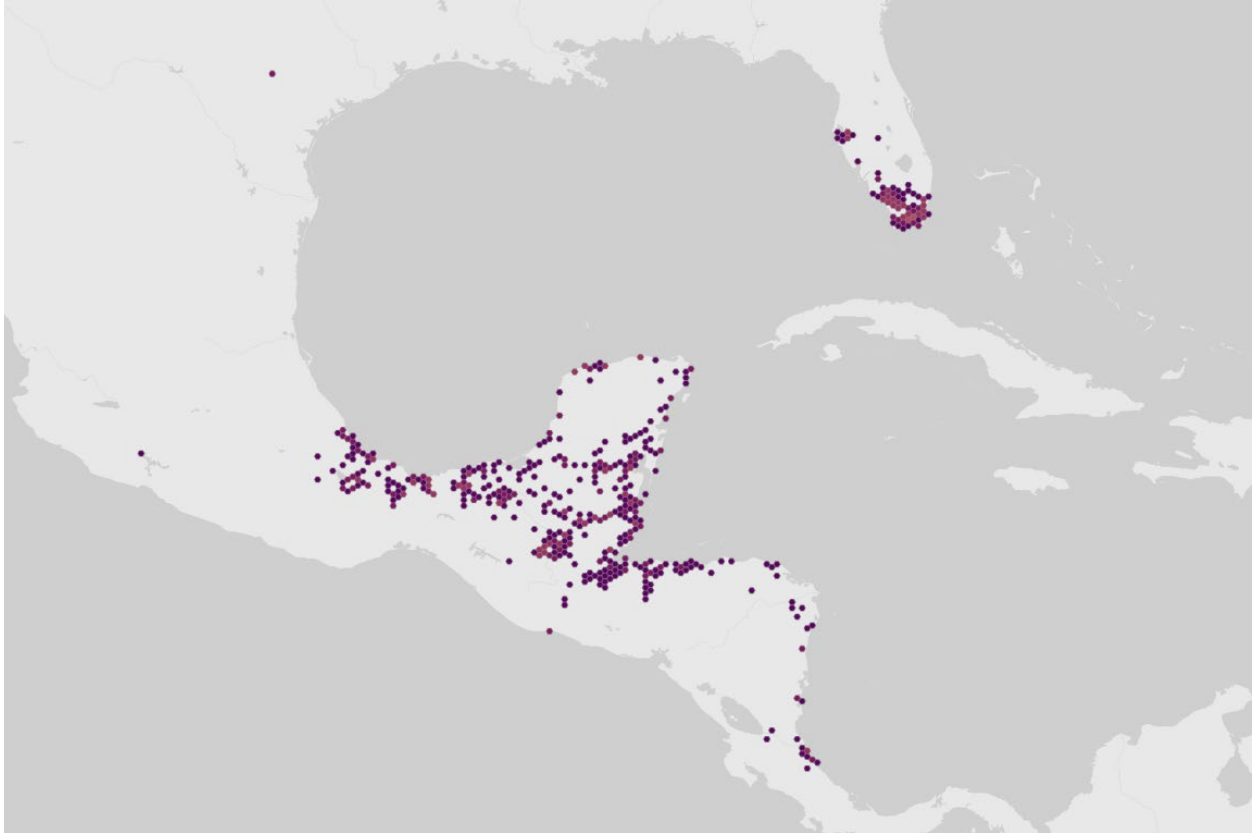


Figure 1. Reported global distribution of *Belonesox belizanus*. Map from GBIF Secretariat (2024). Observations are reported from Belize, Guatemala, Honduras, Mexico, Nicaragua, and the United States. Points in Texas were excluded from the climate matching analysis because they represent an extirpated population. A point in Michoacán, Mexico (western Mexico) was excluded from climate matching analysis because of incorrect coordinates.

6 Distribution Within the United States



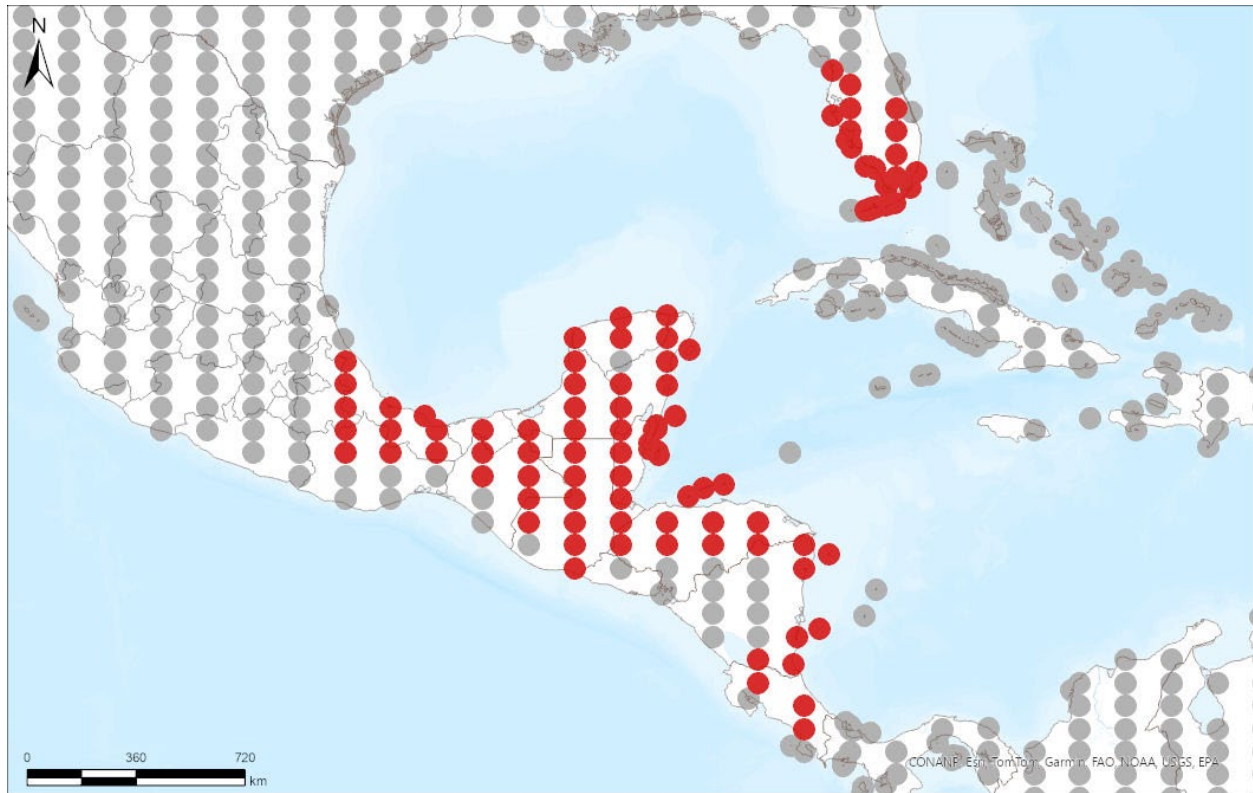
Figure 2. Reported distribution of *Belonesox belizanus* in the United States. Map from Schofield et al. (2025). Observations are reported from Florida and Texas. The observation in Texas represents an extirpated population of *B. belizanus* and was not used to select source points in the climate matching analysis.

7 Climate Matching

Summary of Climate Matching Analysis

The climate matching analysis for *Belonesox belizanus* to the contiguous United States indicated high match in Florida around areas with existing established populations. Medium matches were found along Gulf and southern Atlantic coastal areas, the southern California coast, and in patches in the Southwest. Elsewhere, the climate match was generally low. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.039, indicating that Yes, there is establishment concern for this species. The Climate 6 score is calculated as: $(\text{count of target points with scores} \geq 6) / (\text{count of all target points})$. 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 *Belonesox belizanus* (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.



Species: *Belonesox belizanus*

Selected Climate Stations ●



RAMP

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Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations in general geographic area selected as source locations (red; United States, Mexico, Belize, Costa Rica, Guatemala, Honduras, Nicaragua) and non-source locations (gray) for *Belonesox belizanus* climate matching. Source locations from GBIF Secretariat (2024). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

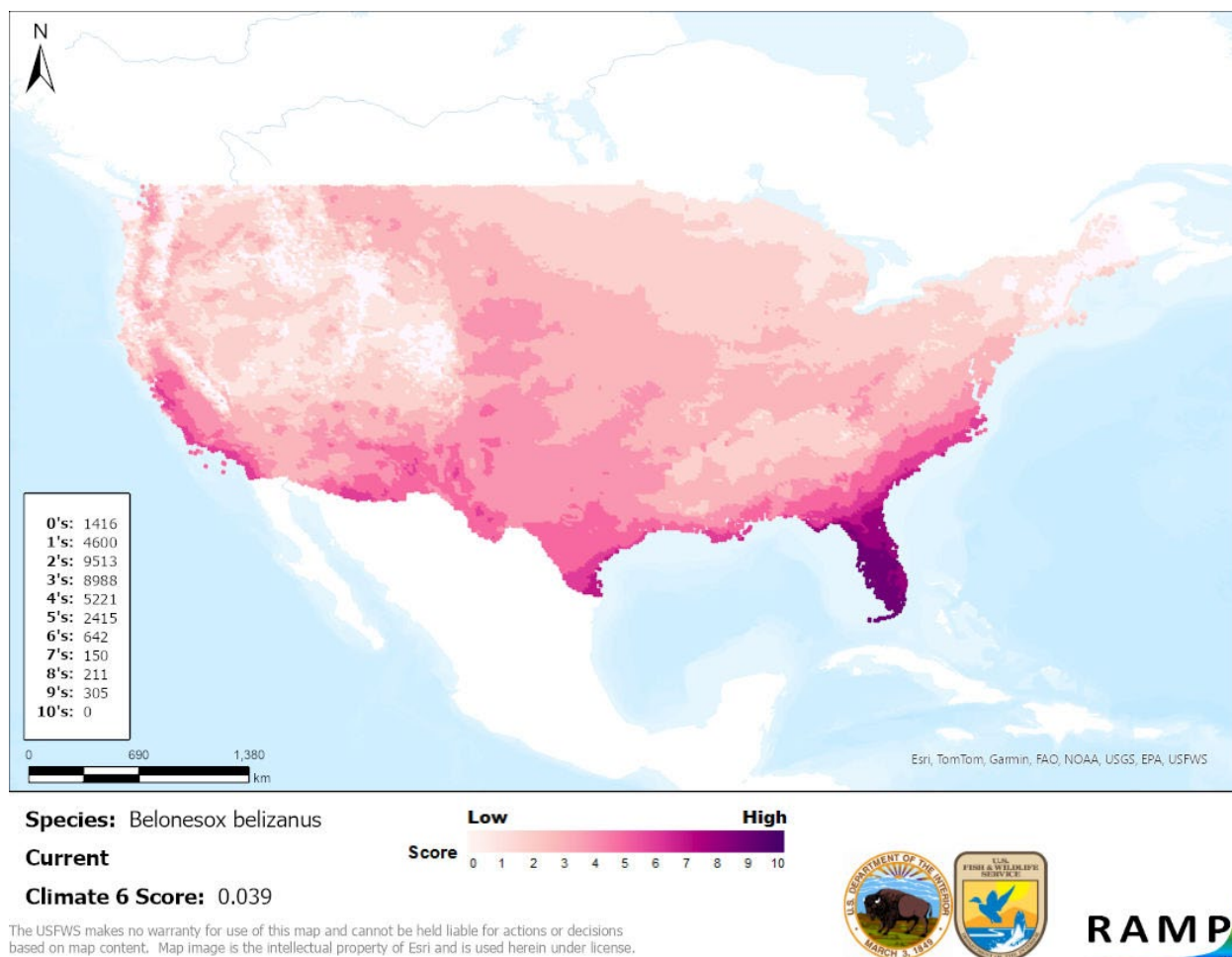


Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Belonesox belizanus* in the contiguous United States based on source locations reported by GBIF Secretariat (2024). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Belonesox belizanus* is classified as High. Information regarding the biology, ecology, and distribution of the species was available. Clear and convincing records of introduction and impacts from introduction were found.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Belonesox belizanus, Pike Killifish, is a small euryhaline fish species native to the Atlantic drainages of Mexico and Central America. It is available in the aquarium trade, although its possession is regulated in several states. *B. belizanus* is mainly piscivorous, but it capable of consuming a variety of prey. Currently, this species is only established in Florida, but the species was present for a short time in Texas. Pathways of introduction include fish farm escape and deliberate release from captivity. The History of Invasiveness for *Belonesox belizanus* is

classified as High due to its successful establishment within the state of Florida and documented negative impacts of its presence there including reductions in abundance of native fish species. The climate matching analysis for the contiguous United States indicates establishment concern for *Belonesox belizanus*. Climate match was highest in Florida and coastal Texas. The Certainty of Assessment for this ERSS is classified as High due to availability of general information and clear, documented negative impacts of introduction of this species reported in scientific literature. The Overall Risk Assessment Category for *Belonesox belizanus* in the contiguous United States is High.

Assessment Elements

- **History of Invasiveness (see Section 4): High**
- **Establishment Concern (see Section 7): Yes**
- **Certainty of Assessment (see Section 8): High**
- **Remarks, Important additional information: None**
- **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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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 (2024).

Under the future climate scenarios (figure A1), on average, high climate match for *Belonesox belizanus* was projected to occur in the Southern Florida region of the contiguous United States. Under most scenarios, areas of medium match were found in southern California, New Mexico, Arizona, and Texas. Areas of low climate match were projected to occur in the Colorado Plateau, Great Basin, Great Lakes, Northeast, Northern Pacific Coast, Northern Plains, and Western Mountains regions. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.028 (model: IPSL-CM6A-LR, SSP5, 2085) to a high of 0.058 (model: MRI-ESM2-0, 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 (0.039, figure 4) falls within the range of scores for future projections. The time step and climate scenario with the most change relative to current conditions was SSP3, 2085. Under one or more time step and climate scenarios, areas within the Appalachian Range, Colorado Plateau, Great Lakes, Northeast, and Northern Pacific Coast saw a moderate increase in the climate match relative to current conditions. No large increases were observed regardless of time step and climate scenarios. Under one or more time step and climate scenarios, areas within the Gulf Coast, Southern Atlantic Coast, and Southern Florida saw a moderate decrease in the climate match relative to current conditions. No large decreases were observed regardless of time step and climate scenarios. Additional, very small areas of large or moderate change may be visible on the maps (figure A3).

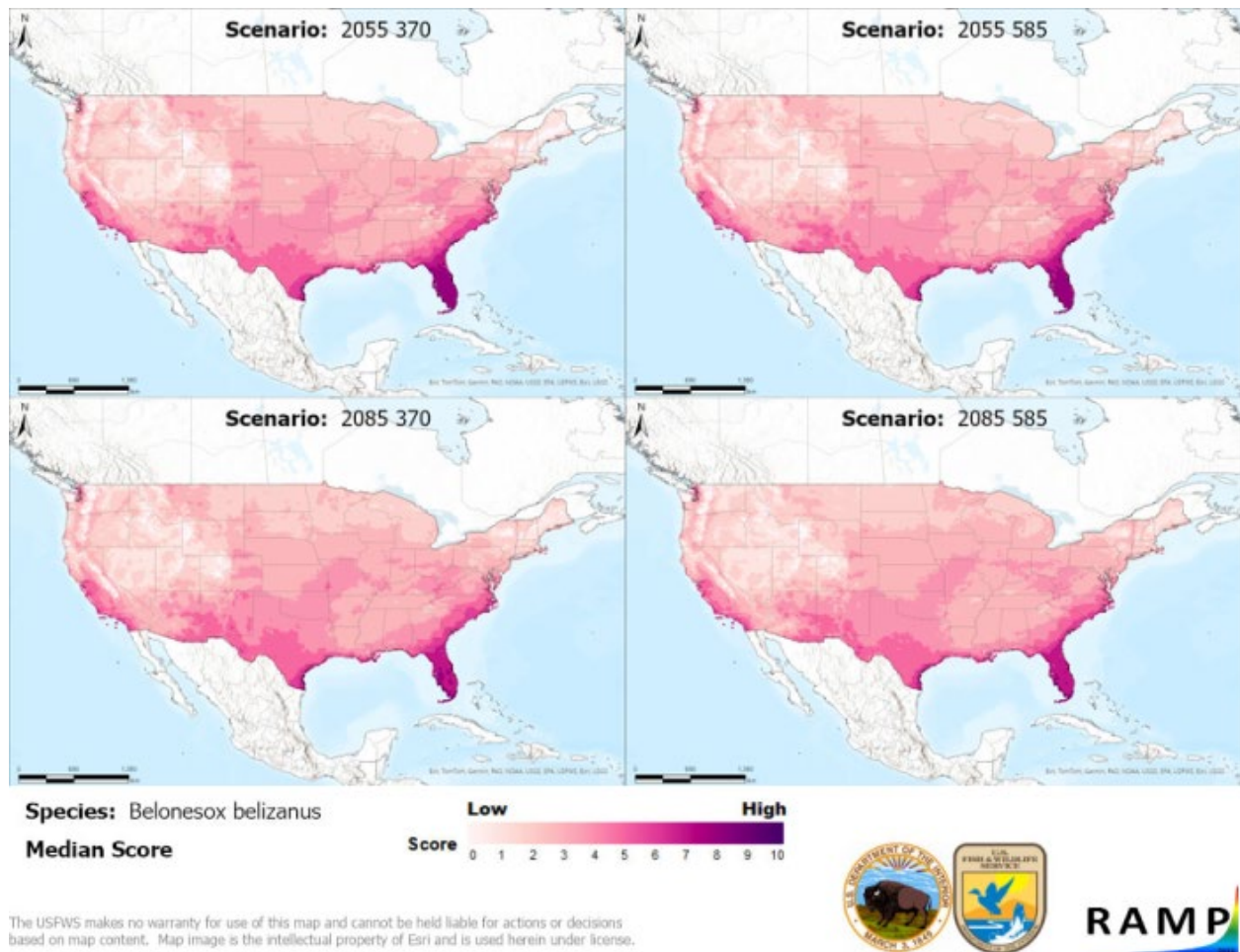


Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Belonesox belizanus* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2024). Shared 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.

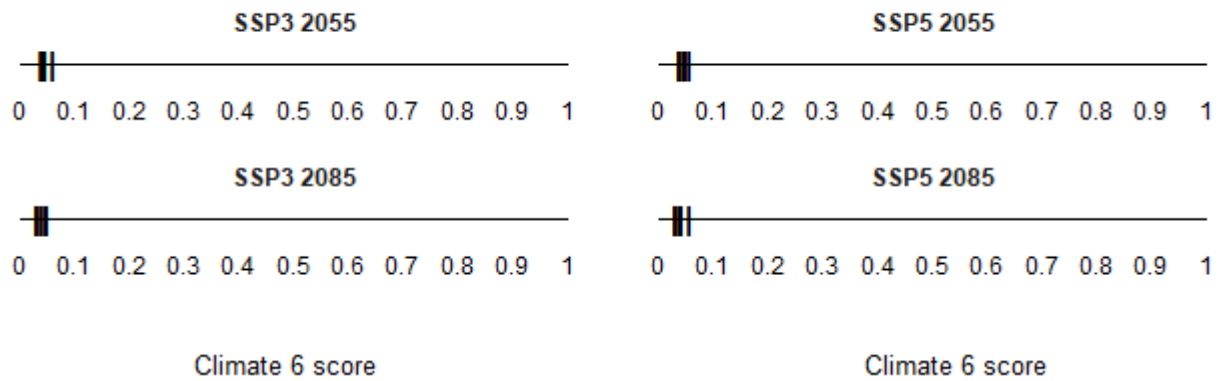


Figure A2. Comparison of projected future Climate 6 scores for *Belonesox belizanus* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; 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.

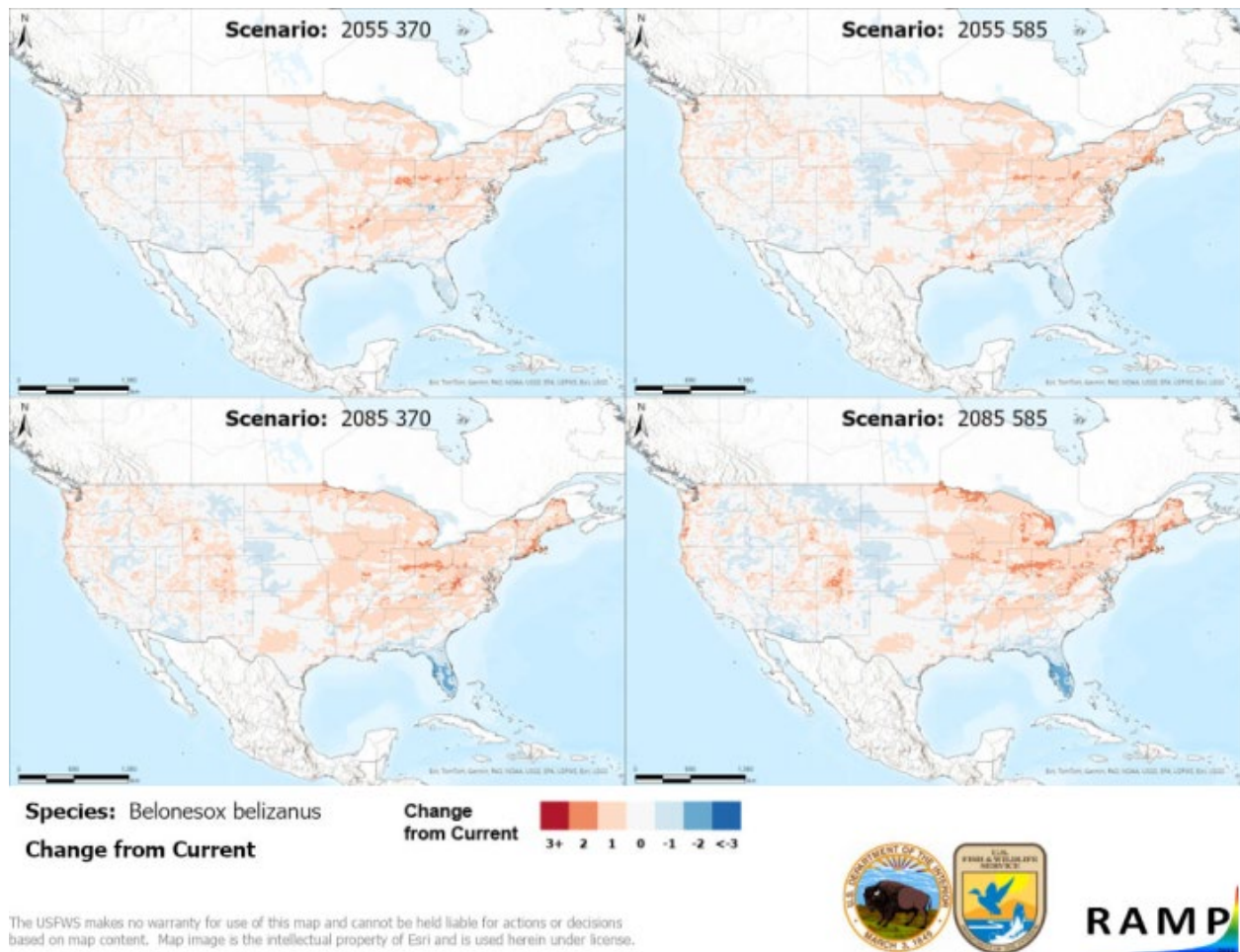


Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Belonesox belizanus* based on source locations reported by GBIF Secretariat (2024). 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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