Bigmouth Buffalo (*Ictiobus cyprinellus*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, January 2023
Revised, February 2023
Web Version, 3/25/2024

Organism Type: Fish
Overall Risk Assessment Category: Uncertain

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1 Native Range and Status in the United States

Native Range

From Fuller and Sturtevant (2023a):

"Hudson Bay (Nelson River drainage) [Manitoba], lower Great Lakes, and Mississippi River basins from Ontario to Saskatchewan and Montana, and south to Louisiana (Page and Burr 1991)."

"Canada considers this species native to at least Lake Erie and its tributaries, but it may also be native to Lake Michigan (Bailey & Smith 1981; COSEWIC 2009)."

Status in the United States

From Fuller and Sturtevant (2023b):

"Native Range: […] Occurs from Lake Erie south through Ohio and Mississippi River basins to the Tennessee River in northern Alabama, west to Arkansas, south to near the Gulf of Mexico in Louisiana, northwest through eastern Texas and Oklahoma (rare), north through Iowa and South Dakota to the Milk River in central Montana. From Illinois in the Mississippi River drainage northwest through western Minnesota and north in the Red River […]."

From Fuller and Sturtevant (2023a):

"The status of *I. cyprinellus* is cryptogenic in the southern reaches of the Great Lakes (Becker 1983, Scott & Crossman 1998). […] Canada considers this species native to at least Lake Erie and its tributaries, but it may also be native to Lake Michigan (Bailey & Smith 1981; COSEWIC 2009). It expanded to Lake Ontario and Southern Lake Huron through the Welland Canal around the year 2000 (COSEWIC 2009)."

From Fuller and Sturtevant (2023b):

"This species is established in the [sic] Lake Michigan, Lake St. Clair, Michigan and Lake Erie (Cudmore-Vokey and Crossman 2000; Bailey et al 2004). There are several published reports of this species from the Lake Michigan drainage in Wisconsin; however, there are no voucher specimens and the one photograph that is available has been identified by experts as this genus, but the species identification is uncertain (Becker 1983). Another collection of this species in Wisconsin is of a single fish from Big Lake in Vilas County. It is supported by a voucher specimen (Becker 1983)."

"In the early 1900s all three species of buffalofishes were stocked; *I. bubalus*, *I. cyprinellus*, and *I. velifer* (Leach 1921, 1923). However, when the stockings were reported they were lumped together as 'buffalofish' and it is not possible to determine which species were planted. Stocking of buffalofishes occurred outside their native ranges in Lake Erie in Ohio, the Pee Dee and Catawba drainages in North Carolina, and in unknown locations in Massachusetts (Leach 1921, 1923)."

According to Fuller and Sturtevant (2023a), nonindigenous occurrences of *Ictiobus cyprinellus* have been reported in the following States. Range of observation years, watersheds, and populations status (one or more watersheds) where reported in parentheses:

- Alabama (1992; Cahaba; failed)
- Arizona (1918–2012; Agua Fria, Lower Colorado, Lower Salt, Tonto, Upper Salt; established)
- California (1948–1976; Indian Wells-Searles Valleys; established)
- Colorado (2010; Middle South Platte-Sterling; collected)
- Indiana (1962; St. Joseph; established)
- Michigan (2000–2015; Detroit, Lake St. Clair; established)
- New York (2015; Irondequoit-Ninemile; unknown)

- North Carolina (1991–2009; Lower Pee Dee, Rocky, Upper Catawba, Upper Yadkin; established)
- Ohio (1962–2004; Auglaize, Chautauqua-Conneaut, Grand, Lake Erie, Sandusky; established)
- South Carolina (2009; Lower Pee Dee; unknown)
- Texas (1989; Lower Angelina; collected)
- Virginia (1967; Mattaponi; failed)
- Wisconsin (1964–2000; Lake Michigan, Lake Winnebago, Lower Fox, Ontonagon (failed), Wolf; established)

No records of *Ictiobus cyprinellus* in live trade in the United States were found.

Regulations

The states of Arkansas and Virginia have restrictions on the importation, possession, selling or trade of *Ictiobus cyprinellus* that require adequate permits (Arkansas Game and Fish Commission 2022; Virginia Department of Wildlife Resources 2022).

California and Arizona have restrictions on the genus *Ictiobus* that also require permits to transport, possess, or sell any species within the genus (Arizona Game and Fish Commission 2022; California Department of Fish and Wildlife 2021).

While effort was made to find all applicable regulations, this list may not be comprehensive.

Means of Introductions within the United States

From Fuller and Sturtevant (2023a):

"Intentional, authorized stocking for sport fishing in Arizona in 1918 (Minckley 1973); unknown in North Carolina. It is speculated that commercial fishermen transplanted this species from Arizona to California to provide a source closer to the Los Angeles Fish Market (Moyle 1976). Escaped from an aquaculture facility in Virginia. Population in Alabama was intentionally stocked by a federal fish hatchery during studies (Mettee et al. 1996). Bigmouth Buffalo were introduced to western Lake Erie and Sandusky Bay around 1920 (Trautman 1981) by the federal government - however, they may have already occurred there. The introduction in Big Lake, Wisconsin, is probably a result of a transplant associated with fish rescue operations from the Mississippi River in the 1930s (Becker 1983). The Lake Michigan drainage records may be the result of movement through the Wisconsin-Fox Canal."

Remarks

Ictiobus cyprinellus 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.

Ictiobus cyprinellus can hybridize with smallmouth buffalo (*Ictiobus bubalus*) (Fuller and Sturtevant 2023a).

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to Fricke et al. (2023), *Ictiobus cyprinellus* (Valenciennes, 1844) is the current valid name for this species.

From ITIS (2023):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygi
Class Teleostei
Superorder Ostariophysi
Order Cypriniformes
Superfamily Cobitoidea
Family Catostomidae
Subfamily Ictiobinae
Genus *Ictiobus* Rafinesque, 1820
Species *Ictiobus cyprinellus* (Valenciennes in Cuvier and Valenciennes, 1844)

Size, Weight, and Age Range

From Fuller and Sturtevant (2023a):

"43-52 cm on average"

From Lackmann et al. (2019):

"[…] reaching lengths exceeding 1.25m and body masses >36 kg"

"[…] Bigmouth Buffalo can live to 112 years […]"

Environment

From Fuller and Sturtevant (2023a):

"A demersal fish living near the lake bottom, Bigmouth Buffalo Inhabits [sic] main channels, pools, and backwaters of small to large rivers as well as lakes and impoundments. It prefers water less than 5m depth (Johnson 1963). This fish is well-adapted to reservoirs, preferring slow water and tolerant of turbidity, low oxygen and high temperatures."

Climate

From Froese and Pauly (2024):

"Subtropical; 16°C - 30°C [COSEWIC 2009]; 52°N - 29°N, 108°W - 70°W [Page and Burr 2011]"

Distribution Outside the United States

Native

Part of the native range for this species is within the United States, see section 1 for a complete description of the native range.

From Fuller and Sturtevant (2023a):

"Hudson Bay (Nelson River drainage) [Manitoba], lower Great Lakes, and Mississippi River basins from Ontario to Saskatchewan […] (Page and Burr 1991)."

"Canada considers this species native to at least Lake Erie and its tributaries, but it may also be native to Lake Michigan (Bailey & Smith 1981; COSEWIC 2009)."

Introduced

According to NOBANIS (2023), *Ictiobus cyprinellus* was introduced to the Czech Republic and Lithuania. It is not established in Lithuania and established but rare in Czech Republic.

Froese and Pauly (2024) lists *Ictiobus cyprinellus* as introduced but not established in Israel, China, and Panama; as introduced but without a population status in Jordan, Romania, and Cuba; and as introduced and established in Bulgaria.

From Froese and Pauly (2024):

"Known from Syr-Darya [Uzbekistan] (Kamilov and Urchinov 1995). Introduced to the Balykchi fish farm but have disappeared in 2000 (E. Khurshut, pers. comm.)."

"This [*Ictiobus cyprinellus*] has been introduced to areas within the country [Russia] for aquaculture and stocking in open waters however, it failed to establish self-sustaining populations [Bogutskaya and Naseka 2002]."

"A total of 75,000 fingerlings were stocked twice in Lake Kinneret [Israel]. The species is capable of surviving local conditions but its ability to reproduce in the Kinneret is uncertain [Golani and Mires 2000]. Stocked into Lake Tiberias from 1960 to 1962; last record was in 1974 [Welcomme 1988]."

"Reintroduced [to Romania] in 1980 and 1993. Attempted aquaculture in the Danube Delta lakes."

From EIFAC (1982):

"Romania has been the recipient of 15 non-native fishes since the last century [Bacalbasa-Dobrovici 1982]. Those of foreign origin include […] smallmouth buffalo (*Ictiobus bubalus*), largemouth buffalo (*I. cyprinellus*), black buffalo, (*I. niger*) […] all three buffalo […] are established."

From Kalous et al. (2018):

"The findings of our study confirmed the occurrence of two non-native species of buffalo fishes *Ictiobus cyprinellus* and *I. niger* in the rivers of Czechia based on anglers records."

"On the other hand, the presence of both species *I. cyprinellus* and *I. niger* in the rivers of Czechia at least 28 years after their introduction is surprising and can be explained either by their natural reproduction in rivers or by their continuous artificial reproduction in aquaculture followed by escapes or stocking. Since natural reproduction is not likely in European waters and has never been recorded an unofficial stocking is a more probable explanation."

Means of Introduction Outside the United States

According to NOBANIS (2023), *Ictiobus cyprinellus* was intentionally introduced into lakes in the Czech Republic and Lithuania.

Musil et al. (2010) state that *Ictiobus cyprinellus* was introduced for aquaculture purposes into the Czech Republic.

Short Description

From Fuller and Sturtevant (2023a):

"Largest member of the sucker family, deep-bodied and laterally compressed. Long dorsal fin like other suckers but has a large oblique terminal mouth with thin sucker lips. No barbells [sic] or spines. Pharyngeal teeth present, but no teeth in mouth. Gill rakers, each with many lateral projections, on both sides of the arch, those on the anterior edge of the first arch long, fine, closely spaced, at least 60 in number. Tail moderately long, very broad, moderately forked and with pointed tips. Easily confused with carp, but lacks the single serrated spine at the beginning of the dorsal fin that is present in carp. Eye level with the tip of the upper jaw. Green-gold to black with a coppery sheen."

Biology

From Fuller and Sturtevant (2023a):

"Unlike other suckers, this species eats plankton as well as benthos, feeding primarily on cladocera and cyclopoid copepods supplemented with midge larvae (Etnier and Starnes, 1993). Larger adults are probably not susceptible to predators due to their body shape."

"This species is oviparous (Breder and Rosen 1966). Spawns in spring for a very short period (mid-May to June) at water temperatures 60-65F (15.5-18.3C) in small tributaries, marshes or flooded lake margins. Up to ~750,000 eggs per spawning female – eggs adhere to vegetation. Will hybridize with smallmouth buffalo (Johnson and Minckley 1969)."

From NatureServe (2023):

"[…] often occur in schools. Spawning occurs in spring or (in the northern part of the range) early summer, often with seasonal flooding. Adults may migrate long distances upstream prior to spawning. Spawning females may attract multiple males that may thrash and tumble at the water surface. Eggs hatch in 1-2 weeks. Individuals become sexually mature in 1 (south) to 10 or more (north) years (Becker 1983)."

Human Uses

From Wilkinson et al. (2022):

"[…] subject to targeted commercial and recreational harvest […]"

"They are a culturally and economically important species in North America (Lackmann et al. 2019), with a fishery valued at approximately $1.2 million USD annually for the Upper Mississippi River basin (U.S. Army Corps of Engineers 2012)"

From Froese and Pauly (2024):

"Artificially maintained in aquaculture installations only [in Hungary]."

From Kleinholz (2000):

"Most 'cultured' buffalo are caught by commercial fishermen and held in ponds until harvested and sold. Producing buffalo in catfish ponds may now be economically feasible, because market demand is increasing while commercial harvest is declining."

Diseases

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

According to CABI (2019), *Ictiobus cyprinellus* is a host species to *Lernaea cyprinacea*.

According to Poelen et al. (2014), *Ictiobus cyprinellus* is a host species to the following: *Ovarionematobothrium texomense*, *Parodia* (*Acanthocephala*) sp., *Bialovarium giganteum*, *Gyrodactylus dakotensis*, *Icelanonchohaptor icrlanonchohaptor*, *Philometra* sp., *Pellucidhaptor planacrus*, *Pomphorhynchus* sp., *Spartoides wardi*, *Monobothrium* sp., *Glaridacris confusa*, *Filarioidea* sp., and *Lissorchis gullaris*.

From Herman and Bies (2014):

"Haff disease was first reported in the U.S. in Texas in 1984 with only 23 cases reported in the U.S. between 1984 and 2001. All victims had eaten buffalo fish […]"

Threat to Humans

From Herman and Bies (2014):

"Haff disease was first reported in the U.S. in Texas in 1984 with only 23 cases reported in the U.S. between 1984 and 2001. All victims had eaten buffalo fish […]"

3 Impacts of Introductions

No information regarding documented impacts from introductions was found. However, there was some information available regarding the *possibility* of impacts.

From Fuller and Sturtevant (2023b):

"While this species may compete with native planktivores, there is currently no evidence to suggest that this competition is stressing any native fish population in the Great Lakes."

"It eats plankton as well as benthos (generalist) and evidence suggests that it may compete with other filter feeders under certain conditions. When feeding in the benthos, this species may disrupt sediment (Scott and Crossman 1998)."

"[…] demonstrated to compete with common carp in laboratory settings, but impact to wild populations has not been demonstrated to be significant."

From Wilkinson et al. (2022):

"There were clear cascading trophic interactions that occurred with the addition of bigmouth buffalo to the experimental ponds that varied with fish density."

Ictiobus cyprinellus is regulated in Arizona, Arkansas, California, and Virginia (California Department of Fish and Wildlife 2021; Arizona Game and Fish Commission 2022; Arkansas Game and Fish Commission 2022; Virginia Department of Wildlife Resources 2022).

4 History of Invasiveness

The History of Invasiveness for *Ictiobus cyprinellus* is classified as Data Deficient. Records of nonnative established populations are available. There is information indicating possible negative impacts or possible lack of negative impacts. However, there was no information found documenting observed impacts in the wild.

5 Global Distribution

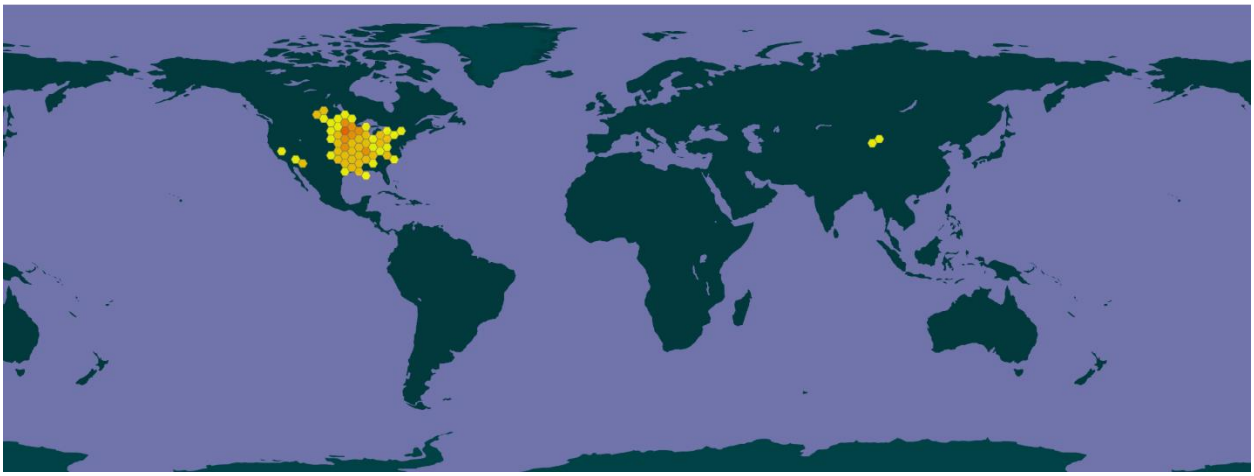

Figure 1. Reported global distribution of *Ictiobus cyprinellus*. Observations reported from Eastern, Midwest, and Southwest United States, Southeastern Canada, and China. Map from GBIF Secretariat (2023). Reported occurrences in the Gansu Province (China) were excluded from the climate matching analysis as these occurrences had coordinate errors. These points related to observations from Nebraska (United States), but the coordinates reported placed the observations in China.

No georeferenced observations were found for the reported Czech Republic, Romanian, or Bulgarian introductions.

6 Distribution Within the United States

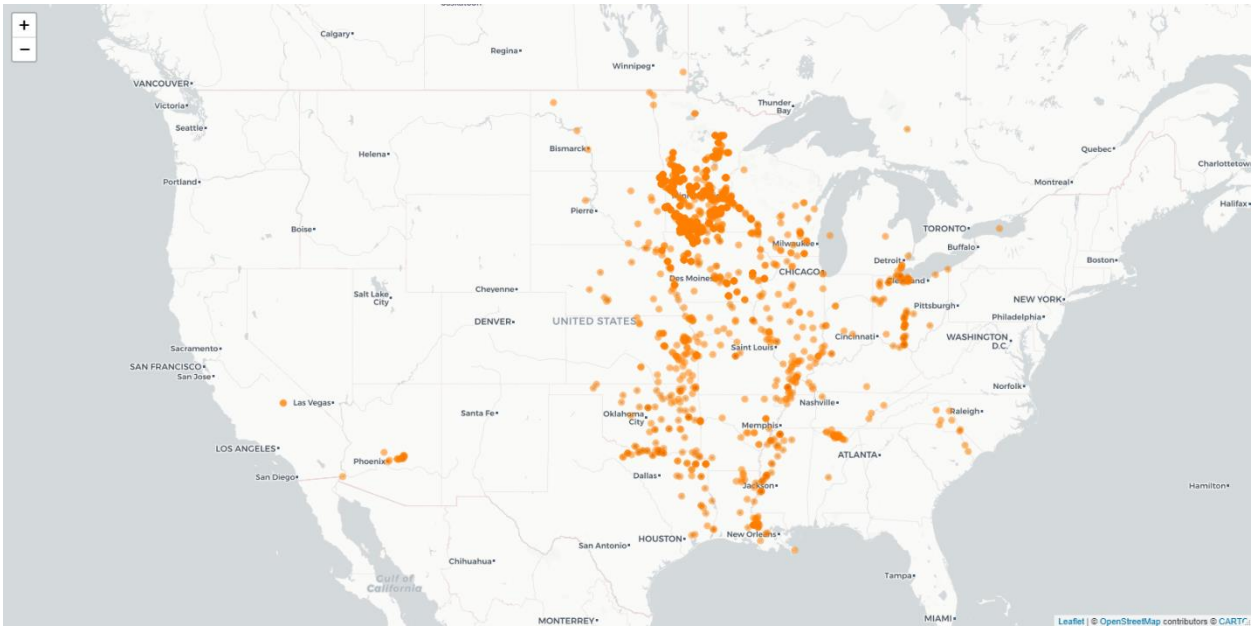

Figure 2. Reported distribution of *Ictiobus cyprinellus* in the United States. Map created in RStudio (2022) by utilizing data from GBIF Secretariat (2023) and using the rgbif, leaflet, and tidyverse packages (Wickham et al. 2019; Cheng et al. 2022; Chamberlain et al. 2023). Observations reported from the Midwestern, Eastern, and Southwestern United States.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Ictiobus cyprinellus* to the contiguous United States was highest in the along the East Coast and in the Midwest, especially in the Mississippi River basin. This area of high match was centered around the current distribution of the species but did expand beyond. The climate match was low along the Pacific Coast and in the Cascade and Sierra Nevada ranges. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.925, indicating 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 *Ictiobus cyprinellus* (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.

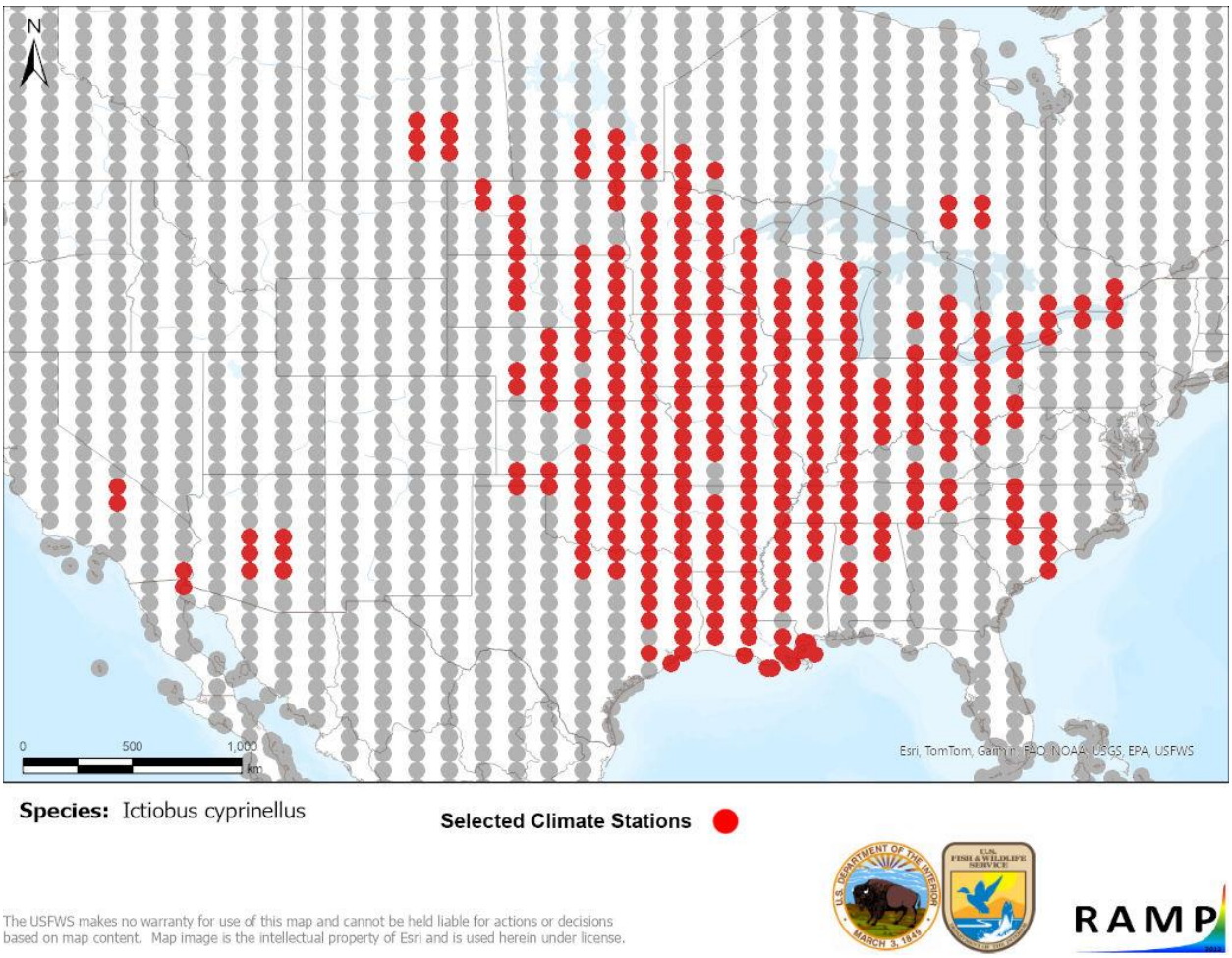

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations in Midwestern United States, Eastern United States, Southwestern United States, and Southern Canada selected as source locations (red; United States, Canada) and non-source locations (gray) for *Ictiobus cyprinellus* climate matching. Source locations 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.

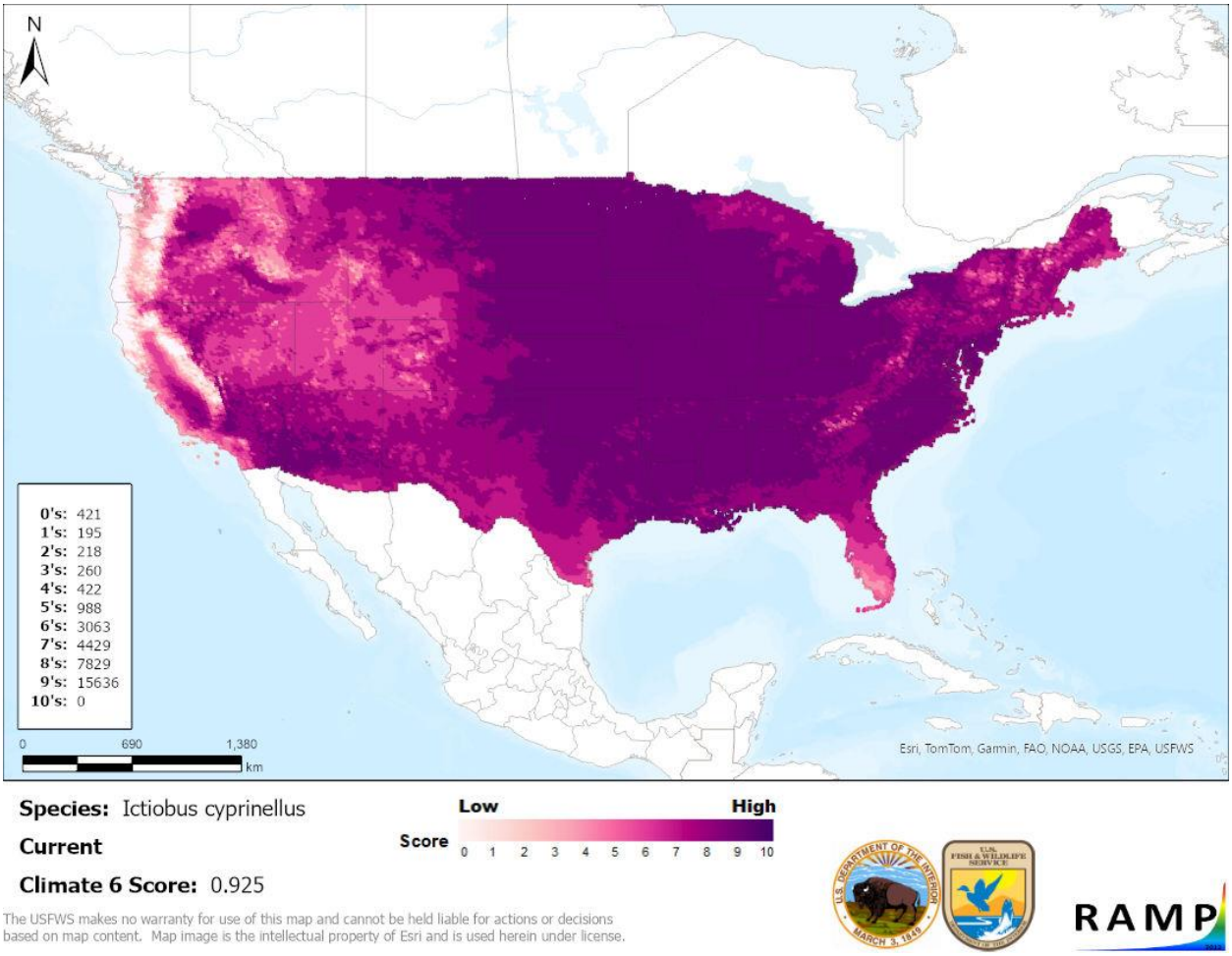

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Ictiobus cyprinellus* in the contiguous United States based on source locations reported by GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Ictiobus cyprinellus* is classified as Low. There is adequate information about the species' ecology, biology, and distribution. Information is available indicating possible negative impacts or possible lack of negative impacts. However, this information fails to highlight clear, convincing, and reliable evidence of realized impacts or lack thereof.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Ictiobus cyprinellus, Bigmouth Buffalo, is a fish that is native to the Hudson Bay, lower Great Lakes, and Mississippi River basins. *I. cyprinellus* is a large demersal fish that inhabits rivers, lakes, bayous, and marshes. Spawning occurs in shallow streams and marshes. *I. cyprinellus* is native to much of the contiguous United States and has been introduced to various U.S. States

intentionally for both recreational and sustenance harvest. Impacts from those introductions have not yet been documented, although it is hypothesized that competition may exist between *I. cyprinellus* and native filter feeders. The History of Invasiveness for *I. cyprinellus* is classified as Data Deficient due to the lack of clear, convincing, and reliable characterizations of impacts. The climate matching analysis for the contiguous United States indicates establishment concern for this species outside its native range. The climate match was highest in the Midwest, Southeast Atlantic, and Southwest both within and outside the native range of the species. The Certainty of Assessment for this ERSS is classified as Low due to the lack of information regarding documented impacts from introductions. The Overall Risk Assessment Category for *Ictiobus cyprinellus* 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: No additional remarks**
- **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 *Ictiobus cyprinellus* was projected to occur in the Appalachian Range, Colorado Plateau, Great Lakes, Mid-Atlantic, Northeast, Northern Plains, Southeast except southern Florida, Southern Plains, and Southwest regions of the contiguous United States. Areas of low climate match were projected to occur in the Northern Pacific Coast region and along the Sierra-Nevada Range. Areas of high match decreased with time and between SSP3 and SSP5. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.902 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.94 (model: IPSL-CM6A-LR, SSP5, 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 (0.925, 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 SSP5, 2085 (figure A3). Under one or more time step and climate scenarios, areas within the Northeast and Western Mountains 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 Appalachian Range, California, Gulf Coast, Mid-Atlantic, Northern Plains, Southeast, Southern Plains, and Southwest saw a moderate decrease in the climate match relative to current conditions. No large decreases were observed regardless of time step and climate scenarios. The degree of change increased with time and between SSP3 and SSP5.

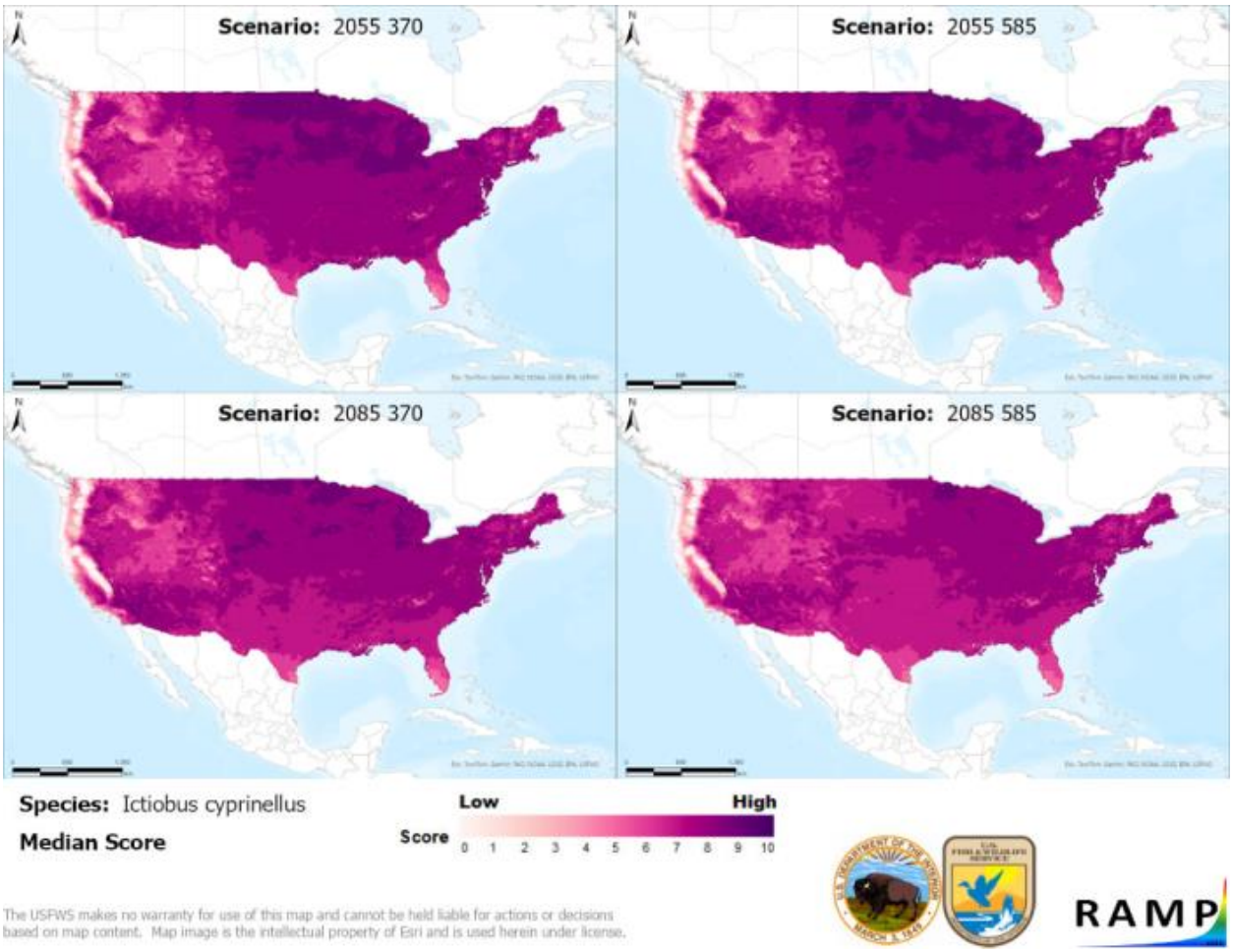

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Ictiobus cyprinellus* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023). Shared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

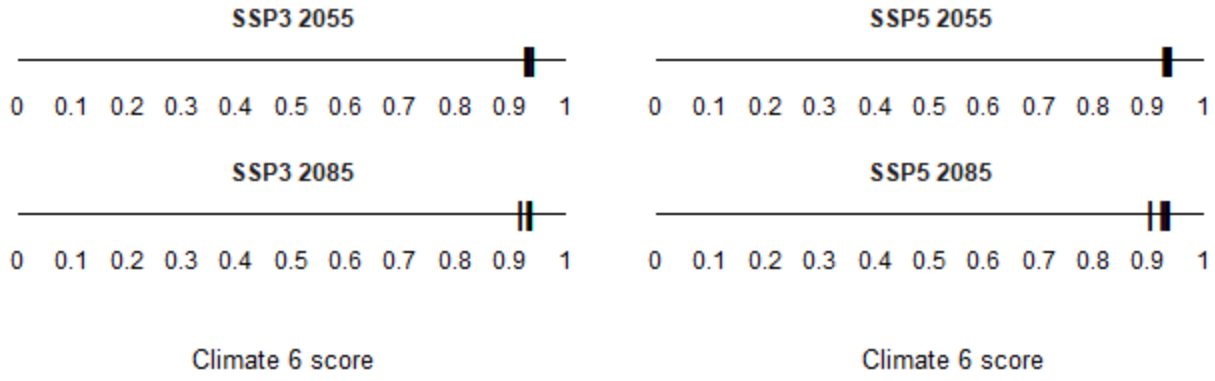

Figure A2. Comparison of projected future Climate 6 scores for *Ictiobus cyprinellus* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018;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

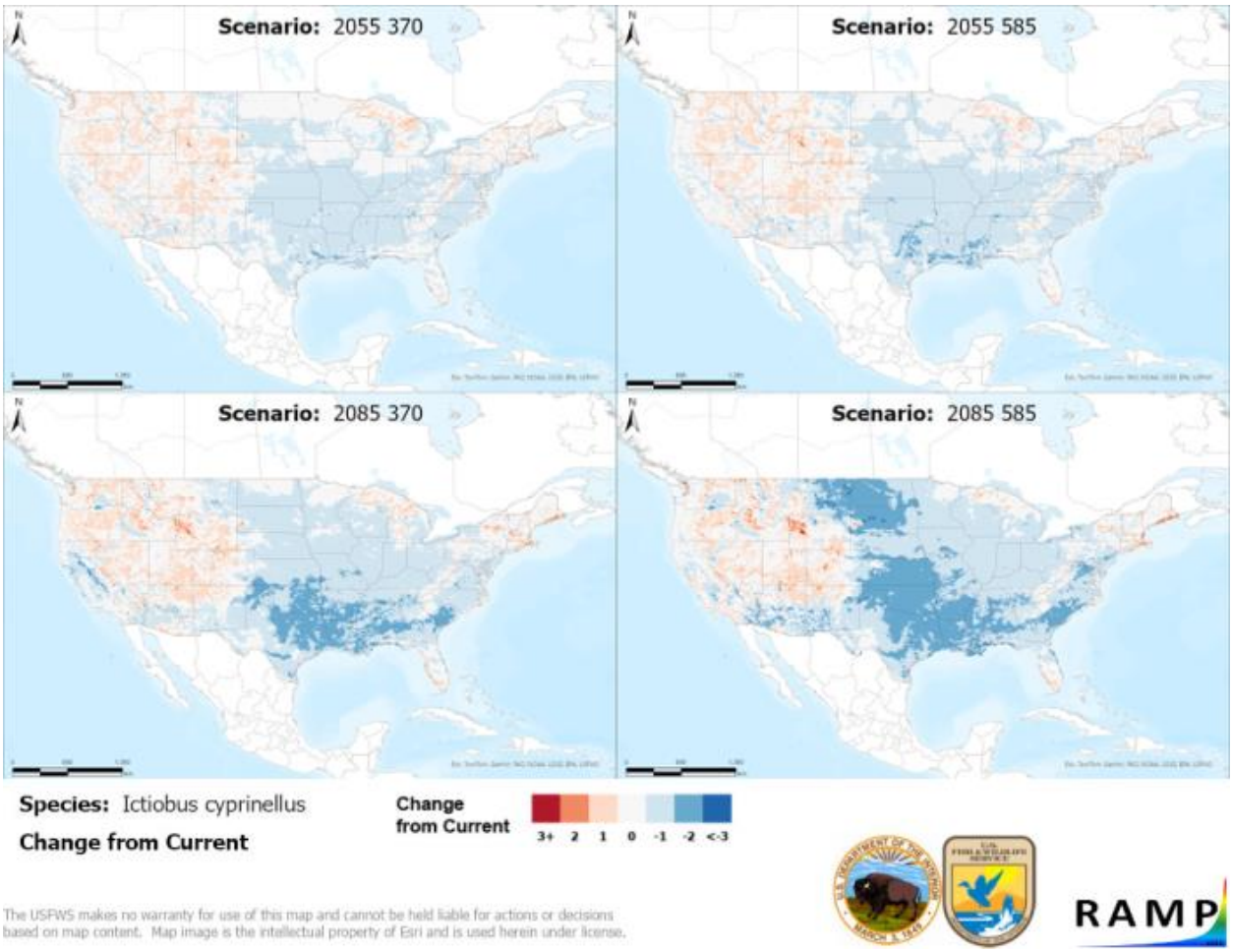

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Ictiobus cyprinellus* based on source locations reported by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