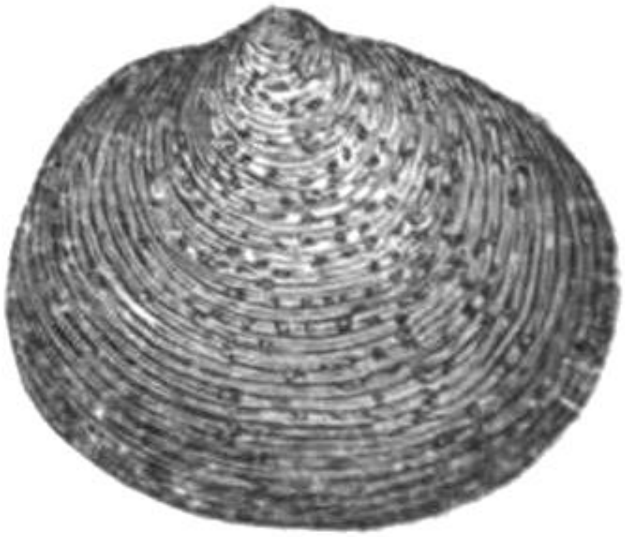
Striate Peaclam (*Pisidium punctiferum*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, February 2023
Revised, February 2023
Web Version, 7/24/2024

Organism Type: Mollusk
Overall Risk Assessment Category: Uncertain



Author: Robert John Lechmere Guppy. Public Domain - US. Available: https://commons.wikimedia.org/wiki/File:Pisidium_punctiferum.png (February 2023).

1 Native Range and Status in the United States

Native Range

From Mackie (2007):

"It is a species endemic to Mexico, Central America, South America and the Caribbean Islands of the Neotropical realm […]."

From Massemin et al. (2011):

"*Pisidium punctiferum* was described from the Caribbean Island of Trinidad in 1867, under the name *Cyclas punctifera*; the type locality is a pond at Saint Ann's River, near Port of Spain […]."

"*Pisidium punctiferum* is mentioned in literature […] from […] southern Brazil [Rio Grande do Sul State (AgudoPadrón, 2009; Martello et al., 2006; Simone, 2006)] and Uruguay (Henry, 1897), including the West Indies [Dominica (Starmühlner, 1988), Guadeloupe (Pointier 1974; 1976; 2008), Martinique (Guyard & Pointier, 1979; Pointier 2008), Saint-Lucia (Jordan, 1985 ; Mc Killop & Harrison, 1981; 1982) and Saint-Vincent (Harrison & Rankin, 1978)]."

"The present discovery expands the distribution of *P. punctiferum* to French Guiana and, consequently, to the Guiana Shield. Otherwise, the presence in neighbouring Suriname, where the species is not yet mentioned, is highly probable because 20 specimens were found in the Maroni River, frontier between Suriname to the west and French Guiana to the east […]. So, if the species has already been recorded in southern Brazil, its distribution area is potentially also extended to the northeast Brazil, because one piece was collected in the Oyapock River, frontier between French Guiana to the west and the Amapa State to the east."

Status in the United States

According to U.S. Geological Survey (2023), nonindigenous occurrences of *Pisidium punctiferum* have been reported in the following States. Range of observation years, watersheds, and population status where reported (one or more watersheds) in parentheses.

- Florida (1999; South Atlantic-Gulf Region; established)
- North Carolina (2007; Watauga, North Carolina, Tennessee; unknown)
- Texas (1999; no watershed given; established)

From Mackie (2007):

"In North America, this rare species has been found only in Florida and Texas […] (Burch, 1975)."

"Heard (1967) reports the occurrence of *P. punctiferum* in the Great Lakes, but identification of museum specimens proved the species to be *Pisidium punctatum*, a species that Herrington described in his taxonomic revision in 1962, but synonymized as *P. punctiferum*. The taxonomies of the two species was clarified by Burch (1975)."

No records of *Pisidium punctiferum* in trade in the United States were found.

Regulations

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

Means of Introductions within the United States

From Mackie (2007):

"It would appear that *P. punctiferum* advanced northward from Mexico into Texas and then into Florida. Although its northward progress appears to be very slow, the records of occurrence in Texas and Florida are very obscure and it is difficult to determine the time of its original introduction."

Remarks

From Massemin et al. (2011):

"The species is mentioned in literature as living in Cuba (Starmühlner, 1988). It is probably due to misidentification, because even after recent investigations it has not been found there (Pointier et al., 2005). It is also signalled by the same author as inhabiting Mexico, Panama, Jamaica, Venezuela and Paraguay but without any precise mention nor author."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2023):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Protostomia
Superphylum Lophozoa
Phylum Mollusca
Class Bivalvia
Subclass Heterodonta
Order Veneroida
Superfamily Corbiculoidea
Family Pisidiidae
Genus *Pisidium*
Species *Pisidium punctiferum* (Guppy, 1867)

According to ITIS (2023), *Pisidium punctiferum* (Guppy, 1867) is the current valid name for this species.

MolluscaBase (2015) lists *Cyclas punctifera*, *Pisidium* (*Neopisidium*) *punctiferum*, and *P. inoratum* as synonyms of *P. punctiferum*.

Size, Weight, and Age Range

From Massemin et al. (2011):

"[…] The average size [of *Pisidium punctiferum*] when adult is around 3 mm in length and 2.5 mm in height […]"

Environment

From Massemin et al. (2011):

"In literature, most authors mentioned to have observed *P. punctiferum* in lentic habitat […]. The species has a large ecological plasticity because it occupies a numerous variety of habitats as it

was recorded from small streams with clear water […] to muddy large rivers […] The species was mainly found in water without entropic pressure."

Climate

From Mackie (2007):

"It is a species endemic to […] the Neotropical realm [...]."

Distribution Outside the United States

Native

From Mackie (2007):

"It is a species endemic to Mexico, Central America, South America and the Caribbean Islands of the Neotropical realm […]."

From Massemin et al. (2011):

"*Pisidium punctiferum* was described from the Caribbean Island of Trinidad in 1867, under the name *Cyclas punctifera*; the type locality is a pond at Saint Ann's River, near Port of Spain […]."

"*Pisidium punctiferum* is mentioned in literature […] from […] southern Brazil [Rio Grande do Sul State (AgudoPadrón, 2009; Martello et al., 2006; Simone, 2006)] and Uruguay (Henry, 1897), including the West Indies [Dominica (Starmühlner, 1988), Guadeloupe (Pointier 1974; 1976; 2008), Martinique (Guyard & Pointier, 1979; Pointier 2008), Saint-Lucia (Jordan, 1985 ; Mc Killop & Harrison, 1981; 1982) and Saint-Vincent (Harrison & Rankin, 1978)]."

"The present discovery expands the distribution of *P. punctiferum* to French Guiana and, consequently, to the Guiana Shield. Otherwise, the presence in neighbouring Suriname, where the species is not yet mentioned, is highly probable because 20 specimens were found in the Maroni River, frontier between Suriname to the west and French Guiana to the east […]. So, if the species has already been recorded in southern Brazil, its distribution area is potentially also extended to the northeast Brazil, because one piece was collected in the Oyapock River, frontier between French Guiana to the west and the Amapa State to the east."

Introduced

No records were found of introductions of *Pisidium punctiferum* outside the United States.

Means of Introduction Outside the United States

No records were found of introductions of *Pisidium punctiferum* outside the United States.

Short Description

From Massemin et al. (2011):

"Diagnose [sic] of the striate peaclam *P. punctiferum* was established according to the following criteria: 1/ The average size when adult is around 3 mm in length and 2.5 mm in height; 2/ The shell is oval and thin, the anterior valve is shorter and angulated in its posterior part; 3/ The test is diaphanous, finely striate concentrically and covered with numerous granular points, which are finer and more crowded on the umbones, where the concentric striation is less evident; 4/ A short periostracum may be present and 5/ The hinge is well-developed with lateral teeth in both valves (1-1/1-1) and small cardinal teeth (2/2)."

Biology

From McMahon (1991):

"Passive, current-mediated downstream transport is also reported for juvenile sphaeriids (*Pisidium punctiferum)* (McKillop and Harrison 1982) and may be an important but uninvestigated means of dispersal for many species in this family."

From Pereira et al. (2014):

"In *Pisidium* Pfeiffer, 1821 a synchronized development in a single marsupial brood sac occurs (Cooley & O ´ Foighil, 2000). An exception was observed in *Pisidium punctiferum* (Guppy, 1867) which form one brood at a time, but with different sizes of embryos which suggest unsynchronized release (Anflor & Mansur, 2001)."

Human Uses

No information was found on human uses of *Pisidium punctiferum*.

Diseases

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

No information was found on diseases associated with *Pisidium punctiferum*.

Threat to Humans

No information was found on threats to humans from *Pisidium punctiferum*.

3 Impacts of Introductions

Records of introduction were found for *Pisidium punctiferum* but no information on impacts from those introductions was available.

No species-specific regulations were found for this species.

4 History of Invasiveness

The History of Invasiveness for *Pisidium punctiferum* is classified as Data Deficient. Established populations of *P. punctiferum* have been found in Texas and Florida. No information was available about actual pathways of introduction or regarding impacts from the established populations.

5 Global Distribution

Figure 1. Reported global distribution of *Pisidium punctiferum*. Map from GBIF Secretariat (2022). Observations are reported from Trinidad and Tobago, United States, French Guiana, Colombia, Guadeloupe, Martinique, Mexico, and Venezuela. Locations in North America outside of Florida and Texas were not used as source points for the climate matching analysis as they could not be confirmed to represent established populations of *Pisidium punctiferum.*

Additional observations in southern Brazil given in Kotzian and Simões (2006), Martello et al. (2006), and Miyahira et al. (2023) were used to select source points for the climate matching analysis. No georeferenced observations for the species' reported range in Uruguay were found.

6 Distribution Within the United States

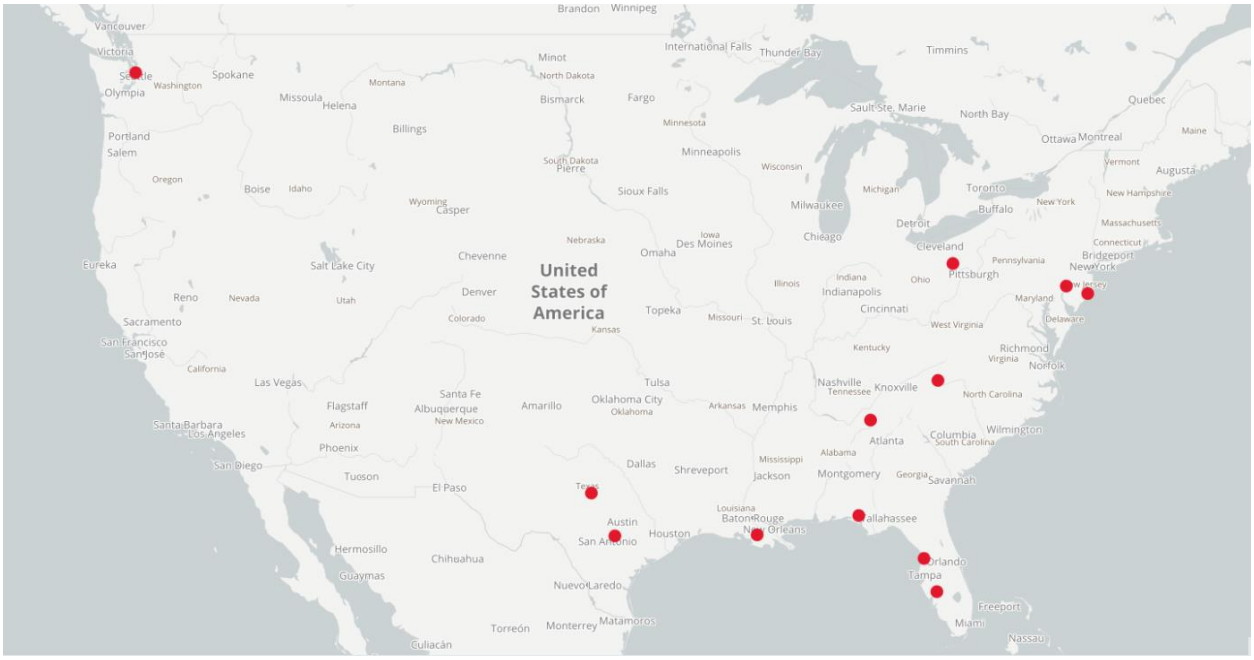


Figure 2. Reported distribution of *Pisidium punctiferum* in the United States. Map adapted from GBIF-US (2023). Observations are reported from Florida, Georgia, Louisiana, New Jersey, North Carolina, Ohio, Pennsylvania, Texas, and Washington. Locations outside Florida and Texas were not used to select source points for the climate match as they could not be confirmed to represent established populations of *Pisidium punctiferum*.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Pisidium punctiferum* was medium throughout much of the contiguous United States. Areas of high match occurred in the southern Plains, mainly in Texas and Oklahoma, across the coastal areas of the Gulf Coast, Florida, and the southern Atlantic Coast. Areas of low match were found across much of the mountainous West along with the central and northern Pacific Coast. Other areas of low match were found in the northern Plains near the border with Canada, the Northeast, and the Cumberland Plateau of Tennessee and North Carolina. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.389 indicating that Yes, there is establishment concern for this species. 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 *Pisidium punctiferum* (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.

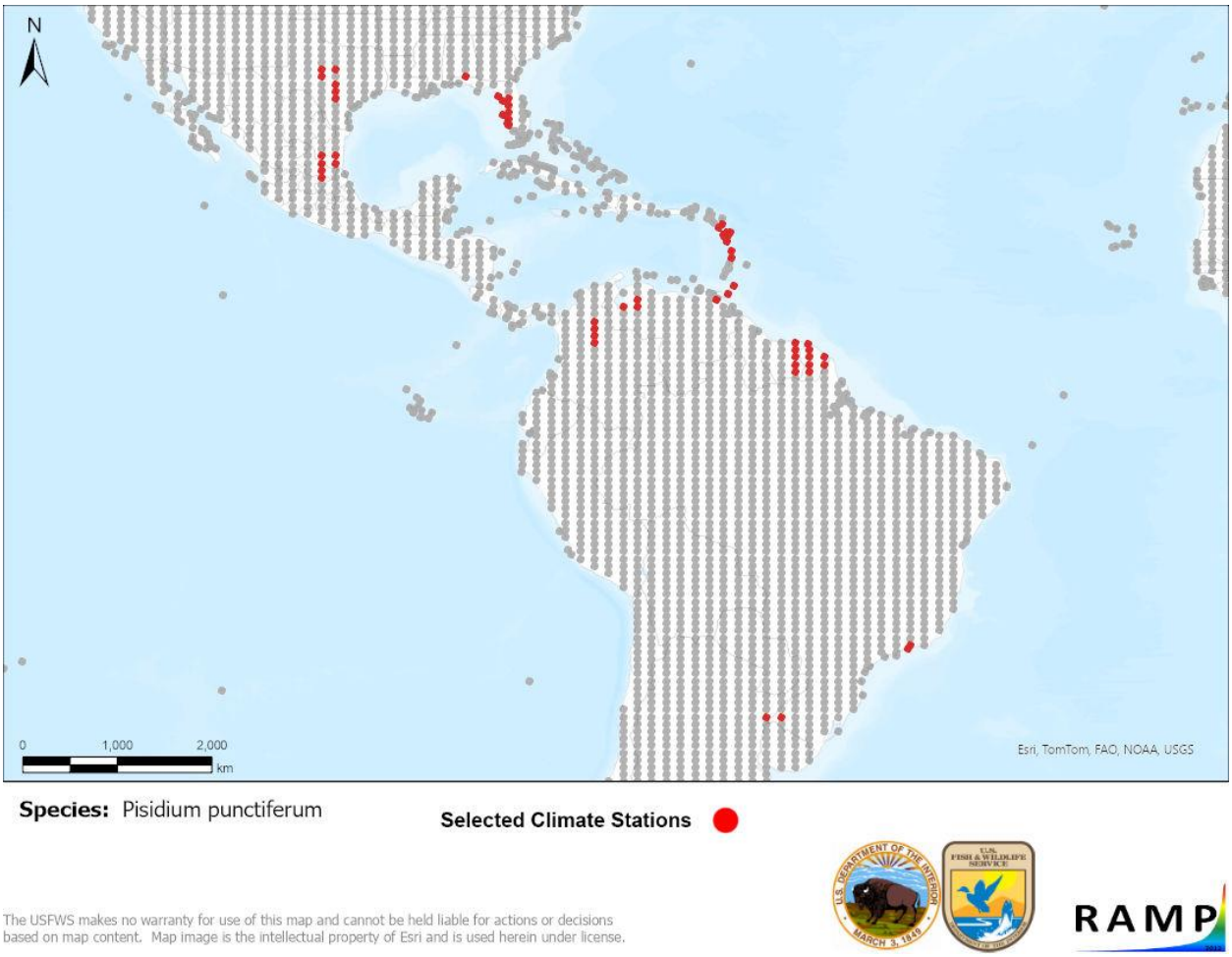


Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations in North America, Central America, the Caribbean, and South America selected as source locations (red; Trinidad and Tobago, United States, Brazil, French Guiana, Colombia, Guadeloupe, Martinique, Mexico, and Venezuela) and non-source locations (gray) for *Pisidium punctiferum* climate matching. Source locations from Kotzian and Simões (2006), Martello et al. (2006), GBIF Secretariat (2022), and Miyahira et al. (2023). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

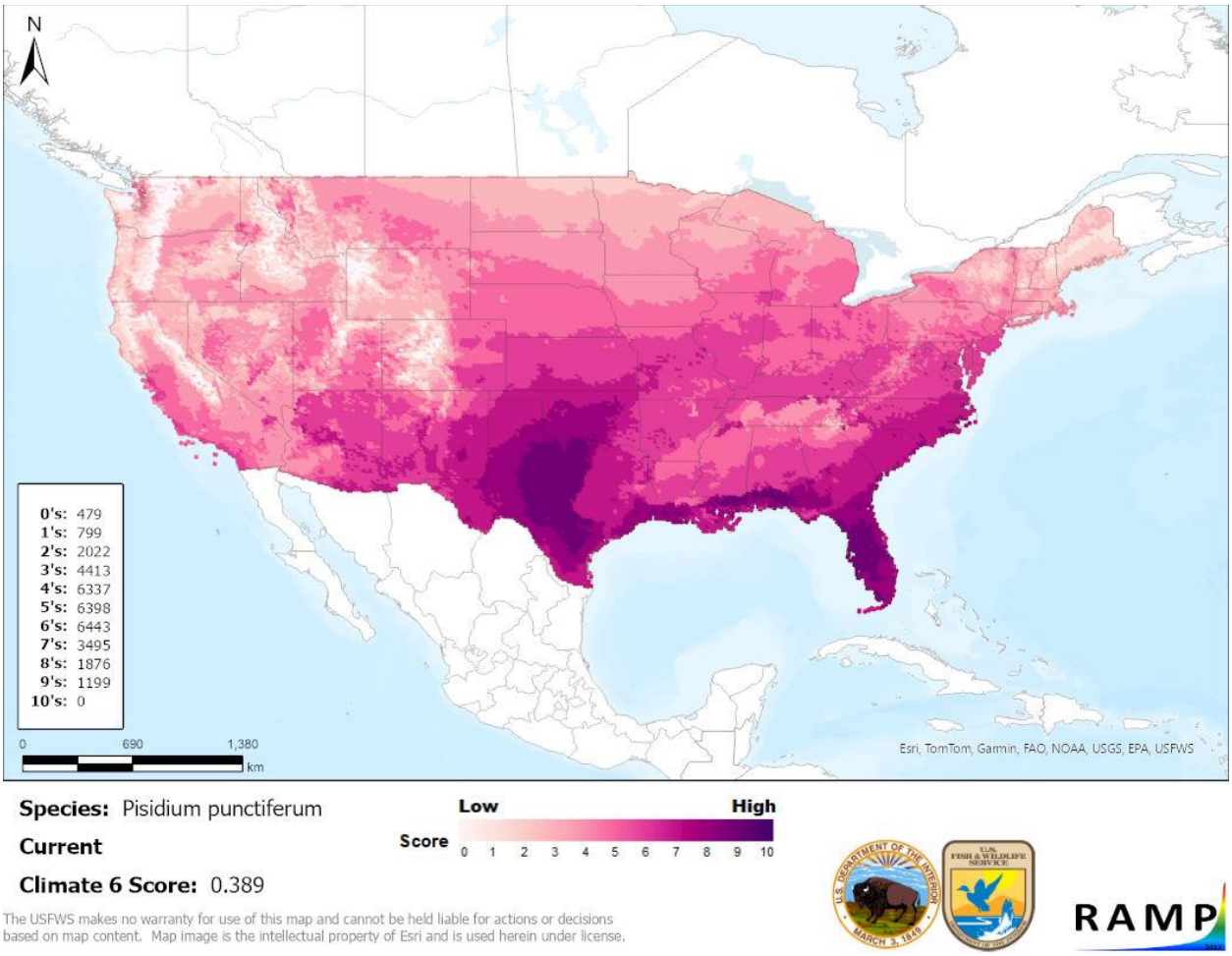


Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Pisidium punctiferum* in the contiguous United States based on source locations reported by Kotzian and Simões (2006), Martello et al. (2006), GBIF Secretariat (2022), Miyahira et al. (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Pisidium punctiferum* is classified as Low. There is some information available on the biology and ecology of this species. Parts of the species' reported range is not represented in the climate match. While records of introduction and establishment were found, there was no information available regarding impacts from introductions.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Pisidium punctiferum, Striate Peaclam, is a mollusk that is native to Mexico, Central America, the Caribbean, and South America. It is most often observed in lentic habitats and has much ecological plasticity. *P. punctiferum* has been introduced and become established in Florida and Texas. The History of Invasiveness for *P. punctiferum* is classified as Data Deficient due to lack of information on impacts from the introductions. The climate matching analysis for the contiguous United States indicates establishment concern for this species. Areas of high match occurred in the southern Plains and along the Gulf and southern Atlantic coasts. Western and more northern areas tended to have a medium to low match. The Certainty of Assessment for this ERSS is classified as Low due to limited information regarding impacts from the introductions and incomplete distribution information to use for the climate match. The Overall Risk Assessment Category for *Pisidium punctiferum* 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.

GBIF Secretariat. 2022. GBIF backbone taxonomy: *Pisidium punctiferum* (Guppy, 1867). Copenhagen: Global Biodiversity Information Facility. Available: https://www.gbif.org/species/2286703 (January 2023).

GBIF-US. 2023. Species occurrences: *Pisidium punctiferum* (Guppy, 1867). Available: https://doi.org/10.15468/dl.p5rxe9 (January 2023).

[ITIS] Integrated Taxonomic Information System. 2023. *Pisidium punctiferum* (Guppy, 1867). Reston, Virginia: Integrated Taxonomic Information System. Available: https://www.itis.gov/servlet/SingleRpt/SingleRpt#null (January 2023).

Kotzian CB, Simões MG. 2006. Taphonomy of recent freshwater molluscan death assemblages, Touro Passo stream, southern Brazil. Revista Brasileira de Palentologia 9(2):243–260.

Mackie GL. 2007. Biology of freshwater corbiculid and sphaeriid clams of North America. Columbus, Ohio: Ohio Biological Survey. Volume 15, Number 3.

Martello AR, Kotzian CB, Simões MG. 2006. Quantitative fidelity of recent freshwater mollusk assemblages from the Touro Passo River, Rio Grande do Sul, Brazil. Iheringia Série Zoologia 96(4):453–465.

Massemin D, Clavier S, Pointier J-P. 2011. First record of *Pisidium punctiferum* (Guppy, 1867) and *Eupera viridans* (Prime, 1865) (Mollusca: Sphaeriidae) from French Guiana. Novapex 12:109–118.

McMahon RF. 1991. Mollusca: Bivalvia 11. Pages 315–391 in Thorp JH, Covich AP, editors. Ecology and classification of North American freshwater invertebrates. San Diego: Academic Press.

Miyahira IC, Gonçalves ICB, Lacerda LEM, Ximenes RF, Santos SB. 2023. The introduction of *Physa acuta* (Gastropoda: Physidae) on Ilha Grande, Southeast Brazil, from initial stages to an established population. Brazilian Journal of Biology 83:e243801.

MolluscaBase editors. 2023. *Pisidium punctiferum* (Guppy, 1867). MolluscaBase. Available: https://www.molluscabase.org/aphia.php?p=taxdetails&id=857220 (February 2023).

Pereira D, Mansur MCD, Duarte LDS, de Oliveira AS, Pimpão DM, Callil CT, Ituarte C, Parada E, Peredo S, Darrigran G, Scarabino F, Clavijo C, Lara G, Miyahira IC, Rodriguez MTR, Lasso C. 2014. Bivalve distribution in hydrographic regions in South America: historical overview and conservation. Hydrobiologia 735:15–44.

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.

U.S Geological Survey. 2023. *Pisidium punctiferum* (Guppy, 1867). Gainesville, Florida: U.S. Geological Survey, Nonindigenous Aquatic Species Database. Available: https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=2248 (January 2023).

World Organisation for Animal Health. 2023. Animal diseases. Paris: World Organisation for Animal Health. Available: https://www.woah.org/en/what-we-do/animal-health-and-welfare/animal-diseases/ (January 2023).

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.

Agudo-Padrón AI. 2009. Recent terrestrial and freshwater molluscs of Rio Grande do Sul State, RS, Southern Brazil Region: a comprehensive synthesis and check list. Visaya Net (May 2009):1–13.

Anflor LM, Mansur MCD. 2001. *Pisidium punctiferum* (Guppy, 1867) (Bivalvia, Sphaeriidae) – Aspectos do seu desenvolvimento em amostras da população do Arroio Bom Jardim, Rio Grande do Sul. Biociências 9:141–154.

Burch JB. 1975. Freshwater sphaeriacean clams (Mollusca: Pelecypoda) of North America. Report to U.S Environmental Protection Agency, Washington, D.C.

Cooley LR, O´Foighil D. 2000. Phylogenetic analysis of the Sphaeriidae (Mollusca: Bivalvia) based on mitochondrial 16S rDNA gene sequences. Invertebrate Biology 119:299–308.

Guyard A, Pointier J-P. 1979. Faune malacologique dulçaquicole et vecteurs de la Schistosomiase intestinale en Martinique. *Annales de Parasitologie Humaine et Comparée* 54:193–205.

Harrison AD, Rankin JJ. 1978. Hydrobiological studies of eastern Lesser Antillean Islands: III. St. Vincent: freshwater molluscs; their distribution, population's dynamics and biology. Archiv für Hydrobiologie 54:123–188.

Heard. 1967. [Source material did not give full citation for this reference.]

Heard WH. 1979. Identification manual of the freshwater clams of Florida. Report to State of Florida Department of Environmental Regulation.

Henry A. 1897. New species of mollusks from Uruguay. Pilsbry Proceedings of the Academy of Natural Sciences of Philadelphia 49.

Jordan P. 1985. Schistosomiasis. The St Lucia project. Cambridge: Cambridge University Press.

Martello AR, Kotzian CB, Simões MG. 2006. Quantitative fidelity of recent freshwater mollusk assemblages from the Touro Passo River, Rio Grande do Sul, Brazil. Iheringia, Série Zoologia 96:453–465.

McKillop WB, Harrison AD. 1981. Hydrobiological studies on eastern Lesser Antillean Islands VI: St. Lucia: Freshwater molluscs and the marsh environment. Archiv für Hydrobiologie 58:357–419.

McKillop WB, Harrison AD. 1982. Hydrobiological studies of eastern Lesser Antillean Islands, VII. St. Lucia: Behavioural drift and other movements of freshwater marsh molluscs. Archiv für Hydrobiologie 94:53–69.

Pointier JP. 1974. Faune malacologique dulçaquicole de l'île de la Guadeloupe (Antilles Françaises). Bulletin du Muséum National d'Histoire Naturelle de Paris 3:905–933.

Pointier JP. 1976. Répartition locale et biogéographie des mollusques dulçaquicole de la Guadeloupe (Antilles françaises). Malacological Review 9:85–103.

Pointier JP. 2008. Guide to the freshwater molluscs of the Lesser Antilles. Hackenheim, Germany: ConchBooks.

Pointier JP, Yong M, Gutiérrez A. 2005. Guide to the freshwater molluscs of Cuba. Hackenheim, Germany: ConchBooks.

Simone LRL. 2006. Land and freshwater mollusks of Brazil: An illustrated inventory on the Brazilian malacofauna, including neighbor regions of the South America, respect to the terrestrial and freshwater ecosystem. São Paulo, Brazil: EGB, FAPEST.

Starmühlner F von 1988. Ergebnisse der Österreichisch-Französischen Hydrobiologischen Mission 1979 nach Guadeloupe, Dominica und Martinique (Kleine Antillen). Teil II: Beiträge zur Kenntnis der Süß- und Brackwassermollusken von Guadeloupe, Dominica und Martinique. Annalen des Naturhistorischen Museums in Wien 90(Serie B):221–340.

Turgeon DD, Quinn JF, Bogan AE, Coan EV, Hochberg FG, Lyons WG, Mikkelsen PM, Neves RJ, Roper CFE, Rosenberg G, Roth B, Scheltema A, Thompson FG, Vecchione M, Williams JD. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks. 2nd Edition. Bethesda, Maryland: American Fisheries Society. Special Publication 26.

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 Kotzian and Simões (2006), Martello et al. (2006), GBIF Secretariat (2022), and Miyahira et al. (2023).

Under the future climate scenarios (figure A1), on average, high climate match for *Pisidium punctiferum* was projected to occur in the Southern Atlantic Coast and Southern Florida regions of the contiguous United States along with an area in central Texas and Oklahoma. Areas of low climate match was projected to occur in the Northern Pacific Coast and Western Mountains regions. Describe other notable similarities and differences between the four future scenarios; see SOP for examples. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.453 (model: GFDL-ESM4, SSP3, 2055) to a high of 0.623 (model: MRI-ESM2-0, 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 (0.389, 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, the most extreme climate change scenario. Under one or more time step and climate scenarios, areas within the Colorado Plateau, Great Basin, Great Lakes, Northeast, and Northern Plains saw a large increase in the climate match relative to current conditions. Additionally, areas within the Appalachian Range, Mid-Atlantic, Northern Pacific Coast, 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 and Southeast saw a large decrease in the climate match relative to current conditions. Additionally, areas within the Great Basin, Southern Atlantic Coast, Southern Florida, Southern Plains, and Southwest saw a moderate decrease in the climate match relative to current conditions. Additional, very small areas of large or moderate change may be visible on the maps (figure A3). The degree of change was greater in time step 2085 for both SSP scenarios.

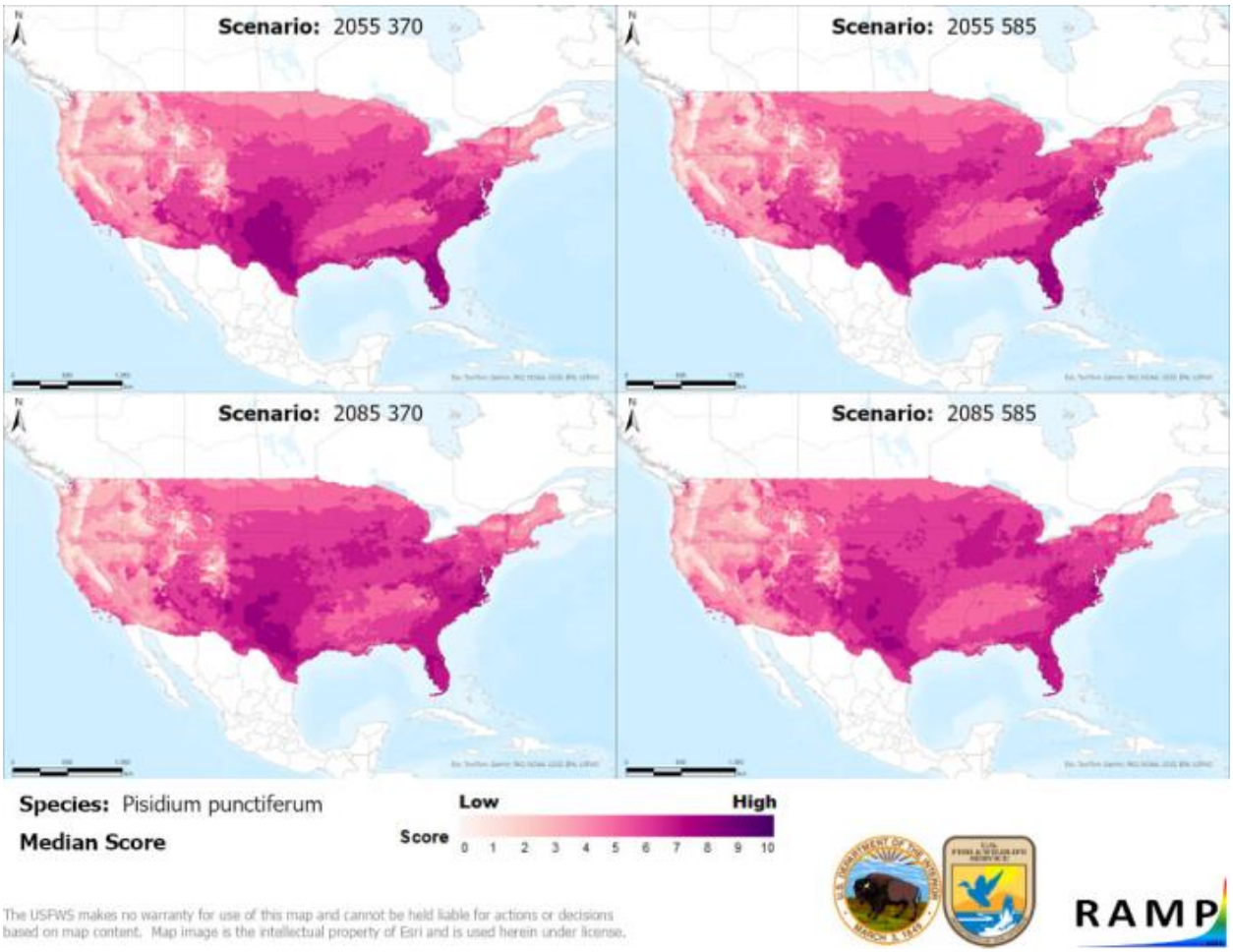


Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Pisidium punctiferum* in the contiguous United States. Climate matching is based on source locations reported by Kotzian and Simões (2006), Martello et al. (2006), GBIF Secretariat (2022), and Miyahira et al. (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.

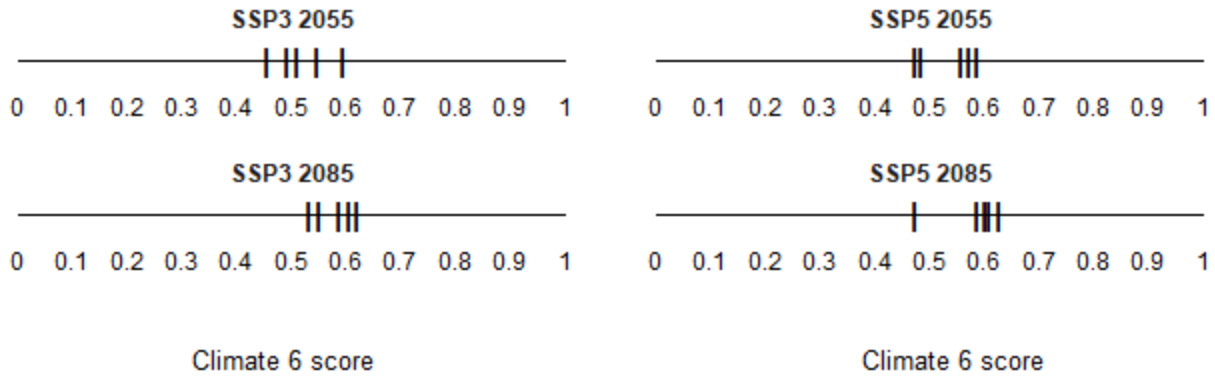


Figure A2. Comparison of projected future Climate 6 scores for *Pisidium punctiferum* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018;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

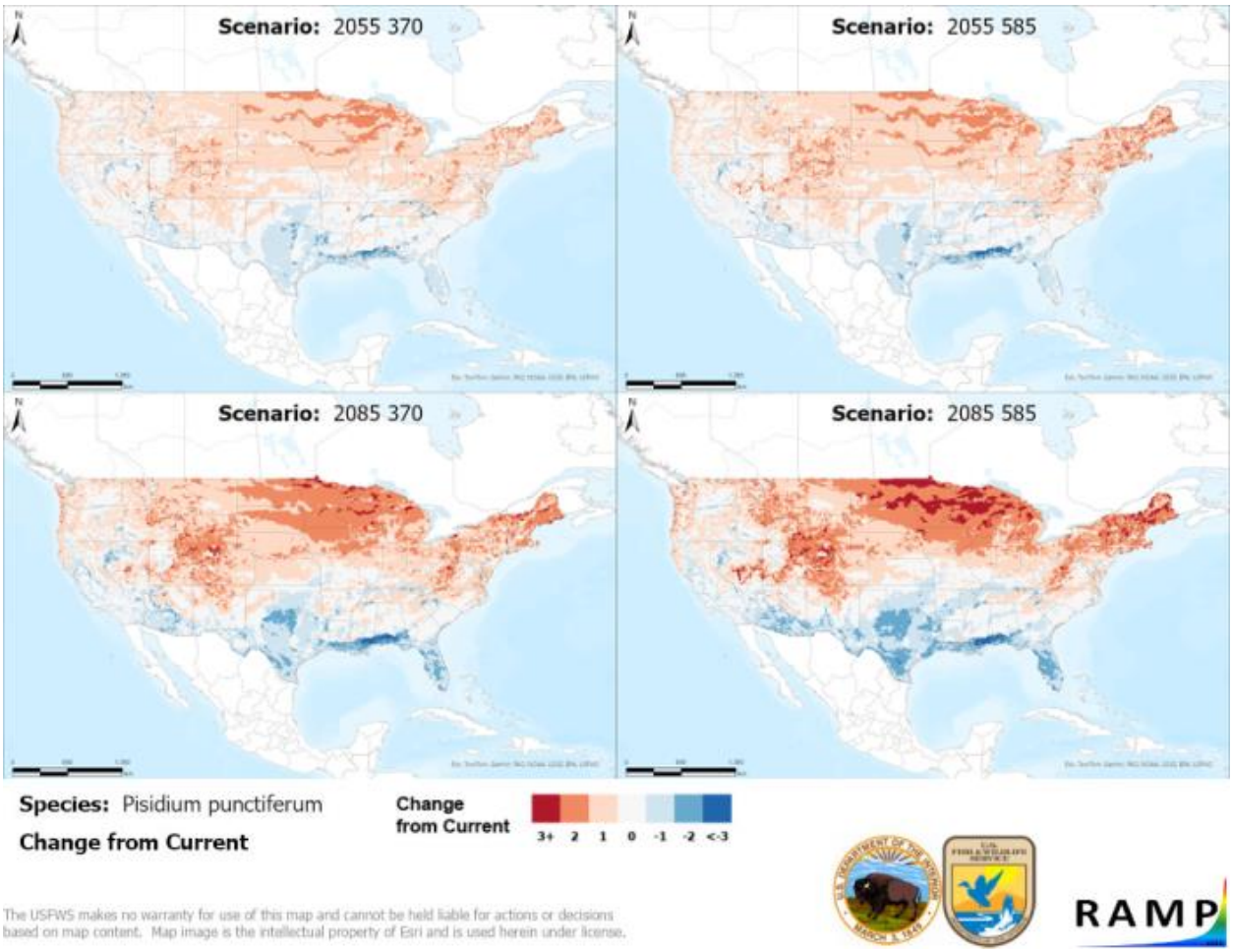


Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Pisidium punctiferum* based on source locations reported by Kotzian and Simões (2006), Martello et al. (2006), GBIF Secretariat (2022), and Miyahira et al. (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.

Literature Cited

GBIF Secretariat. 2022. GBIF backbone taxonomy: *Pisidium punctiferum* (Guppy, 1867). Copenhagen: Global Biodiversity Information Facility. Available: https://www.gbif.org/species/2286703 (January 2023).

[IPCC] Intergovernmental Panel on Climate Change. 2021. Climate change 2021: the physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder HP, Kessler M. 2018. Data from: Climatologies at high resolution for the earth's land surface areas. EnviDat. Available: https://doi.org/10.16904/envidat.228.v2.1.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder P, Kessler M. 2017. Climatologies at high resolution for the Earth land surface areas. Scientific Data 4:170122.

Kotzian CB, Simões MG. 2006. Taphonomy of recent freshwater molluscan death assemblages, Touro Passo stream, southern Brazil. Revista Brasileira de Palentologia 9(2):243–260.

Martello AR, Kotzian CB, Simões MG. 2006. Quantitative fidelity of recent freshwater mollusk assemblages from the Touro Passo River, Rio Grande do Sul, Brazil. Iheringia Série Zoologia 96(4):453–465.

Miyahira IC, Gonçalves ICB, Lacerda LEM, Ximenes RF, Santos SB. 2023. The introduction of *Physa acuta* (Gastropoda: Physidae) on Ilha Grande, Southeast Brazil, from initial stages to an established population. Brazilian Journal of Biology 83:e243801.

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.