U.S. Fish & Wildlife Service

Henslow Peaclam (*Euglesa henslowana*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife, January 2023
Revised, February 2023
Web Version, 3/4/2025

Organism Type: Mollusk
Overall Risk Assessment Category: Uncertain

Photo: Francisco Welter Schultes. Public domain. Available: http://www.animalbase.uni-goettingen.de/zooweb/servlet/AnimalBase/home/picture?id=2359 (January 2023).

1 Native Range and Status in the United States

Native Range

From Kipp et al. (2024):

"*Pisidium henslowanum* [synonym of *Euglesa henslowana*] is a Holarctic species found in Eurasia, in countries such as Iceland, Scandinavia, France, Germany, Belgium, the territory of the former USSR, and the United Kingdom (Clarke 1981, Mackie 2000)."

From Cordeiro and Killeen (2011):

"In Europe, this species is found in Hungary, Portugal, Finland, Sweden, Denmark, south east Norway and north east Iceland (Kuiper *et al.* 1989). Within these countries it has been found in the River Danube, at Kismaros and Göd in Hungary (Bodis 2007); and the River Minho estuary in Portugal (Sousa *et al.* 2007). It is likely to occur in other European countries."

From Kuiper et al. (1970):

"In the Netherlands the species [*Euglesa henslowana*] is fairly common."

From Pettinelli et al. (2009):

"[…] *Pisidium henslowanum* living in Lake Piediluco (southwestern Umbria, Italy)."

From Graf and Cummings (2023):

"Native range from Europe to Kamchatka [Russian Far East]"

Status in the United States

From Kipp et al. (2023):

"*Pisidium henslowanum* probably first appeared in the Great Lakes basin sometime prior to 1916, maybe even as early as the 1890s. It has been recorded from the Lake Ontario, Lake Michigan, and Lake Erie watersheds (Clarke 1981, Grigorovich et al. 2000, 2003, Heard 1961,1962, Herrington 1962, Johnson and Matheson 1968, Krieger 1984, Mackie 2000, Mackie et al. 1980, Ricciardi 2001, Wolfert and Hiltunen 1968)."

"**Status**: Established where recorded."

According to Kipp et al. (2024), nonindigenous occurrences of *Euglesa henslowana* have been reported in the following States, with range of observation years, number of watersheds, and population status where reported (one or more watersheds) in parentheses:

- Michigan (1995; 1)
- Minnesota (2005-2020; 2; established)
- New York (1916-2001; 1; established)
- Tennessee (2015; 1)
- Wisconsin (2014-2020; 3)

From Cordeiro and Killeen (2011):

"In the United States this species occurs in New York, the Connecticut River in Massachusetts, Lake Michigan and Grand Haven in Michigan, Lake Superior in Minnesota and Lake Champlain in Vermont (Herrington 1962, NatureServe 2009)."

From Heard (1962):

"Among the 20 species in Lake Michigan, the appearance of *P. henslowanum* is of special interest. This species is common in Lake Ontario and has also been found in Lake Erie, but the Lake Michigan record represents a new western extension of its known range (Heard, 1961)."

No records of *Euglesa henslowana* in trade in the United States were found.

Regulations

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

Means of Introductions within the United States

From Kipp et al. (2024):

"*Pisidium henslowanum* very likely arrived in ships to the Great Lakes basin. It was most likely delivered in solid ballast, which was in use at the turn of the [20th] century (Grigorovich et al. 2000, 2003)."

Remarks

Information for this assessment was searched for using the valid name *Euglesa henslowana* and the synonym *Pisidium henslowanum*. Additional information was found during this assessment in languages other than English for both the valid scientific name and various synonyms.

MolluscaBase (2022) listed the following as synonyms for *Euglesa henslowana*: *Pisidium (Tropidocyclas) henslowanum* (Sheppard, 1825), *Pisidium (Tropidocyclas) henslowianum* "Sheppard", *Pisidium henslowaniana* Jenyns, 1832, *Pisidium henslowanum* (Sheppard, 1825), *Pisidium henslowanum* var. *bedoti* Piaget, 1913, *Pisidium henslowianum*, and *Tellina henslowana* Sheppard, 1825.

From Kipp et al. (2023a):

"There has been some debate over whether or not *P. henslowanum* is native to North America. Those who believe it is a native species cite discoveries of occurrences in central and western Canada as well as shell deposits from 7000 years ago (Harris 1973), or mention that the population in the Holyoke Canals would have had difficulty spreading from the Great Lakes, considering that this canal system is not commercially navigable (Smith 1986). However, the general consensus amongst most authors is that *P. henslowanum* is an introduced species."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From MolluscaBase (2022):

"Status
accepted"

"Biota > Animalia (Kingdom) > Mollusca (Phylum) > Bivalvia (Class) > Autobranchia (Subclass) > Heteroconchia (Infraclass) > Euheterodonta (Subterclass) > Imparidentia (Superorder) > Sphaeriida (Order) > Sphaerioidea (Superfamily) > Sphaeriidae (Family) > Sphaeriinae (Subfamily) > *Euglesa* (Genus) > *Euglesa henslowana* (Species)"

Size, Weight, and Age Range

From Kipp et al. (2024):

"Size: reaches 4 to 4.6 mm in length (Clarke 1981, Herrington 1962, Holopainen 1979, Mackie 2000)."

Environment

From Kipp et al. (2024):

"In its native habitat *P. henslowanum* is most often found in rivers, canals, and streams of good water quality, while in North America it is mostly found in lakes and large rivers. Henslow's pea clam can occur down to 20 m depth although it is more limited by lack of oxygen with increasing depth. It is typically associated with silt, mud, and sand assemblages."

"Even though European authors typically indicate that *P. henslowanum* requires relatively hard, calcium rich water, it can survive in somewhat softer water in the Connecticut River system. In this system the pH is 7.0–7.7 and the $CaCO_3$ concentration is 25–35 mg/l (Smith 1986)."

From Cordeiro and Killeen (2011):

"This species is found in both rivers and lakes, is able to live in soft water and thrives in calcium rich waters (Smith 1986). In the United States, this species is most commonly found in large bodies of water, but in Europe it is found in unpolluted canals and rivers (Clarke 1981)."

"**Systems:** Freshwater"

From Kuiper et al. (1970):

"*P. henslowanum* occurs in a fairly wide range of habitat, although it seems to prefer a moderate amount of water movement."

"According to Koli (1961) the species does not occur in brackish water, whereas Van Benthem Jutting (1954) records 0.24‰ Cl′ as its upper limit. According to Jaeckel (1962) its maximum salinity tolerance is about 0.9‰ Cl′. In the Delta area [Netherlands] the highest known salinity tolerated by the species is found in the Brielse Meer, with a salinity varying between 0.1 and 0.9‰ Cl′ in the year before we collected our samples, and also along the Hollands Diep, where the salinity may rise temporarily to well above 0.3‰ Cl′. Its resistance to pollution is rather considerable. We found the species in two grab-samples from the polluted Waal (= Rhine) near Zaltbommel and therefore consider it as belonging to the most pollution-tolerant species of the pisidiids of the Netherlands."

From Heard (1962):

"Samples from dredging in Lake Michigan by the M/V Cisco, U. S. Bureau of Commercial Fisheries, on July 1, 1960, at depths of 3, 5, 5 ½, 10, 15, 25, 28 ½, 30, and 50 fathoms in an east-

west transect off Grand Haven, Ottawa County, Michigan, reveal rather precise patterns of distribution for some species. […] while *P. fallax* and *P. henslowanum* appeared only in samples taken from less than 15 fathoms. It is expected, however, that the distribution of these sphaeriids will prove to be linked to substrate type rather than depth. Too little information is available to permit positive conclusions at the present time."

Climate

From Kuiper et al. (1970):

"Distribution: Palaearctic […]"

Distribution Outside the United States

Native

From Kipp et al. (2024):

"*Pisidium henslowanum* is a Holarctic species found in Eurasia, in countries such as Iceland, Scandinavia, France, Germany, Belgium, the territory of the former USSR, and the United Kingdom (Clarke 1981, Mackie 2000)."

From Cordeiro and Killeen (2011):

"In Europe, this species is found in Hungary, Portugal, Finland, Sweden, Denmark, south east Norway and north east Iceland (Kuiper *et al.* 1989). Within these countries it has been found in the River Danube, at Kismaros and Göd in Hungary (Bodis 2007); and the River Minho estuary in Portugal (Sousa *et al.* 2007). It is likely to occur in other European countries."

"**Native:** Denmark; Finland; Hungary; Iceland; Norway; Portugal (Portugal (mainland)); Sweden"

From Kuiper et al. (1970):

"In the Netherlands the species [*Euglesa henslowana*] is fairly common."

From Pettinelli et al. (2009):

"[…] *Pisidium henslowanum* living in Lake Piediluco (southwestern Umbria, Italy)."

From Graf and Cummings (2023):

"Native range from Europe to Kamchatka [Russian Far East]"

Introduced

From Cordeiro and Killeen (2011):

"It occurs in […] Ontario, Canada (Mackie 2007) […]."

“In Canada, this species occurs in Quebec, Lake Winnipeg in Manitoba, Lake Ontario, Bay of Quinte, Rideau River and St. Lawrence River in Ontario (Herrington 1962, NatureServe 2009).”

Means of Introduction Outside the United States

From Kipp et al. (2024):

“*Pisidium henslowanum* very likely arrived in ships to the Great Lakes basin [Canada]. It was most likely delivered in solid ballast, which was in use at the turn of the century (Grigorovich et al. 2000, 2003).”

Short Description

From Kipp et al. (2024):

“Henslow’s pea clam has a thin, triangle- to oval-shaped, relatively long bivalve shell with evenly spaced coarse striae. The beaks are located posterior to the centre and the joint at the dorsal margin is relatively pointed. The height to length ratio is 0.8–0.9. The 2nd cardinal tooth inside the shell is V-shaped and larger than the 4th cardinal, which begins above the 2nd cardinal and lies obliquely. The 3rd cardinal is relatively thick and located at the posterior margin. In live specimens, there is only an anal siphon (Clarke 1981, Herrington 1962, Mackie 2000, Mackie et al. 1980, Pennak 1989).”

Biology

From Kipp et al. (2024):

“*Pisidium henslowanum* reproduces hermaphroditically and may self-fertilize. The number of embryos per gravid adult ranges from 1–40 and generally increases with parental size. Young are released depending on temperature and oxygen availability. *Pisidium henslowanum* may produce one or two broods per year. The breeding season occurs in spring and summer. Young become mature at age 2 and the lifespan is thought to be 4–5 years (Clarke 1981, Holopainen 1979, Holopainen and Hanski 1986, Holopainen and Jonasson 1983, Mackie 2000, Smith 1986). *Pisidium henslowanum*, like many other pea clams, filters food from the water column directly above the substrate and from the sediments in which it lives, including bacteria, diatoms, detritus and other algae (Holopainen 1979, Mackie 2000).”

“Densities in Europe have reached 330–9000 clams per m^2 (Bishop and Hewitt 1976, Clarke 1981, Hinz et al. 1982, Holopainen 1979, Holopainen and Jonasson 1983, Holopainen and Ranta 1977, Jonasson 1984, Krieger 1984, Mackie et al. 1980, Smit et al. 1994,1995, Steiner and Turner 1998).”

From Pettinelli et al. (2009):

“Morphological and histological analysis of samples taken monthly over a period of two years (February 1993 - February 1995) allowed us to follow the annual changes in the gonad tissues, and to ascertain that the species is fertile for most of the year with two peak periods, which occur

in July and November, when there is massive gamete release. A short period of non-fertilization takes place in January and February when few spermatozoa occur and no ova are produced. Through the monitoring of the ontogenetic stages of *P* [sic] *henslowanum* in Lake Piediluco [Italy], it was possible to determine the average life span of two distinct generations per year to be 12-14 months for the main one (winter generation) and 14-16 months for the subsidiary one (summer generation). The population is semelparous and bivoltine, with hatchings in late spring and late autumn. Self-fertilization was documented in many specimens, since a large number of free spermatozoa and ova were observed within the female follicles."

Human Uses

No information was found on human uses of *Euglesa henslowana*.

Diseases

No information was found associating *Euglesa henslowana* with any diseases listed by the World Organisation for Animal Health (2023).

No information was found on diseases associated with *Euglesa henslowana*.

Threat to Humans

No information was found on threats to humans from *Euglesa henslowana*.

3 Impacts of Introductions

There are records of introductions for *Euglesa henslowana*. However, there are no documented impacts of introduction. The following refers to *potential* impacts of introductions.

From Kipp et al. (2023):

"Recent sampling in Lake Superior indicates that *P. henslowanum* has a greater abundance in the Duluth-Superior Harbor area than any species of native peaclam (*Pisidium* spp.), suggesting that *P. henslowanum* may possess some invasive trait(s) or compete with native species (Trebitz et al. 2010, Mackie 2000)."

4 History of Invasiveness

The History of Invasiveness for *Euglesa henslowana* is classified as Data Deficient. There are records of nonnative introductions of *E. henslowana* in North America, and those introductions have led to established populations. However, the information found on impacts of introductions represents potential impacts on native species and not a scientific consensus of negative impacts.

5 Global Distribution

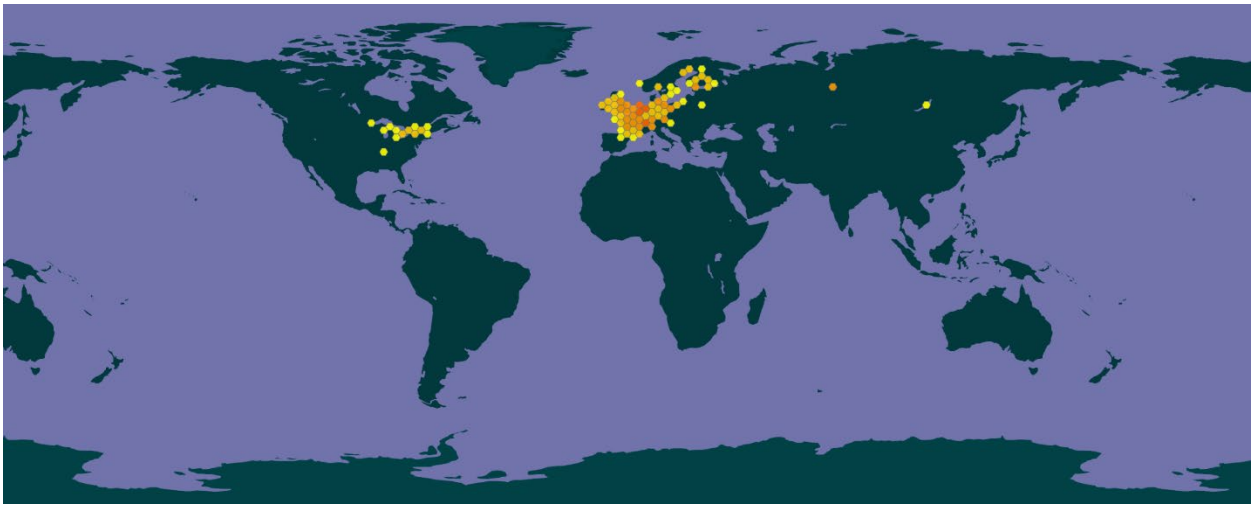

Figure 1. Reported global distribution of *Euglesa henslowana*. Map from GBIF Secretariat (2022). Observations are reported from the United States, Canada, The Netherlands, Belgium, France, Spain, United Kingdom, Switzerland, Germany, Poland, Finland, Austria, Belarus, Ireland, Finland, Sweden, Norway, Russia. Locations in the southern United States were not used for the climate match as they do not represent currently established populations.

An additional observation in Italy was provided by Pettinelli et al. (2009).

6 Distribution Within the United States

Figure 2. Reported distribution of *Euglesa henslowana* in the United States. Map from GBIF-US (2023). Observations are reported from New Hampshire, Vermont, Massachusetts, New York, Ohio, Michigan, Wisconsin, and Minnesota.

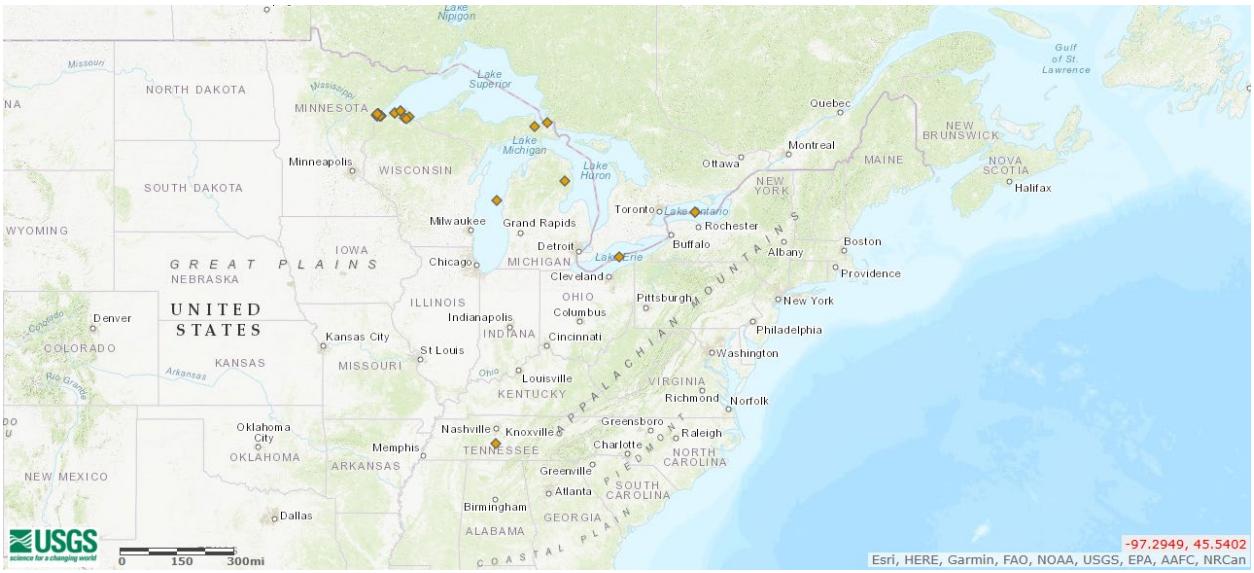

Figure 3. Reported distribution of *Euglesa henslowana* in the United States. Map from Kipp et al. (2024). Observations are reported from New York, Ohio, Michigan, Wisconsin, Minnesota, and Tennessee. The observation in Tennessee was not used in the climate matching analysis as it does not represent an established population.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Euglesa henslowana* was generally high throughout the contiguous United States with few areas of medium and low match. Areas of highest match occurred in the Northeast, Great Lakes, and Midwest regions. Areas of low match were found along the Pacific Coast in the Pacific Northwest and northern California, and in the Cascade and Sierra Nevada Mountains. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.799, 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 *Euglesa henslowana* (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.

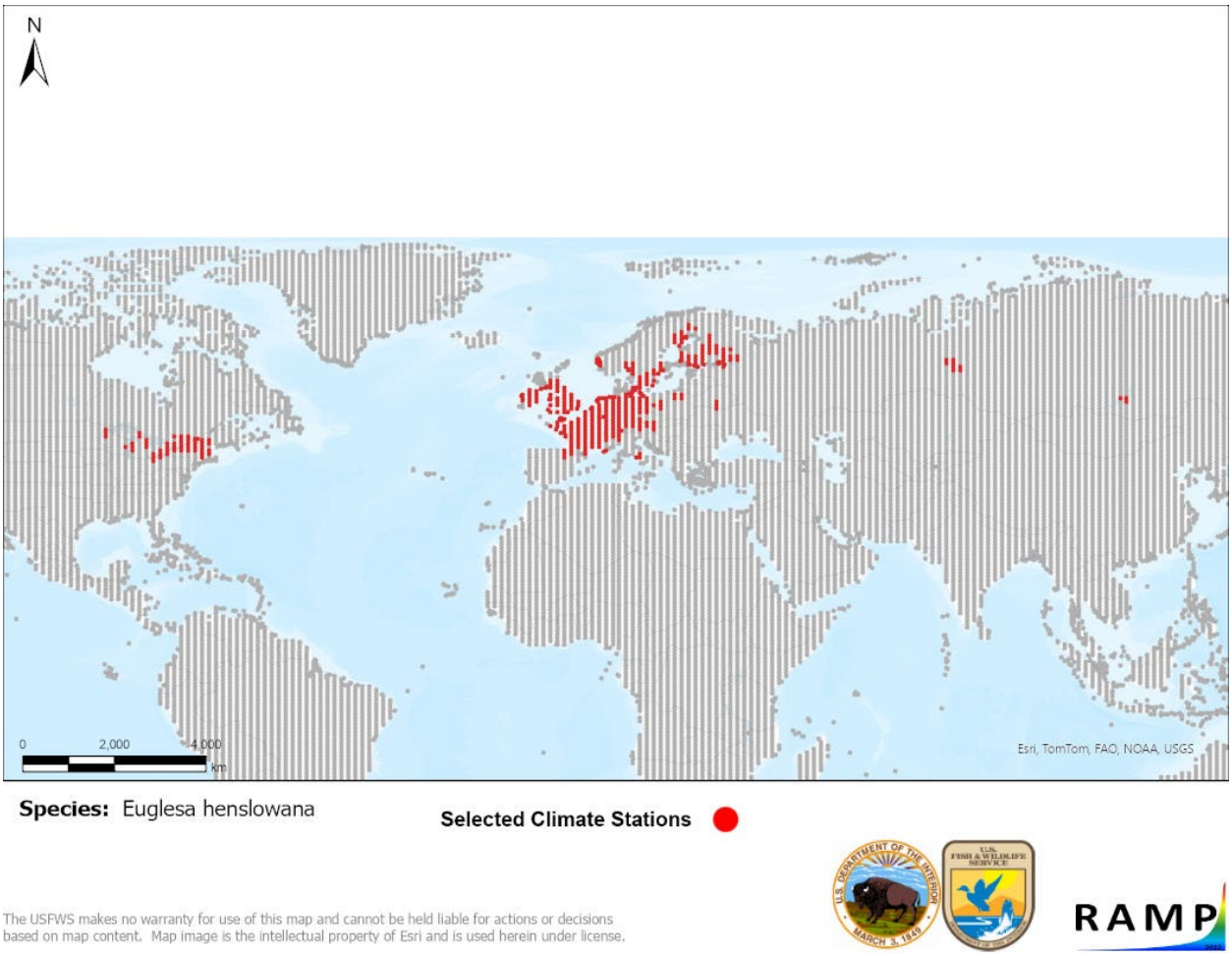

Figure 4. RAMP (Sanders et al. 2023) source map showing weather stations in North America, Europe, and central Russia selected as source locations (red; United States, Canada, The Netherlands, Belgium, France, Spain, United Kingdom, Switzerland, Germany, Poland, Finland, Austria, Czechia, Belarus, Ireland, Finland, Sweden, Norway, Russia) and non-source locations (gray) for *Euglesa henslowana* climate matching. Source locations from Pettinelli et al. (2009) and 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.

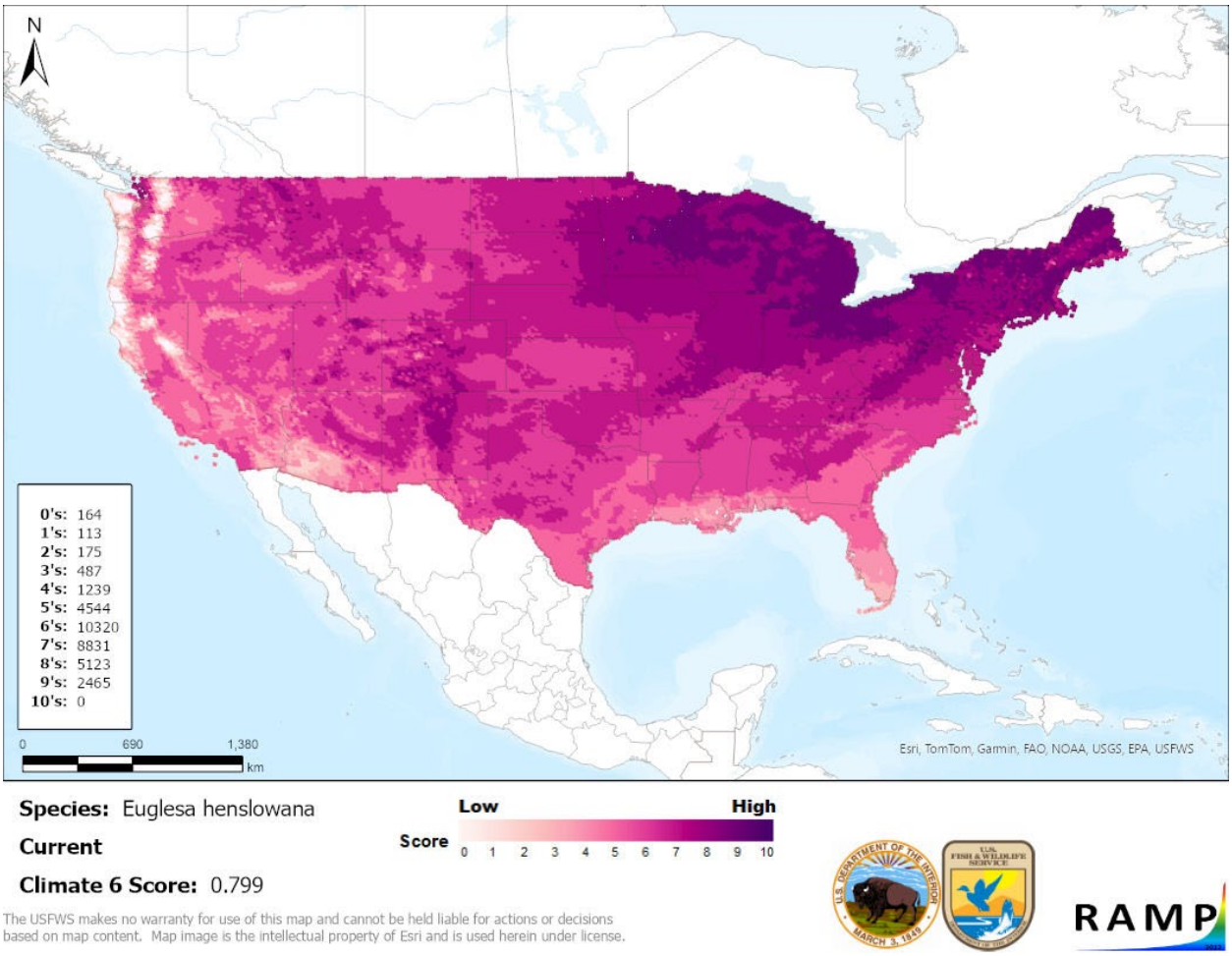

Figure 5. Map of RAMP (Sanders et al. 2023) climate matches for *Euglesa henslowana* in the contiguous United States based on source locations reported by Pettinelli et al. (2009) and GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Euglesa henslowana* is classified as Low. Information on the biology, ecology, and distribution of *E. henslowana* was available, however, limited information on the impacts of introduction and no evidence of *E. henslowana* in trade was found.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Euglesa henslowana, Henslow Peaclam, is a freshwater mollusk that is native to most of northern Eurasia, from the United Kingdom to Russia. *E. henslowana* has been reported as introduced and established beyond its native range to eastern North America. However, there is no indication this species is in trade, and no negative impacts of introduction have been reported. The History of Invasiveness for this species is classified as Data Deficient due to the lack of information on impacts of introduction. The climate matching analysis for the contiguous United

States indicates establishment concern for this species. Areas of high match were particularly concentrated in the Northeast and Great Lakes region where this species is established. The Certainty of Assessment for this ERSS is classified as Low due to the lack of information on impacts of introduction and trade. The Overall Risk Assessment Category for *E. henslowana* 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: 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.

Cordeiro J, Killeen I. 2011. *Euglesa supina*. *Pisidium henslowanum.* The IUCN Red List of Threatened Species 2011. Available: https://www.iucnredlist.org/species/155782/4841963 (January 2023).

GBIF Secretariat. 2022. GBIF backbone taxonomy: *Euglesa henslowana* (Sheppard, 1825). Copenhagen: Global Biodiversity Information Facility. Available: https://www.gbif.org/species/7857878 (January 2022).

GBIF-US. 2023. Species occurrences: *Euglesa henslowana*. Available: https://doi.org/10.15468/dl.hcqshq (January 2023).

Graf DL, Cummings KS. 2022. *Euglesa henslowana* (Sheppard, 1825). The freshwater mussels (Unionoida) of the world (and other less consequential bivalves). MUSSEL Project Web Site. Available: http://mussel-project.uwsp.edu/fmuotwaolcb/validsp_7193.html (February 2023).

Heard WH. 1962. The Sphaeriidae (Mollusca: Pelecypoda) of the North American Great Lakes. The American Midland Naturalist 67:194–198.

Kipp RM, Larson J, Fusaro A. 2024. *Pisidium henslowanum* Shepard, 1825. Gainesville, Florida: U.S. Geological Survey, Nonindigenous Aquatic Species Database. Available: https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=130 (December 2024).

Kipp RM, Larson K, Fusaro A. 2023. *Pisidium henslowanum* Shepard, 1825. Gainesville, Florida: U.S. Geological Survey, Nonindigenous Aquatic Species Database, and Ann Arbor, Michigan: NOAA Great Lakes Aquatic Nonindigenous Species Information System. Available: https://nas.er.usgs.gov/queries/greatLakes/FactSheet.aspx?Species_ID=130&Potential=N&Type=0&HUCNumber=DGreatLakes (January 2023).

Kuiper JGJ, Wolff WJ. 1970. The Mollusca of the estuarine region of the rivers Rhine, Meuse and Scheldt in relation to the hydrography of the area. III. The genus *Pisidium*. Basteria 34(1-2):1–42.

MolluscaBase. 2022. *Euglesa henslowana* (Sheppard, 1825.) MolluscaBase. Available: https://www.molluscabase.org/aphia.php?p=taxdetails&id=1471479 (January 2023).

Pettinelli R, Bicchierai MC. 2009. Life cycle of *Pisidium henslowanum* (Sheppard, 1823) (Bivalvia, Veneroida, Sphaeriidae) from Piediluco Lake (Umbria, Italy). Fundamental and Applied Limnology 175:79–92. [Abstract only.]

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

[USFWS] U.S. Fish and Wildlife Service. 2024. Standard operating procedure: how to prepare an "Ecological Risk Screening Summary." Version 3.

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.

Bishop MJ, Hewitt SJ. 1976. Assemblages of *Pisidium* spp. (Bivalvia: Sphaeriidae) from localities in eastern England. Freshwater Biology 6:177–182.

Bódis E. 2007. Spacio-temporal pattern of the small-sized mussel fauna in the Danube above Budapest. Acta Biologica Debrecina Oecologica Hungarica 16:21–23.

Clarke AH. 1981. The freshwater Molluscs of Canada. Ottawa: National Museum of Natural Sciences.

Grigorovich IA, Korniushin AV, MacIsaac HJ. 2000. Moitessier's pea clam *Pisidium moitessierianum* (Bivalvia, Sphaeriidae): a cryptogenic mollusk in the Great Lakes. Hydrobiologia 435:153–165.

Grigorovich IA, Colautti RI, Mills EL, Holeck K, Ballert AG, MacIsaac HJ. 2003. Ballast-mediated animal introductions in the Laurentian Great Lakes: retrospective and prospective analysis. Canadian Journal of Fisheries and Aquatic Sciences 60:740–756.

Harris SA. 1973. *Pisidium henslowanum* in western Canada. Nautilus 87(3):86–87.

Heard WH. 1961. *Pisidium henslowanum* (Sheppard) in Lake Michigan. Nautilus 74:1–123.

Herrington HB. 1962. A revision of the Sphaeriidae of North America (Mollusca: Pelecypoda). Museum of Zoology, University of Michigan, Miscellaneous Publications 118:1–74.

Hinz W, Daub H, Marx C, Tinz C, Wiersch W. 1982. The mollusk fauna of the Issel system at the time of the 1976-77 expansion. Decheniana 134:176–177.

Holopainen IJ. 1979. Population dynamics and production of *Pisidium* species (Bivalvia, Sphaeriidae) in the oligotrophic and mesohumic Lake Paajarvi, southern Finland. Archiv für Hydrobiologie 54:466–508.

Holopainen IJ, Hanski I. 1986. Life history variation in *Pisidium* (Bivalvia: Pisidiidae). Holarctic Ecology 9:85–98.

Holopainen IJ, Jonasson PM. 1983. Long-term population dynamics and production of *Pisidium* (Bivalvia) in the profundal of Lake Esrom, Denmark. Oikos 41:99–117.

Holopainen IJ, Ranta E. 1977. Carbon dioxide output in the respiration of three *Pisidium* species (Bivalvia, Sphaeriidae). Oecologia 30:1–8.

Jaeckel SGA. 1962. Ergänzungen und Berichtigungen zum rezenten und quartären Vorkommen der mitteleuropäischen Mollusken. Pages 25–253 in Zilch A, Jaeckel SGA, editors. Die Tierwelt Mitteleuropas. Leipzig, Germany: Verlag von Quelle & Meyer.

Johnson MG, Matheson DH. 1968. Macroinvertebrate communities of the sediments of Hamilton Bay and adjacent Lake Ontario. Limnology and Oceanography 13:99–111.

Jonasson PM. 1984. Oxygen demand and long term changes of profundal zoobenthos. Hydrobiologia 115:121–126.

Koli L. 1961. Die Molluskenfauna des Brackwassergebietes bei Tvärminne, Südwestfinnland. Annals Zoologici Fennici Soccciaty Vanamo 22:1–22.

Krieger KA. 1984. Benthic macroinvertebrates as indicators of environmental degradation in the southern nearshore zone of the central basin of Lake Erie. Journal of Great Lakes Research 10(2):197–209.

Kuiper JGJ, Økland KA, Knudsen J, Koli L, von Proschwitz T, Valovirta I. 1989. Geographical distribution of the small mussels (Sphaeriidae) in North Europe (Denmark, Faroes, Finland, Iceland, Norway and Sweden). Annales Zoologici Fennici 26:73–101.

Mackie GL. 2000. Ballast water introductions of Mollusca. Pages 219–254 in Claudi R, Leach JH, editors. Nonindigenous freshwater organisms: vectors, biology and impacts. Boca Raton, Florida: CRC Press.

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

Mackie GL, White DS, Zdeba TW. 1980. A guide to freshwater mollusks of the Laurentian Great Lakes with special emphasis on the genus *Pisidium*. Duluth, Minnesota: EPA. Report 600/3-80-068.

NatureServe. 2009. NatureServe Explore: An online encyclopedia of life. Version 7.1. Arlington, Virginia: NatureServe. Available at: http://explorer.natureserve.org. [Accessed by source author.]

Nobre A. 1941. Fauna Malacológica de Portugal II - Moluscos terrestres e fluviais. Memòrias e Estudos do Museu Zoológico da Universidade de Coimbra 124:1–277.

Pennak R. 1989. Fresh-water Invertebrates of the Unites States. 3rd edition. Protozoa to Mollusca. New York: John Wiley & Sons.

Ricciardi A. 2001. Facilitative interactions among aquatic invaders: is an “invasional meltdown” occurring in the Great Lakes? Canadian Journal of Fisheries and Aquatic Sciences 58:2513–2525.

Smit H, Reinhold-Dudok Van Heel HC, Wiersma SM. 1995. Sublittoral macrozoobenthic assemblages in the enclosed sediment-polluted Rhine-Meuse Delta; their relationship to environmental conditions. Netherlands Journal of Aquatic Ecology 29:31–47.

Smit H, Van Der Velden JA, Klinik A. 1994. Macrozoobenthic assemblages in littoral sediments in the enclosed Rhine-Meuse Delta. Netherlands Journal of Aquatic Ecology 28(2):199–212.

Smith DG. 1986. *Pisidium henslowanum* in the Connecticut River, Massachusetts, USA (Bivalvia: Pisidiidae). Nautilus 100:124–126.

Sousa R, Antunes C, Guilhermino L. 2007. Species composition and monthly variation of the Molluscan fauna in the freshwater subtidal area of the River Minho estuary. Estuarine Costal and Shelf Science 75:90–100.

Steiner P, Turner H. 1998. The Mollusca of Lake Greifensee: inventory and abundance of species in relation to site factors. Vierteljahrsschrift der Naturforschenden Gesellschaft in Zuerich 143:85–96.

Trebitz AS, West CW, Hoffman JC, Kelly JR, Peterson GS, Grigorovich IA. 2010. Status of non-indigenous benthic invertebrates in the Duluth-Superior Harbor and the role of sampling methods in their detection. Journal of Great Lakes Research 36:747–756.

van Benthem JTR. 1954. Mollusca. Pages 233–252 in de Beaufort LF, editor. Veranderingen in de flora en fauna van de Zuiderzee (thans IJsselmeer) na de afsluiting in 1932: Verslag van de onderzoekingen, ingesteld door de Zuiderzee-commissie der Nederlandse Dierkundige Vereniging. Amsterdam: Nederlandse Dierkundige Vereniging.

Wolfert DR, Hiltunen JK. 1968. Distribution and abundance of the Japanese snail, *Viviparus japonicus,* and associated macrobenthos in Sandusky Bay, Ohio. The Ohio Journal of Science 68:32–40.

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 Pettinelli et al. (2009) and GBIF Secretariat (2022).

Under the future climate scenarios (figure A1), on average, high climate match for *Euglesa henslowana* was projected to occur in the Great Lakes and Northeast regions of the contiguous United States. Areas of low climate match were projected to occur in the Northern Pacific Coast and Southern Florida regions. Generally, the areas of high match contracted northward with time, particularly under SSP5. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.177 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.668 (model: MPI-ESM1-2-HR, 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 (0.799, figure 5) falls above 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 all time step and climate scenarios only minor or no increases in the climate match relative to the current match were observed. Under one or more time step and climate scenarios, areas within the Appalachian Range, Colorado Plateau, Great Lakes, Gulf Coast, Mid-Atlantic, Northeast, Northern Plains, Southeast, Southern Plains, and Southwest saw a large decrease in the climate match relative to current conditions. Additionally, areas within California, the Great Basin, Southern Atlantic Coast, Southern Florida, and Western Mountains saw a moderate decrease in the climate match relative to current conditions. The magnitude of decrease was greater under SSP5 than under SSP3, and also greater for 2085 than for 2055. Additional, very small areas of large or moderate change may be visible on the maps (figure A3).

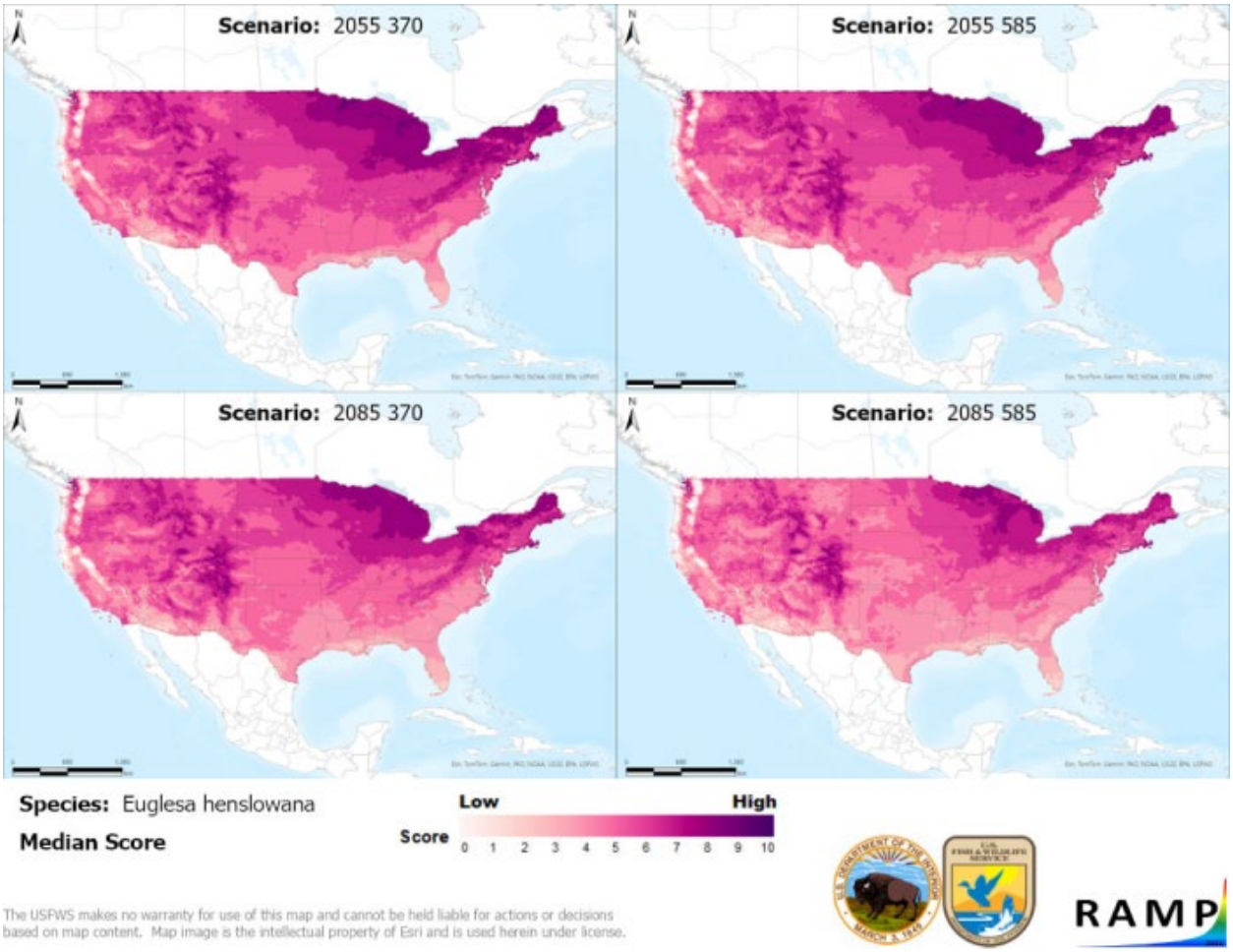

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Euglesa henslowana* in the contiguous United States. Climate matching is based on source locations reported by Pettinelli et al. (2009) and GBIF 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.

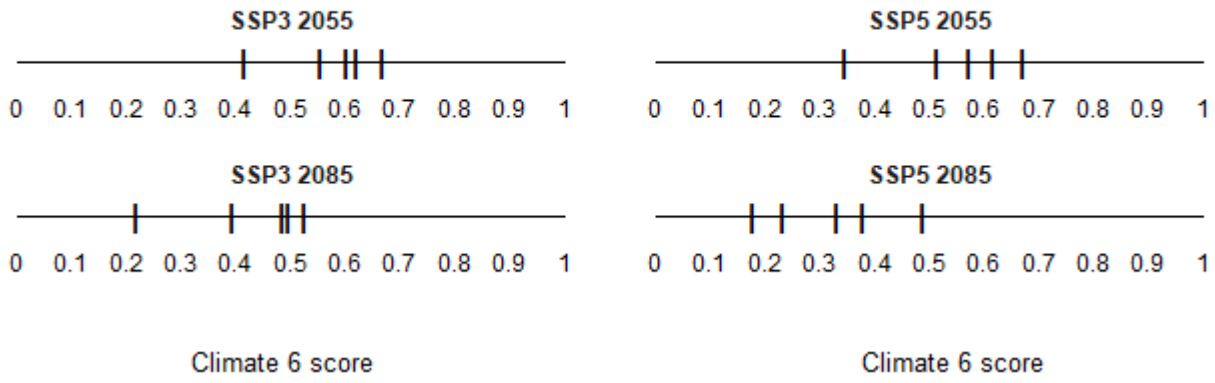

Figure A2. Comparison of projected future Climate 6 scores for *Euglesa henslowana* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018;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

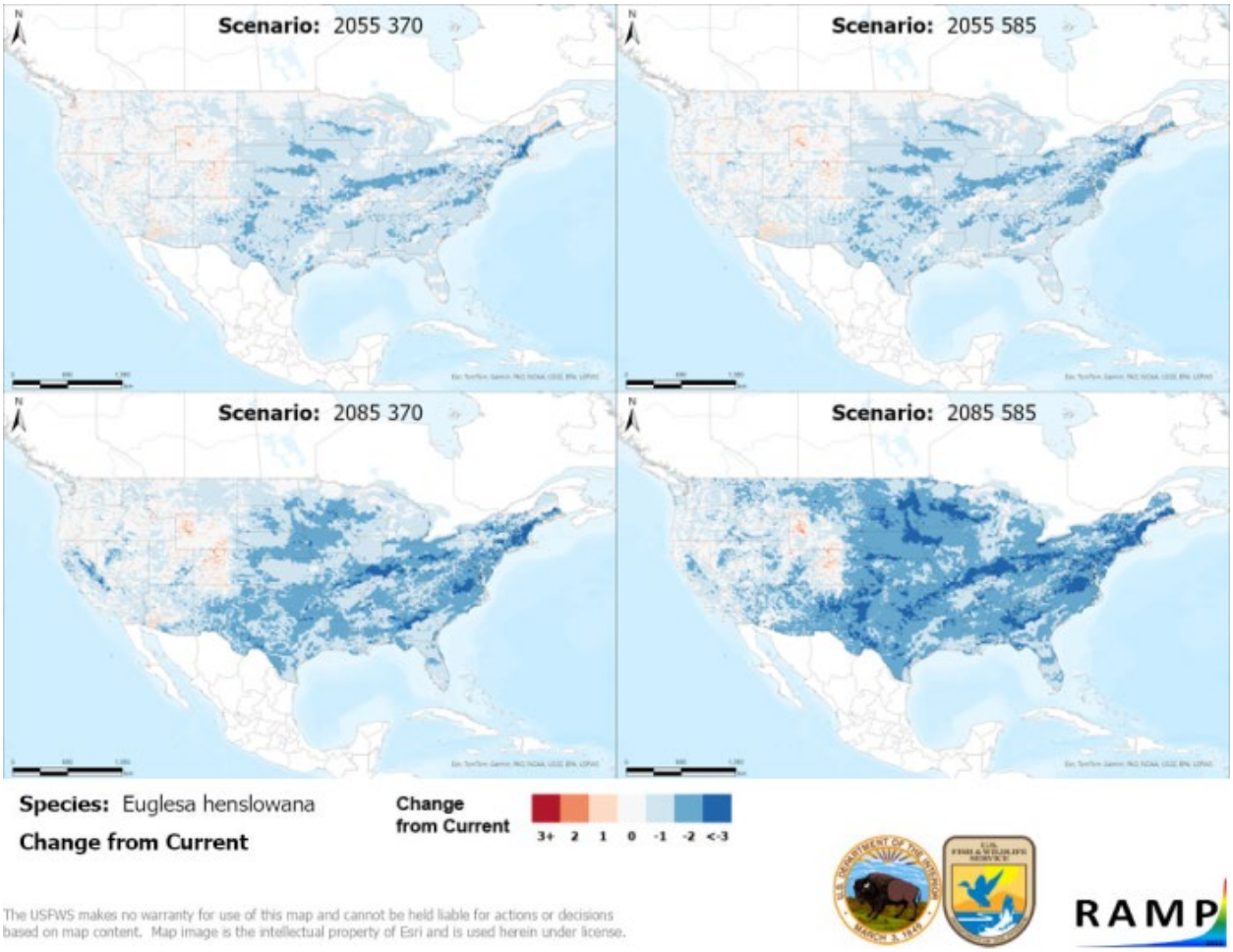

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 5) and the median target point score for future climate scenarios (figure A1) for *Euglesa henslowana* based on source locations reported by Pettinelli et al. (2009) and 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.

Literature Cited

GBIF Secretariat. 2022. GBIF backbone taxonomy: *Euglesa henslowana* (Sheppard, 1825). Copenhagen: Global Biodiversity Information Facility. Available: https://www.gbif.org/species/7857878 (January 2022).

[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 P, Kessler M. 2017. Climatologies at high resolution for the Earth land surface areas. Scientific Data 4:170122.

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.

Pettinelli R, Bicchierai MC. 2009. Life cycle of Pisidium henslowanum (Sheppard, 1823) (Bivalvia, Veneroida, Sphaeriidae) from Piediluco Lake (Umbria, Italy). Fundamental and Applied Limnology 175:79–92. [Abstract only.]

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