Ohio Shrimp (*Macrobrachium ohione*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, April 2023
Revised, May 2023
Web Version, 4/5/2024

Organism Type: Crustacean
Overall Risk Assessment Category: Uncertain

Photo: chrisfrazier. Licensed under Creative Commons BY-NC-ND. Available: https://www.inaturalist.org/observations/98117600 (April 2023).

1 Native Range and Status in the United States

Native Range

From Benson (2023):

"*Macrobrachium ohione* is the most widely distributed and abundant of the six river shrimp species in the United States (Bowles et al., 2000) and originally was described from the Ohio River. It also is found in the middle and lower Mississippi River from Illinois to Louisiana, west to Oklahoma and Texas, in the Atlantic drainage from Virginia to northern Florida, and in the Gulf region in Alabama and Mississippi (Bowles et al., 2000; Hobbs and Lodge, 2010)."

"It is the only endemic species of the genus in North America (Hobbs and Lodge, 2010)."

De Grave and Rogers (2013) list *Macrobrachium ohione* as native to the following U.S. States: Virginia, Texas, South Carolina, Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Louisiana, Mississippi, Missouri, North Carolina, Ohio, and Oklahoma.

Status in the United States

De Grave and Rogers (2013) list *Macrobrachium ohione* as native to the following U.S. States: Virginia, Texas, South Carolina, Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Louisiana, Mississippi, Missouri, North Carolina, Ohio, and Oklahoma.

From De Grave and Rogers (2013):

"In parts of its range, especially northern and the Missouri and Ohio rivers, the species has become very rare in recent decades."

According to Benson (2023), *Macrobrachium ohione* was recorded outside its native range in the Caloosahatchee watershed in Florida in 2005. The status of this introduction is unknown.

No individuals of *Macrobrachium ohione* were found for sale in live trade in the United States.

Regulations

No species-specific regulations on possession or trade were found within the United States.

Means of Introductions within the United States

From Benson (2023):

"Most likely a bait bucket introduction. There has been a commercial fishery throughout its native range for bait as well as for human consumption for many years (Bowles et al., 2000; Bauer and Delahoussaye, 2008)."

Remarks

From De Grave and Rogers (2013):

"Bowles et al. (2000) also mention the species occurs in coastal streams in northeastern Mexico, but this is not substantiated by other publications."

From Bauer and Delahoussaye (2008):

"The decline of the species in the northern part of its range [including the Upper Mississippi and Ohio Rivers] might be partially explained by human impacts on the juvenile migration and subsequent upstream recruitment."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2023):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Protostomia
Superphylum Ecdysozoa
Phylum Arthropoda
Subphylum Crustacea
Class Malacostraca
Subclass Eumalacostraca
Superorder Eucarida
Order Decapoda
Suborder Pleocyemata
Infraorder Caridea
Superfamily Palaemonoidea
Family Palaemonidae
Genus *Macrobrachium*
Species *Macrobrachium ohione* (S. I. Smith, 1874)

According to De Grave (2021), *Macrobrachium ohione* is the current valid name for this species.

Size, Weight, and Age Range

According to Bowels et al. (2000), *Macrobrachium ohione* size ranges from 35 mm to 110 mm in body length.

From Missouri Department of Conservation (2023):

"Adult length: to about 4 inches (not counting appendages; females much larger than males)."

Environment

From De Grave and Rogers (2013):

"The species inhabits larger river systems, preferring low velocity areas, as well as the borders of the main channels."

From NatureServe (2023):

"Ohio shrimp apparently prefer low velocity water (Conaway and Hrabik, 1997); however, open side channels, a preferred habitat of Ohio shrimp, have flow during normal river elevations (Barko and Herzog, 2003). Ohio shrimp prefer borders of the main channel, especially when the borders are flooded and plant and animal material are available for foraging (Truesdale and Mermilliod, 1979). Ohio Shrimp have been reported to have greater abundance in areas with

suspended particulate matter, which may be a predator avoidance response. Ohio shrimp occupy low visibility physical habitats that are also occupied by predatory fishes, such as flathead catfish, a species that is not native to South Carolina (Barko and Herzog, 2003)."

Climate

According to Bowles et al. (2000), *Macrobrachium* spp. are primarily tropical. No information was found on the climatic requirements of *M. ohione* specifically.

Distribution Outside the United States

Native

The native range of *Macrobrachium ohione* is entirely within the United States, see Native Range in section 1.

Introduced

No records were found for introduction of *Macrobrachium ohione* in the wild outside of the United States.

Means of Introduction Outside the United States

No records were found for introduction of *Macrobrachium ohione* in the wild outside of the United States.

Short Description

From Bowles et al. (2000):

"*Macrobrachium ohione* is perhaps the least colorful of the species [within genus *Macrobrachium*] occurring in the U.S. The base color is pale gray to olivaceous with light blue spots and a blue telson and uropods."

According to Missouri Department of Conservation (2023), *M. ohione* is translucent pale to grayish tan with black, brown, or blueish speckles.

Biology

From Bowles et al. (2000):

"[…] we examined ovigerous specimens as small as 35 mm."

From Benson (2023):

"This shrimp inhabits primarily freshwater rivers and streams; however, their life cycle is associated with estuarine waters for reproduction (Bowles et al., 2000)."

"This species is amphidromous, where adults migrate downstream to spawn near estuaries, and juveniles swim back upstream and live as adults in freshwater (Bowles et al. 2000). Females, which are larger than males, can reach 110 mm in total length and are gray to green in color with

light blue spots (Bowles et al., 2000). Females can produce 6,000–24,000 eggs with a lifespan of only 2 years (Huner, 1977)."

From NatureServe (2023):

"[…] it has been reported to receive reproductive cues from spring floods and uses flooded terrestrial habitat for reproduction (Hobbs, 2001)."

From De Grave and Rogers (2013):

"The species migrates downstream for reproduction, historically in excess of over 1000 km, but now restricted by dams."

According to the Missouri Department of Conservation (2023), *M. ohione* feed on small invertebrates, plankton, algae, and a variety of organic detritus. Juveniles are restricted to saltwater habitats.

Human Uses

From Benson (2023):

"There has been a commercial fishery throughout its native range for bait as well as for human consumption for many years (Bowles et al., 2000; Bauer and Delahoussaye, 2008)."

From De Graves and Rogers (2013):

"Historically, the species was fished for human consumption in Illinois, Louisiana and Indiana (Holthuis 1980), but due to declining populations in the last few decades, this is thought to be no longer the case or at most at an artisanal level. In Louisiana an extensive fishery still exists, primarily targeted at fishing bait."

Diseases

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

According to Conner and Bauer (2010), *Macrobrachium ohione* is a host to the branchial parasite *Probopyrus pandalicola*. Conner and Bauer (2010) concluded that "most infections of adult shrimps occur during their migration into estuarine waters, the primary habitat of infective parasite larvae, and that host vulnerability is probably increased following host ecdysis."

Threat to Humans

No information was found on threats to humans from *Macrobrachium ohione*.

3 Impacts of Introductions

No information regarding documented impacts from introduction was found. The following concerns *possible* impacts.

From Benson (2023):

"Probably minimal impacts as this species is on the decline as a result of human impacts such as impoundments, river channelization, pollution, commercial fishing, and exotic predators (Barko and Hrabik, 2004; Bowles et al., 2000; Bauer and Delahoussaye, 2008; Hobbs and Lodge, 2010)."

4 History of Invasiveness

The History of Invasiveness for *Macrobrachium ohione* is classified as No Known Nonnative Population because no established populations of *M. ohione* have been found outside of its native range. *M. ohione* has been recorded as introduced to southern Florida but there was no indication that it resulted in an established population. In addition, there were no individuals found in live trade.

5 Global Distribution

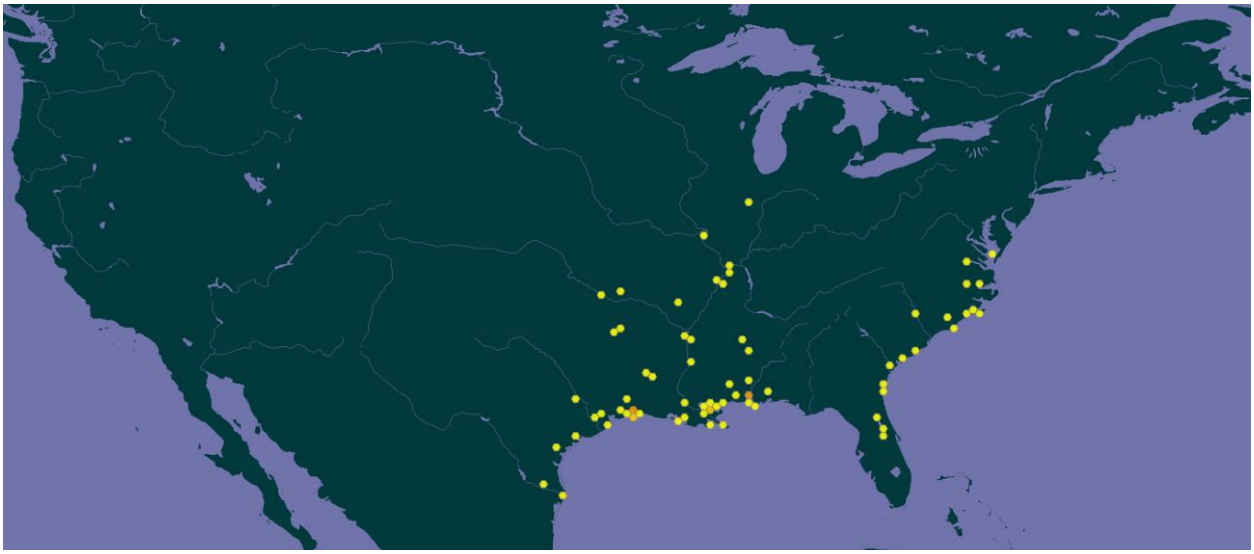

Figure 1. Known global distribution of *Macrobrachium ohione*. Observations are within the United States in the Mississippi River from southern Illinois to Louisiana, the Gulf coast from Alabama to Texas, west to Oklahoma, and the Atlantic coast from Virginia to northern Florida. Map from GBIF Secretariat (2022). The points in central Illinois, northeast Mississippi, and central-east Alabama were not found to be indicative of established populations and were therefore excluded from the climate matching analysis.

6 Distribution Within the United States

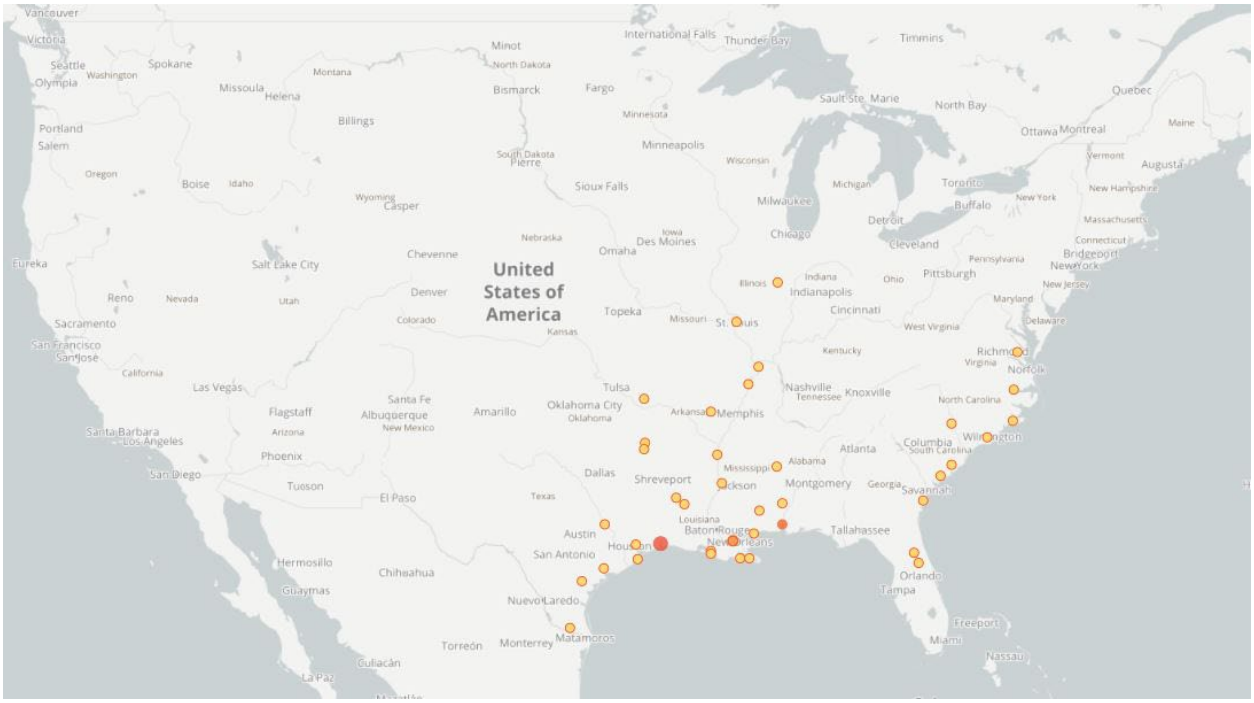

Figure 2. Reported distribution of *Macrobrachium ohione* in the United States. Map from GBIF-US (2023). Observations are in the Mississippi River from southern Illinois to Louisiana, the Gulf coast from Alabama to Texas, west to Oklahoma, and the Atlantic coast from Virginia to northern Florida. The points in central Illinois, northeast Mississippi, and central-east Alabama were not found to be indicative of established populations and were excluded from the climate matching analysis.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Macrobrachium ohione* in the contiguous United States was generally High in the Lower Mississippi river basin, the Great Lakes, and Great Plains regions of the Midwest, the East coast up near the Northeast region, the Southern region, and the Gulf coast. Medium matches were found in the Rocky Mountains region and spanning out towards the North Central and Western regions. The lowest matches were sparsely found throughout the western United States in the Rocky Mountains region, coastal Pacific West, and Cascade-Sierra Mountains region, as well as in the Appalachian Mountains to the Northeast region. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.527, indicating that 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). *M. ohione* requires salinity to reproduce

and for early life stages; the climate match refers only to where the species can survive and not necessarily to where it can reproduce.

Projected climate matches in the contiguous United States under future climate scenarios are available for *Macrobrachium ohione* (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.

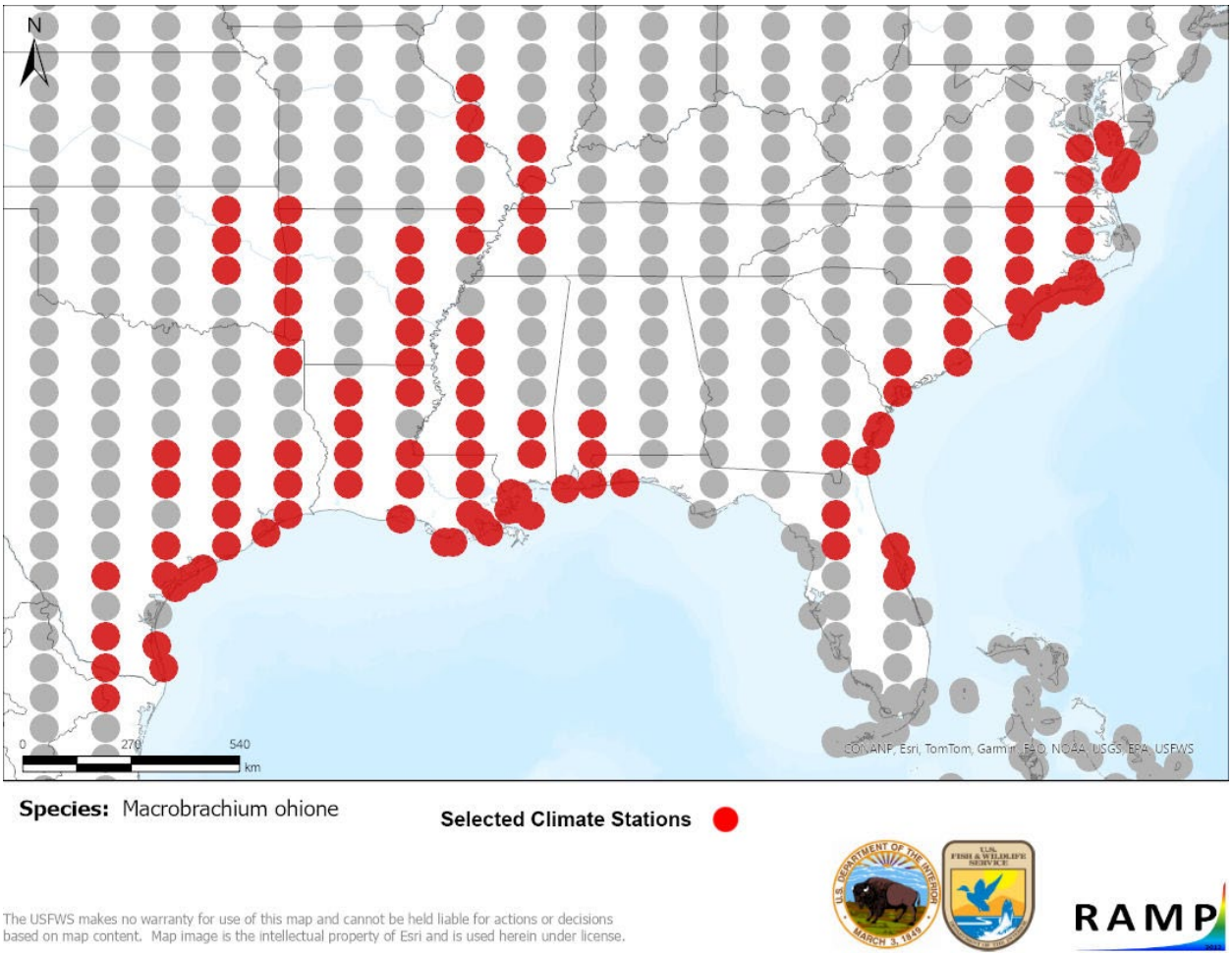

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations from the Lower Mississippi river from southern Illinois to Louisiana, the Gulf coast from Alabama to Texas, west to Oklahoma, the Atlantic coast from Virginia to northern Florida, and the very northeast tip of Mexico (red; Alabama, Arkansas, Florida, Georgia, Illinois, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas; Nuevo León, Tamaulipas, Mexico) and non-source locations (gray) for *Macrobrachium ohione* climate matching. Source locations are 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.

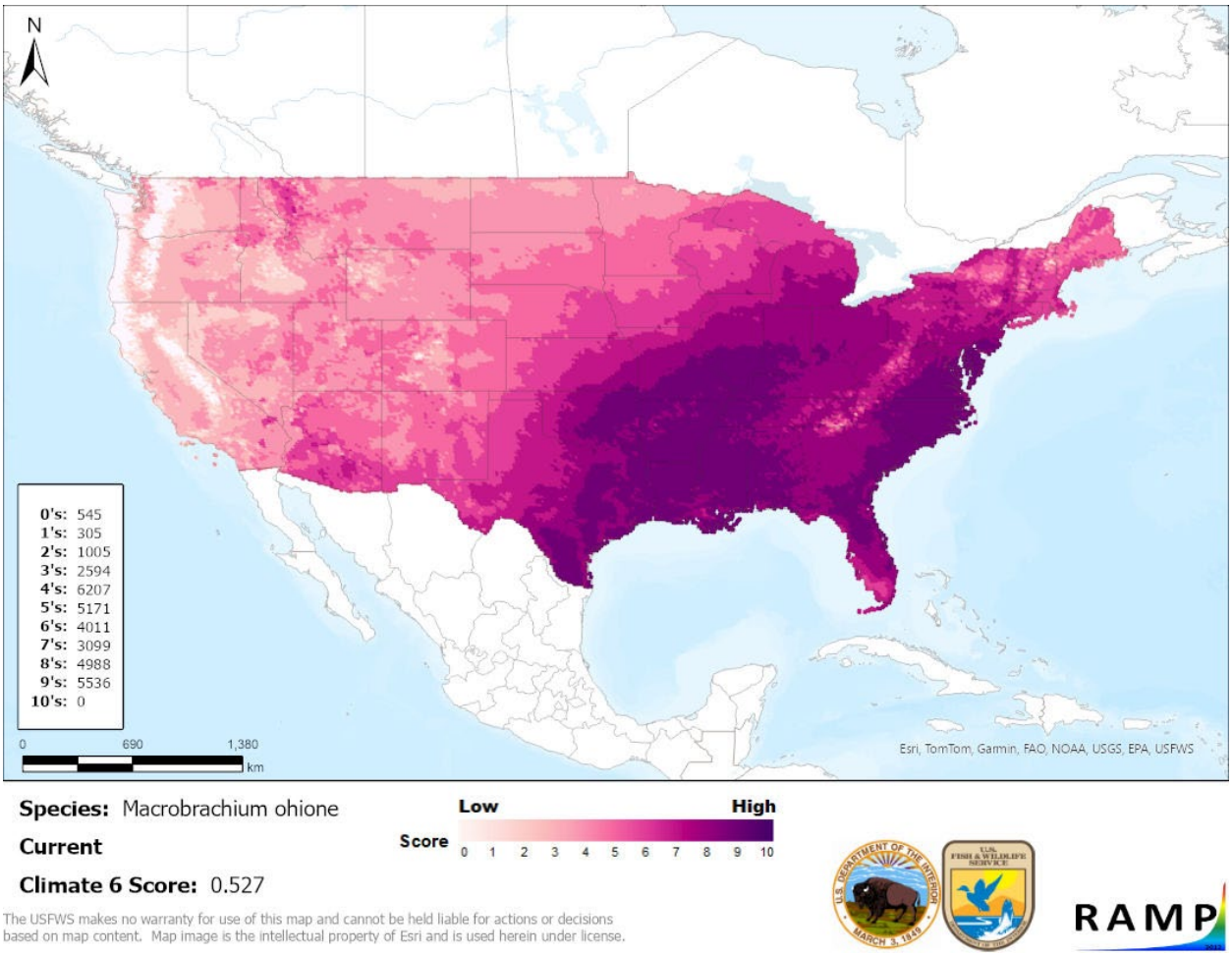

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Macrobrachium ohione* in the contiguous United States based on source locations reported by GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Macrobrachium ohione* is classified as Low. Information is available on the biology, ecology, and distribution of *M. ohione*. However, no established populations of *M. ohione* have been found outside of its native range and there was no indication of a substantial trade history of live individuals. *M. ohione* requires salinity to reproduce, therefore, the climate match analysis only refers to where the species could survive and not necessarily where it could reproduce.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Macrobrachium ohione, Ohio Shrimp, is a freshwater crustacean that is native to the Mississippi River system from Ohio and southern Illinois to Louisiana and the Gulf coast from Alabama to Texas, west to Oklahoma, as well as the Atlantic coast from Virginia to northern Florida.

M. ohione is primarily found in freshwater streams and rivers with low velocity as well as the borders of main channels and open side channels. However, larvae and juvenile *M. ohione* require saltwater to survive and will only migrate upstream to freshwater to feed and grow before going back downstream to reproduce in estuaries. In the southern U.S. States where they commonly occur, they are used as fishing bait and have been fished for human consumption. No established populations of *M. ohione* have been found outside of its native range and there were no individuals found in live trade. Therefore, the History of Invasiveness is classified as No Known Nonnative Population. The climate matching analysis indicates establishment concern for this species outside its native range. High climate matches were found in much of the eastern half of the country, including the native range of the species. *M. ohione* requires salinity to reproduce, therefore, the climate match analysis only refers to where the species could survive and not necessarily where it could reproduce. The Certainty of Assessment for this ERSS is classified as Low because although information is available on the biology, ecology, and distribution of *M. ohione*, the information available to evaluate the history of invasiveness is lacking. The Overall Risk Assessment Category for *Macrobrachium ohione* in the contiguous United States is Uncertain.

Assessment Elements

- **History of Invasiveness (see section 4): No Known Nonnative Population**
- **Establishment Concern (see section 7): Yes**
- **Certainty of Assessment (see section 8): Low**
- **Remarks, Important additional information: None**
- **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 (2022). *M. ohione* requires salinity to reproduce and for early life stages; the climate match refers only to where the species can survive and not necessarily to where it can reproduce. Lack of connectivity to salt water may restrict the species' ability to establish in some of the areas described below as high or medium match under future climate scenarios.

Under the future climate scenarios (figure A1), on average, high climate match for *Macrobrachium ohione* was projected to occur in the Appalachian Range, Great Lakes, Gulf Coast, Mid-Atlantic, Northeast, Southeast, and Southern Atlantic Coast regions of the contiguous United States. Much of this area encompasses the species native range. Areas of low climate match were projected to occur in the Northern Pacific Coast region as well as along the Cascade and Sierra-Nevada ranges. Most of the West had medium matches on average. The areas of high match became smaller with time and from SSP3 to SSP5. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.565 (model: MPI-ESM1-2-HR, SSP5, 2085) to a high of 0.7 (model: UKESM1-0-LL, SSP5, 2085). 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 (0.527, figure 4) falls below 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 saw a large increase in the climate match relative to current conditions. There were also small areas of large increase in the northern Great Lakes and Rocky Mountains in some scenarios. Additionally, areas within the Colorado Plateau, Great Basin, Great Lakes, Northern Plains, Southern Plains, and Western Mountains saw a moderate increase in the climate match relative to current conditions. Under one or more time step and climate scenarios, areas within the Gulf Coast, Mid-Atlantic, Southeast, Southern Atlantic Coast, Southern Florida, 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 from SSP3 to SSP5.

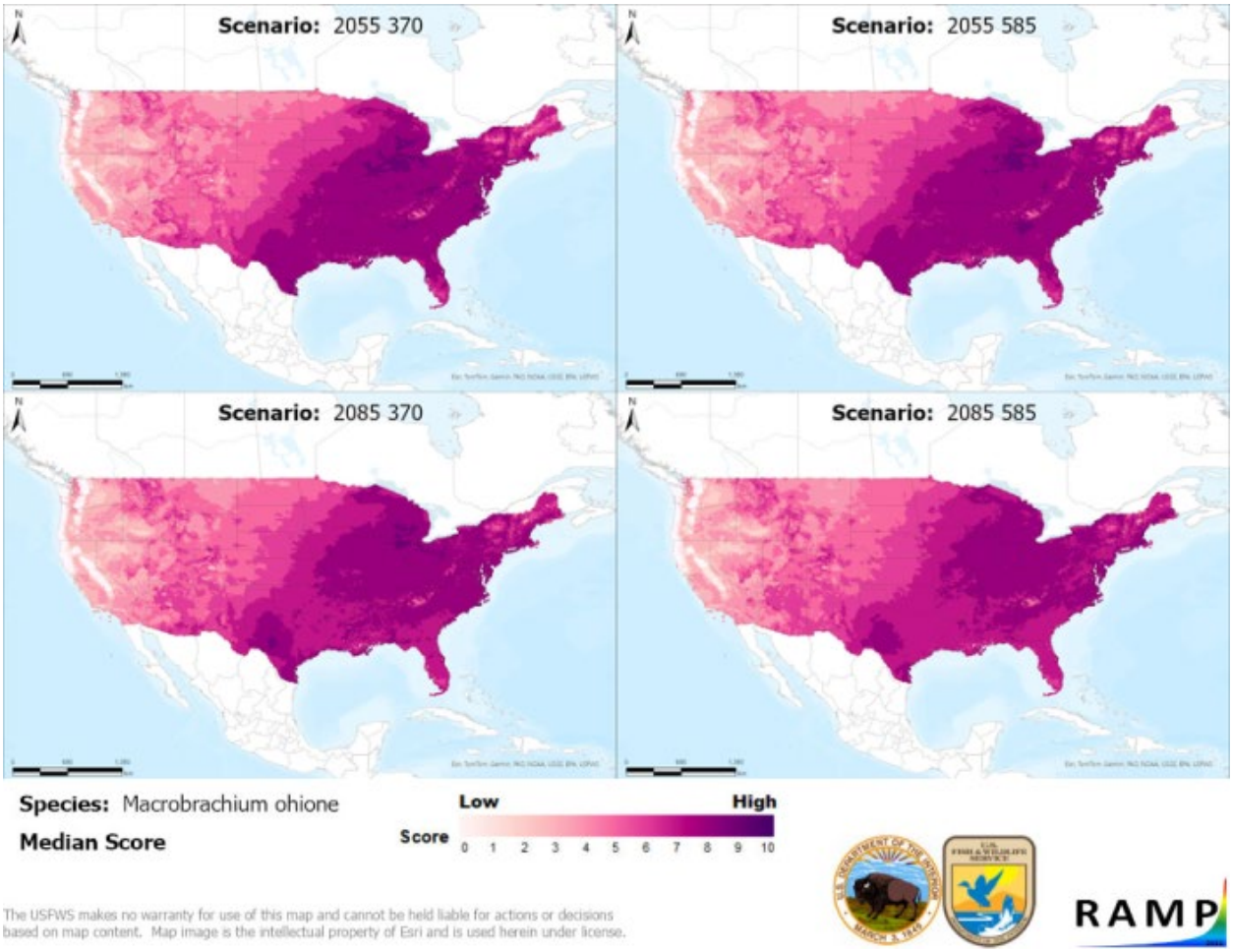

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Macrobrachium ohione* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2022). Shared 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.

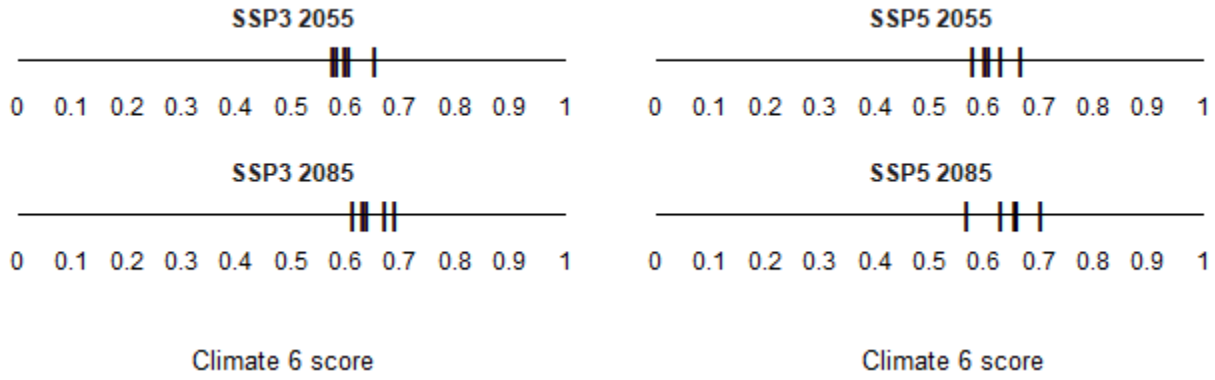

Figure A2. Comparison of projected future Climate 6 scores for *Macrobrachium ohione* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018;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

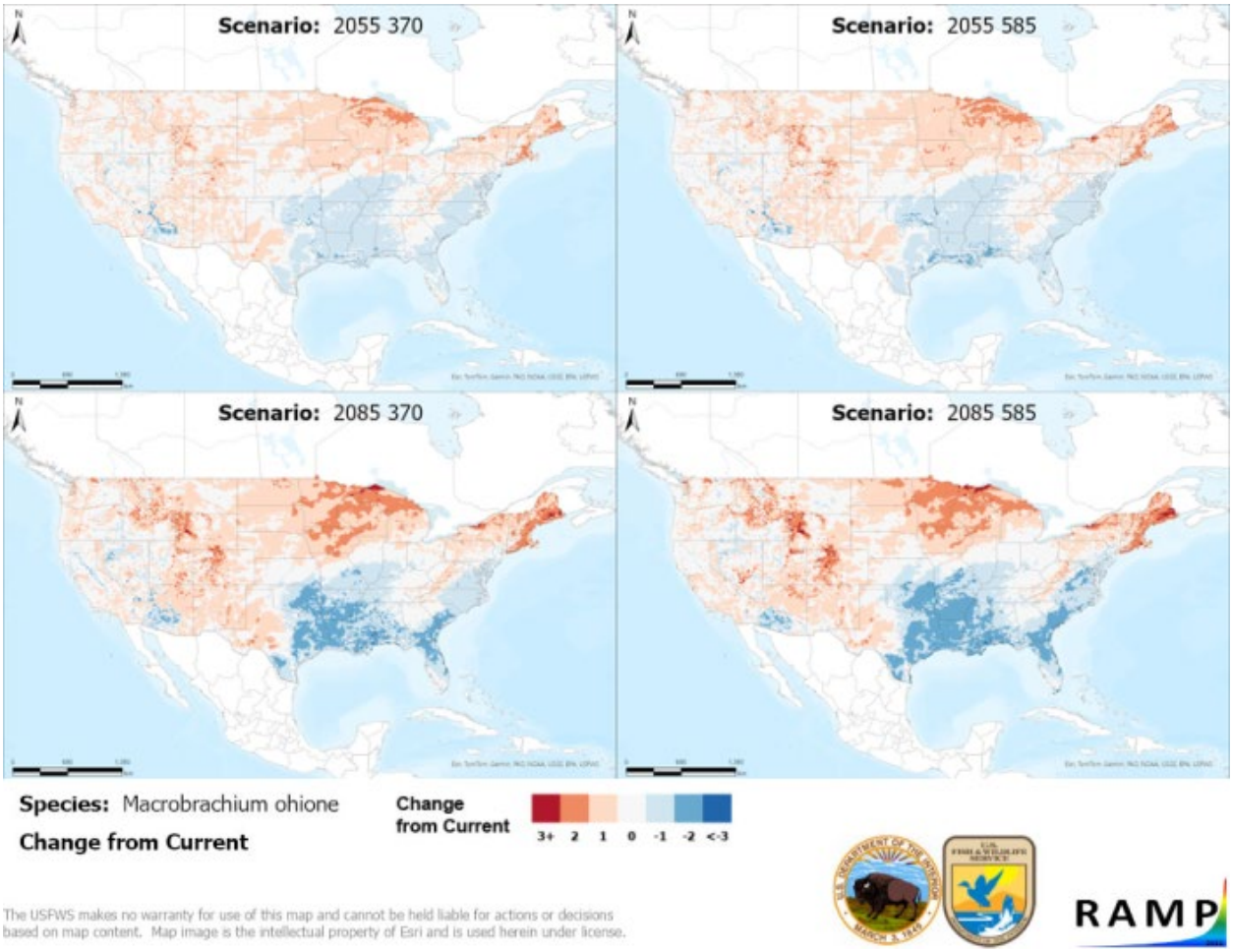

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Macrobrachium ohione* based on source locations reported by GBIF Secretariat (2022). 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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