Piedmont Elimia (*Elimia virginica*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, March 2023
Revised, March 2023
Web Version, 3/4/2025

Organism Type: Mollusk
Overall Risk Assessment Category: Uncertain

Photo: Amy Benson, USGS. Public Domain. Available: https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=1032 (March 2023).

1 Native Range and Status in the United States

Native Range

From Dillon et al. (2019):

"Populations of *P. virginica* [*Elimia virginica* as *Pleurocera virginica*] are widespread in Atlantic coastal drainages, ranging from Connecticut and Massachusetts to North Carolina, and as far west as central New York State (Goodrich 1942, Jokinen 1992, Harman 2000, Stewart and Dillon 2004)."

Status in the United States

From Dillon et al. (2019):

“Populations of *P. virginica* [*Elimia virginica* as *Pleurocera virginica*] are widespread in Atlantic coastal drainages, ranging from Connecticut and Massachusetts to North Carolina, and as far west as central New York State (Goodrich 1942, Jokinen 1992, Harman 2000, Stewart and Dillon 2004). The Hudson River population of *P. virginica* seems to have spread north through the Erie Canal and into the Great Lakes, and we are aware of one population in NW Pennsylvania's Conneaut Lake, in the drainage of The Ohio [River].”

From Kipp et al. (2023):

“The first record in the Great Lakes drainage is in 1860 when it was found in the Erie Canal, New York State (USEPA 2008). Populations later increased throughout the canal in the late 1800s and reached Buffalo, at the mouth of Lake Erie. In the 1960s, this species was recorded from Oneida Lake, New York State (Mills et al. 1993).”

“Range is shrinking in the native Connecticut River range. The species is considered established in the Lake Ontario drainage.”

“It is considered rare in Connecticut (Jokinen and Pondick 1981). This species, although introduced to the Lake Ontario drainage, has been largely out-competed by the introduced snail *Bithynia tentaculata*, and is thus virtually absent now from the Oswego drainage and possibly very reduced in abundance in other localities where it was introduced, due to such competition (Mills et al. 1993).”

No records of *Elimia virginica* in trade in the United States were found.

Regulations

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

Means of Introductions within the United States

From Kipp et al. (2023):

“Migrated from the Atlantic drainage through the Erie Canal to the Lake Ontario drainage.”

Remarks

From Dillon et al. (2019):

“This species has travelled through three genera in thirty years. Although predominantly assigned to *Goniobasis* through most of the 20th century, in the 1980s many workers began placing it in the resurrected generic nomen, "*Elimia*." Both *Goniobasis* and *Elimia* were subsumed under *Pleurocera* by Dillon (2011).”

"Bianchi et al. (1994) used allozyme data to document a (quite surprising!) hybrid zone between *P. virginica* and *P. livescens* of the American interior, apparently promoted by the opening of the Erie Canal. Holznagel & Lydeard (2000) reported sequence data from the 16S rRNA gene of an individual sampled from Pennsylvania."

From Kipp et al. (2023):

"*Elimia virginica* is synonymous with *Goniobasis virginica* and *Oxytrema virginica*."

The following synonyms of *Elimia virginica* from Bieler (2019) and Dillon et al. (2019) were used to search for information for this report: *Goniobasis virginica*, *Oxytrema virginica*, and *Pleurocera virginica*.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2023):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Protostomia
Superphylum Lophozoa
Phylum Mollusca
Class Gastropoda
Order Neotaenioglossa
Family Pleuroceridae
Genus *Elimia*
Species *Elimia virginica* (Gmelin, 1791)

According to Bieler (2019), *Elimia virginica* is the current valid name for this species.

Size, Weight, and Age Range

From Kipp et al. (2023):

"*Elimia virginica* from New York State and the Connecticut River range from 27–33 mm high, with an aperture height of 9–12 mm (Smith 1980)."

"It is often sexually mature in a year; can live 5 years."

Environment

From Kipp et al. 2023):

"Found in freshwater rivers and streams with cobble bottoms and boulders. […] *Elimia virginica* usually inhabits slow to medium velocity rivers and streams with firm and clean gravel, cobble and rock substrate (Smith 1980). Pleurocerids in general are sensitive to abiotic stresses, and the

E. virginica is not tolerant to siltation (Smith 1980). In Connecticut, the *E. virginica* is at the edge of its range and is most likely limited to hard water habitats only (Jokinen and Pondick 1981). During collections made in the Connecticut River, the snail was found to inhabit regions with water temperatures up to 27.5 degrees C, dissolved oxygen between 7 and 14 ppm, CaCO3 concentration from 42–160 ppm, pH from 7.6–9.0 and CO2 concentration from 0–10 ppm (Smith 1980). However, it should be noted that at some of these sites, population abundance was very low and/or decreasing, especially in conditions of high water temperature and alkalinity (Smith 1980)."

Climate

No information was found on climate requirements of *Elimia virginica*.

Distribution Outside the United States

Native

The native range of *Elimia virginica* is entirely within the United States, see section 1.

Introduced

No records were found for introductions of *Elimia virginica* in the wild outside the United States.

Means of Introduction Outside the United States

No records were found for introductions of *Elimia virginica* in the wild outside the United States.

Short Description

From Kipp et al. 2023):

"*Elimia virginica* belongs to the family Pleuroceridae, a group of snails with thick, elongated shells. The opercula are withdrawn, proteinaceous, corneous, and paucispiral. The shells are dextral and have a very high and narrow spire, with little space in the incisions between the whorls. This species has two distinct shell morphologies, one smooth and one lirate (i.e. finely lined or grooved) (Smith 1980). Specimens of this species often vary in coloration; in general, *E. virginica* is yellow to chestnut in hue, but it may or may not exhibit 2 darker brown spiral bands (Peckarsky et al. 1993). Juveniles (snails with an aperture height of no more than 7 mm) display the banding more frequently than adults (Smith 1980). It is straightforward to distinguish the female of this species by way of the external genital sinus (Jones and Branley 1964)."

Biology

From Kipp et al. 2023):

"A short study in the Potomac River, Virginia, found that the snail has a very strong shell that is adapted to withstand predation by such predators as crayfish and ducks. However, there is an evolutionary trade-off between predator defense and rapid growth and reproduction amongst snail populations found in this river."

"*Elimia virginica*, unlike softer shelled physid snails, grows very slowly and has the lowest intrinsic rate of increase, along with *Mudalia carinata*, in this environment (Hamilton 1980). *Elimia virginica* is dioecious (Jones and Barclay [Branley] 1964) and lays its eggs from spring to summer, in particular in June and July (Smith 1980). It is often sexually mature in a year; can live 5 years."

"In the Connecticut River, shells of *E. virginica* is [sic] often used as substrate by epizootic algae and the Entoproct *Urnatella gracilis* (Smith 1980)."

From Dillon et al. (2019):

"This and other pleurocerids are grazers of epilithic periphyton (Harman 2000). Where they reach high densities, grazing by pleurocerid populations can have a significant effect on energy flow in streams (Dillon 2000: 86 - 91). Habitat degradation caused declines and local extinctions of stream- and lake-dwelling *Pleurocera virginica* populations in the northeastern United States during the 20th century (Smith 1980, Harman 2000)."

"Like other pleurocerids, *P. virginica* is dioecious, eggs being deposited on hard substrates from spring to mid-summer. Eggs are spirally arranged in masses of 2-15 or more, with a tough, membranous outer covering (Smith 1980, Jokinen 1992). Although we are unaware of any study specifically directed toward the life history of *P. virginica*, it seems reasonable to expect that two years will be required for maturity, and that several years of iteroparous reproduction can be expected thereafter, as is the case for pleurocerids generally (Dazo 1965)."

Human Uses

No information was found on human uses of *Elimia virginica*.

Diseases

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

From Kipp et al. 2023):

"*Elimia virginica* is a known host of trematode parasites, including *Philophthalmus megalurus* and *Sphaeridiotrema globulus* (Huffman and Fried 1983, Smith 1980). In one New Jersey Lake, multiple mute swan (*Cygnus olor*) deaths appeared to be caused by *S. globulus* hosted in *E. virginica* at an infection rate of roughly 50% (Huffman and Fried 1983)."

According to Poelen et al. (2014), *Elimia virginica* hosts the following parasites: *Cercaria megalura* and *C. trifurcate*.

Threat to Humans

No information was found on threats to humans from *Elimia virginica*.

3 Impacts of Introductions

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

From Kipp et al. 2023):

"During glaciation, the Alleghenian Divide geographically isolated congeners *E. virginica* and *E. livescens*—the former was only found in Atlantic Slope drainages, while the latter was only found in Interior Basin drainages (Bianchi et al. 1994). There is recent evidence for hybridization and introgression between the species, whose populations were brought into contact with the opening of the Erie Canal (Bianchi et al. 1994). Hybridization and introgression have the potential to jeopardize the genetic integrity of a species, especially when the population is already small."

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

4 History of Invasiveness

The History of Invasiveness for *Elimia virginica* is classified as Data Deficient. There are records of nonnative introductions of *E. virginica* in the United States, specifically in Lake Ontario and a lake in the Ohio River drainage. Introductions have led to established populations, however the information found on impacts of introductions represents potential impacts on native species and not a documented negative impact.

5 Global Distribution

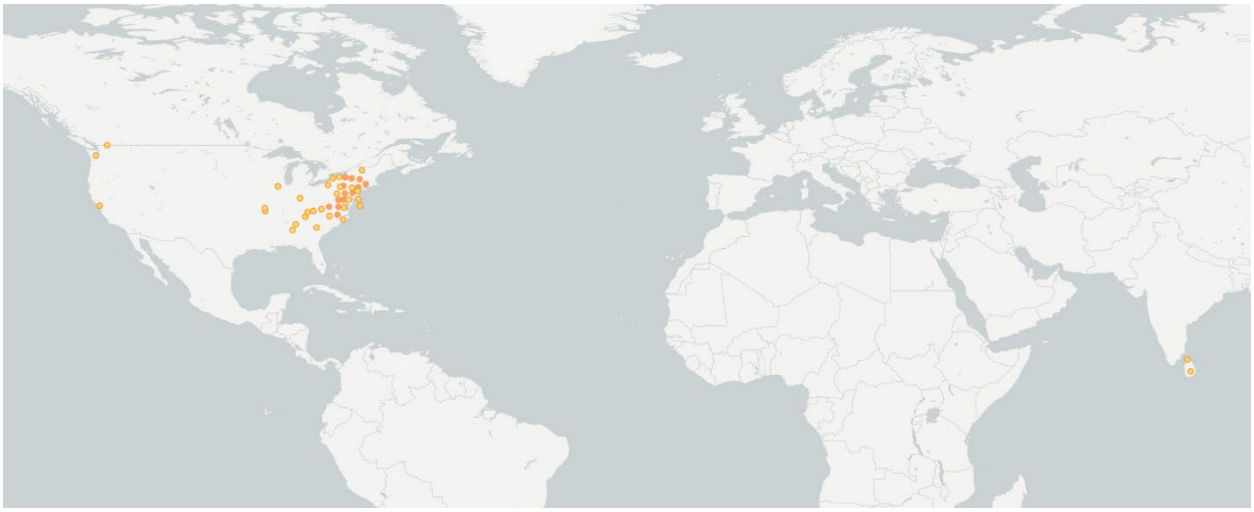

Figure 1. Reported global distribution of *Elimia virginica*. Map from GBIF Secretariat (2023). Observations are reported from the eastern United States, in the Pacific Northwest, and along the central California coast. Locations are also reported from Sri Lanka. Some locations in the United States (Atlantic Ocean, Washington, and California) and those in Sri Lanka were found to be coordinate errors and excluded from the climate matching analysis. Additional locations in Missouri, Illinois, Indiana, southeastern Pennsylvania, Tennessee, Kentucky, Alabama, and South Carolina were also excluded from the climate matching analysis as they do not fall within the native range reported by Dillon et al. (2019) and no introductions have been reported from these locations.

6 Distribution Within the United States

Figure 2. Reported distribution of *Elimia virginica* in the United States. Map from GBIF-US (2023). Observations are reported from the eastern United States, in the Pacific Northwest, and along the central California coast. Some locations in the United States (Atlantic Ocean, Washington, and California) were found to be coordinate errors and excluded from the climate matching analysis. Additional locations in Missouri, Illinois, Indiana, southeastern Pennsylvania,

Tennessee, Kentucky, Alabama, and South Carolina were also excluded from the climate matching analysis as they do not fall within the native range reported by Dillon et al. (2019) and no introductions have been reported from these locations.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Elimia virginica* was generally high throughout most of the eastern portion of the contiguous United States from the Mississippi River eastward, where this species is native. Isolated areas of high match were also found in portions of the Rocky Mountains. Medium matches were generally found west of the Mississippi River, in the interior Southeast, and peninsular Florida. Areas of low match were found along the Pacific Coast, in portions of the Southwest, and in the Cascade-Sierra Nevada Mountains. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.471, 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).

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

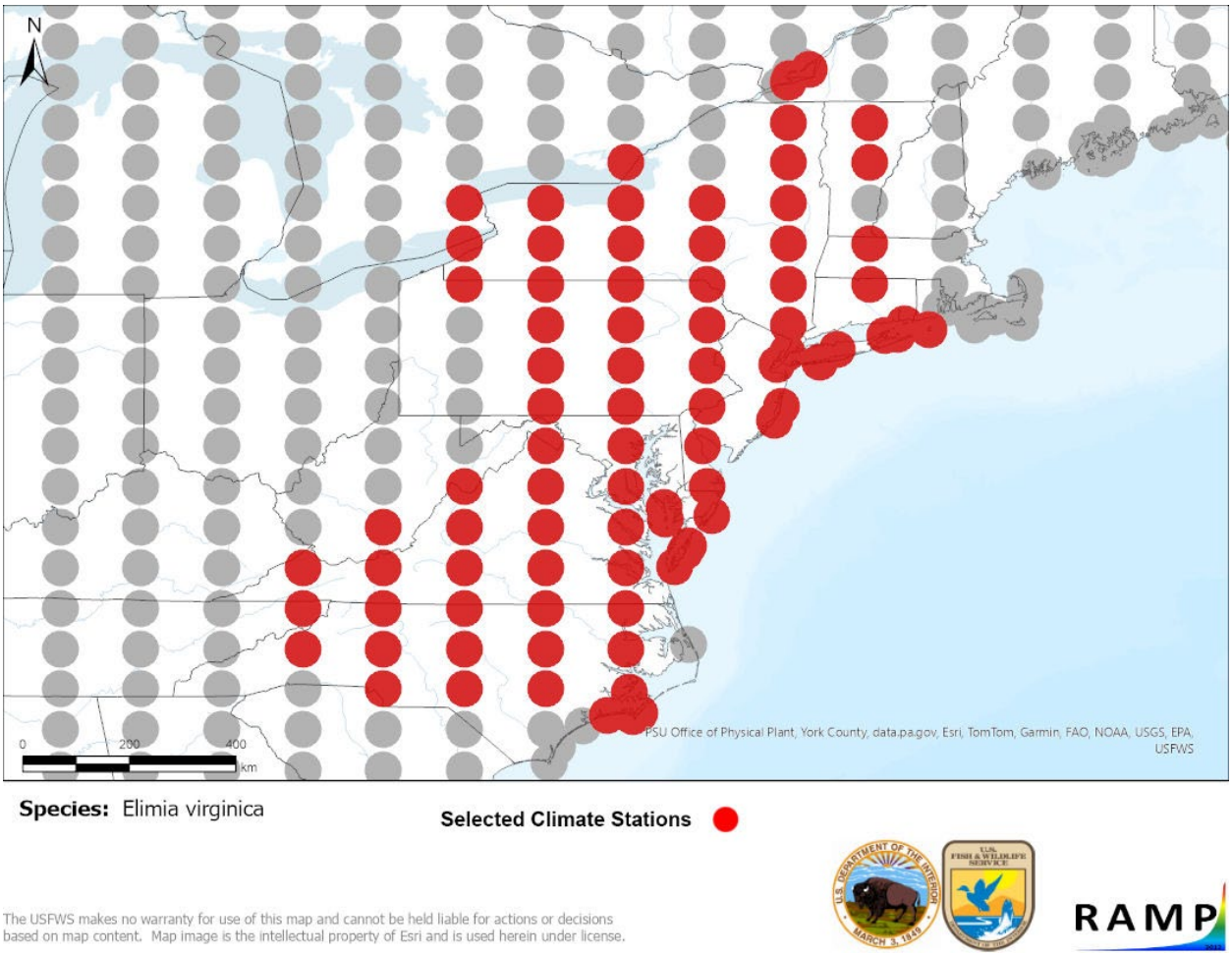

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations in the northeastern United States and southern Quebec, Canada selected as source locations (red; Canada [southern Quebec] and United States [Vermont, New York, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Delaware, Pennsylvania, Maryland, Washington DC, Virginia, and North Carolina]) and non-source locations (gray) for *Elimia virginica* 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.

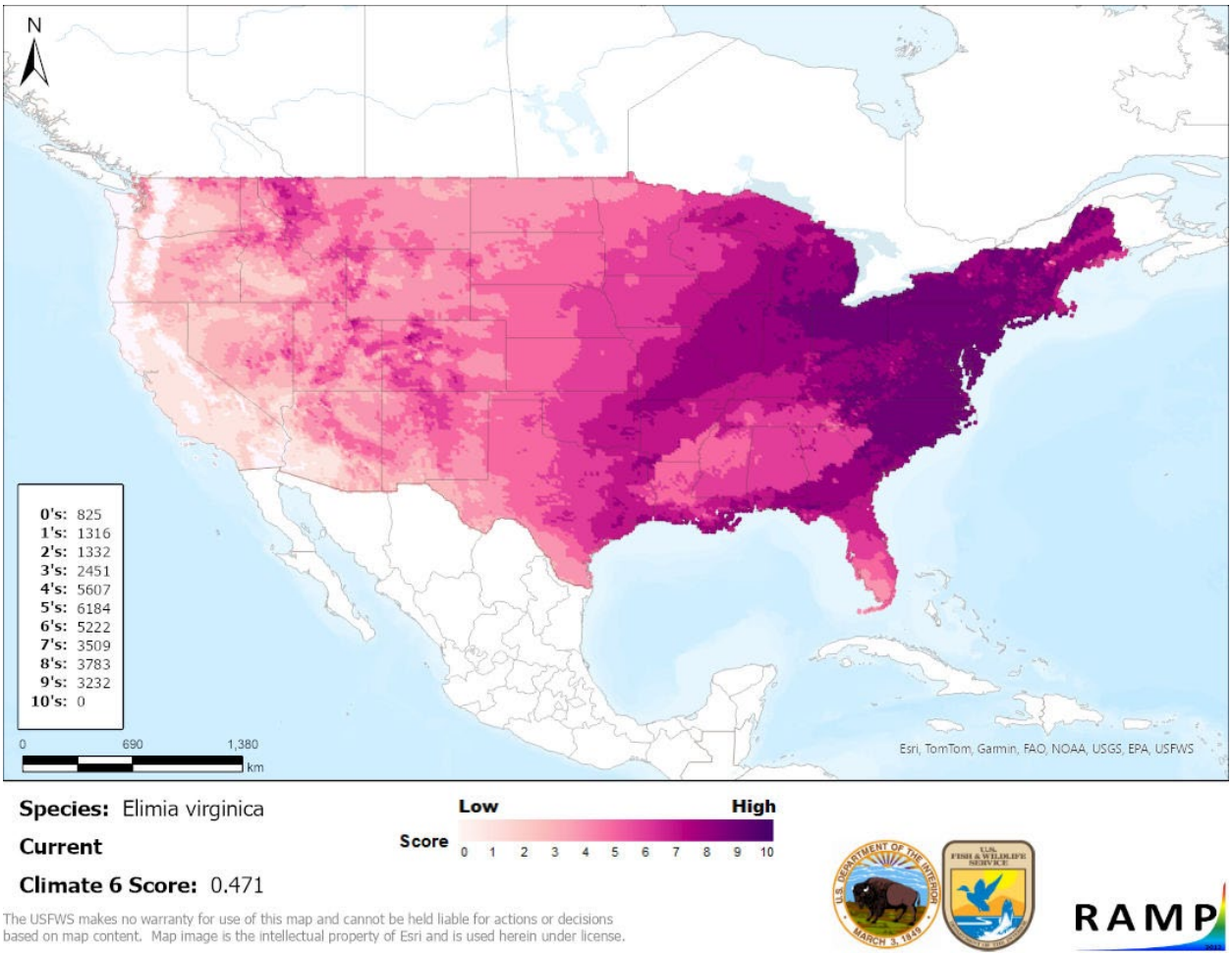

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Elimia virginica* in the contiguous United States based on source locations reported by GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Elimia virginica* is classified as Low. Information on the biology, ecology, and distribution of *E. virginica* was available. Records of introduction and establishment were found. However, the impacts of introduction are unknown.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Elimia virginica, the Piedmont Elimia, is a freshwater gastropod that is native to Atlantic coastal drainages in the United States from Connecticut and Massachusetts to North Carolina. *E. virginica* has been reported as introduced beyond its native range to the Lake Ontario drainage via the Erie Canal and in a lake in the Ohio River drainage. However, there is no indication this species is in trade, and no impacts from the introductions 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 outside its native range. Areas of high match were found in the Northeast, Mid-Atlantic, and Great Lakes regions where this species is native or introduced and 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. virginica* 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.

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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 *Elimia virginica* was projected to occur in the Appalachian Range, Great Lakes, Mid-Atlantic, and Northeast regions of the contiguous United States which encompass the native range of the species. Areas of low climate match were projected to occur in California, the Great Basin, Northern Pacific Coast, and Southwest regions. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.214 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.443 (model: MRI-ESM2-0, SSP3, 2055). All future scenario Climate 6 scores were above the Establishment Concern threshold, indicating that Yes, there is establishment concern for this species under future scenarios. The Climate 6 score for the current climate match (0.471, figure 4) 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 one or more time step and climate scenarios, areas within the Colorado Plateau 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, Gulf Coast, Mid-Atlantic, Northeast, and Southeast saw a large decrease in the climate match relative to current conditions. These areas encompass the native range of the species. Additionally, areas within the Colorado Plateau, Great Basin, Great Lakes, Northern Plains, Southern Atlantic Coast, Southern Florida, Southern Plains, Southwest, and Western Mountains 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 and geographic scope of change increased with time and between SSP3 and SSP5.

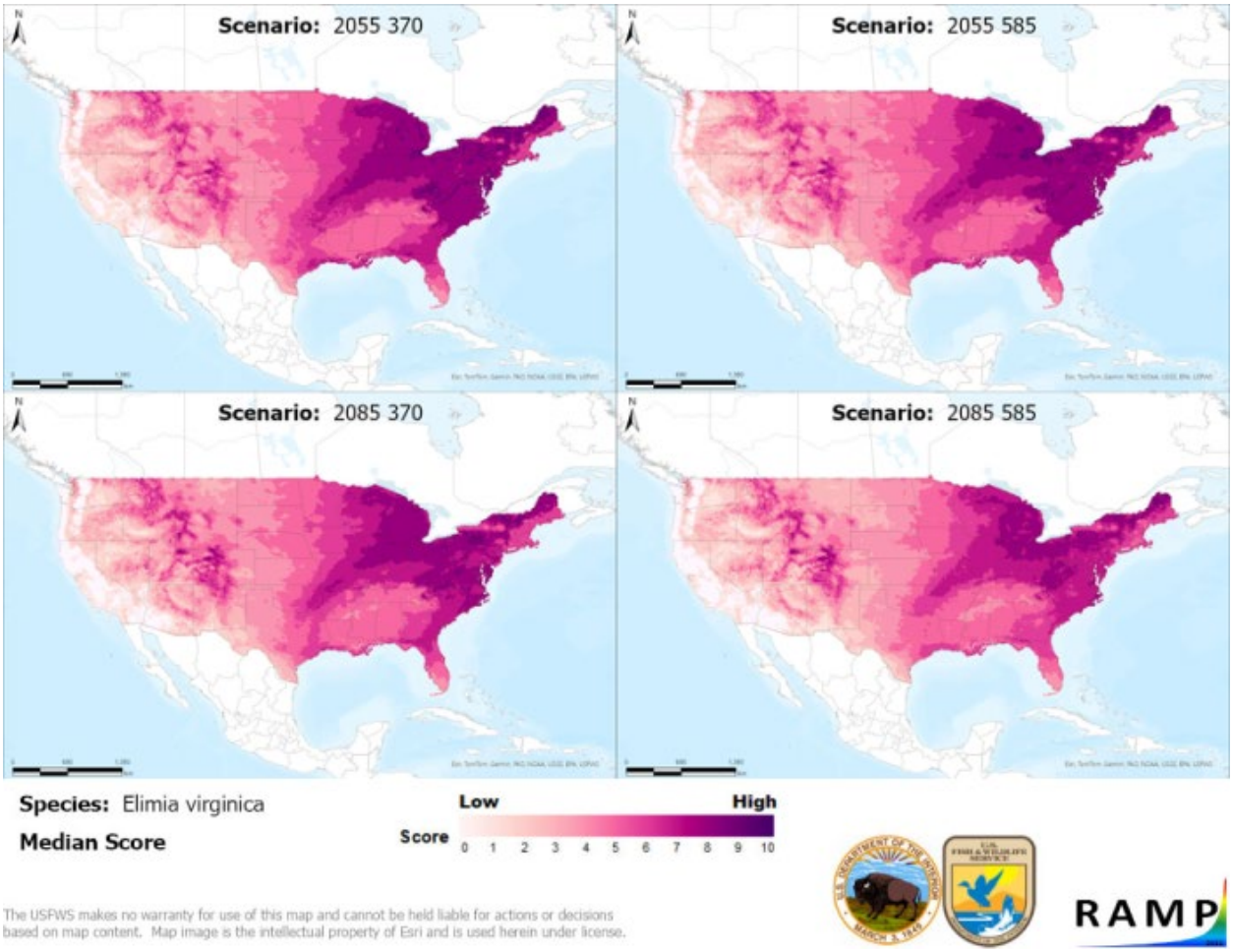

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Elimia virginica* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023). Shared Socioeconomic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

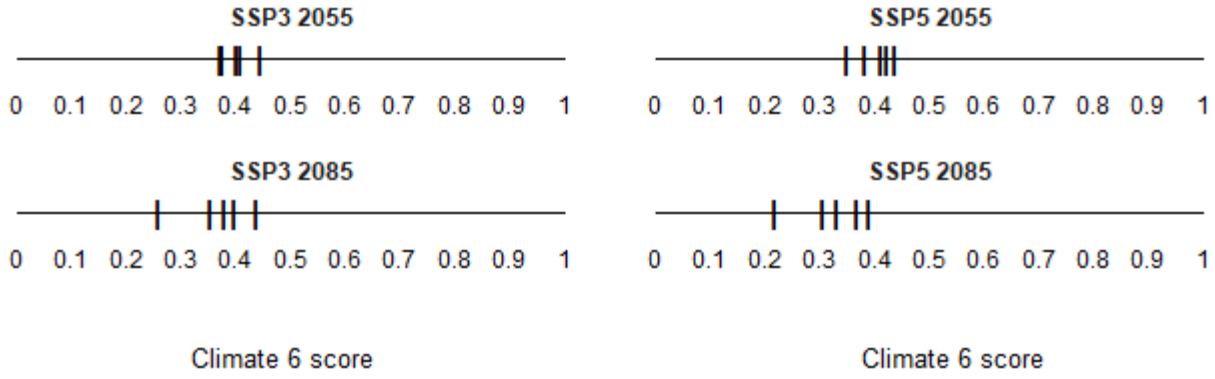

Figure A2. Comparison of projected future Climate 6 scores for *Elimia virginica* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC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

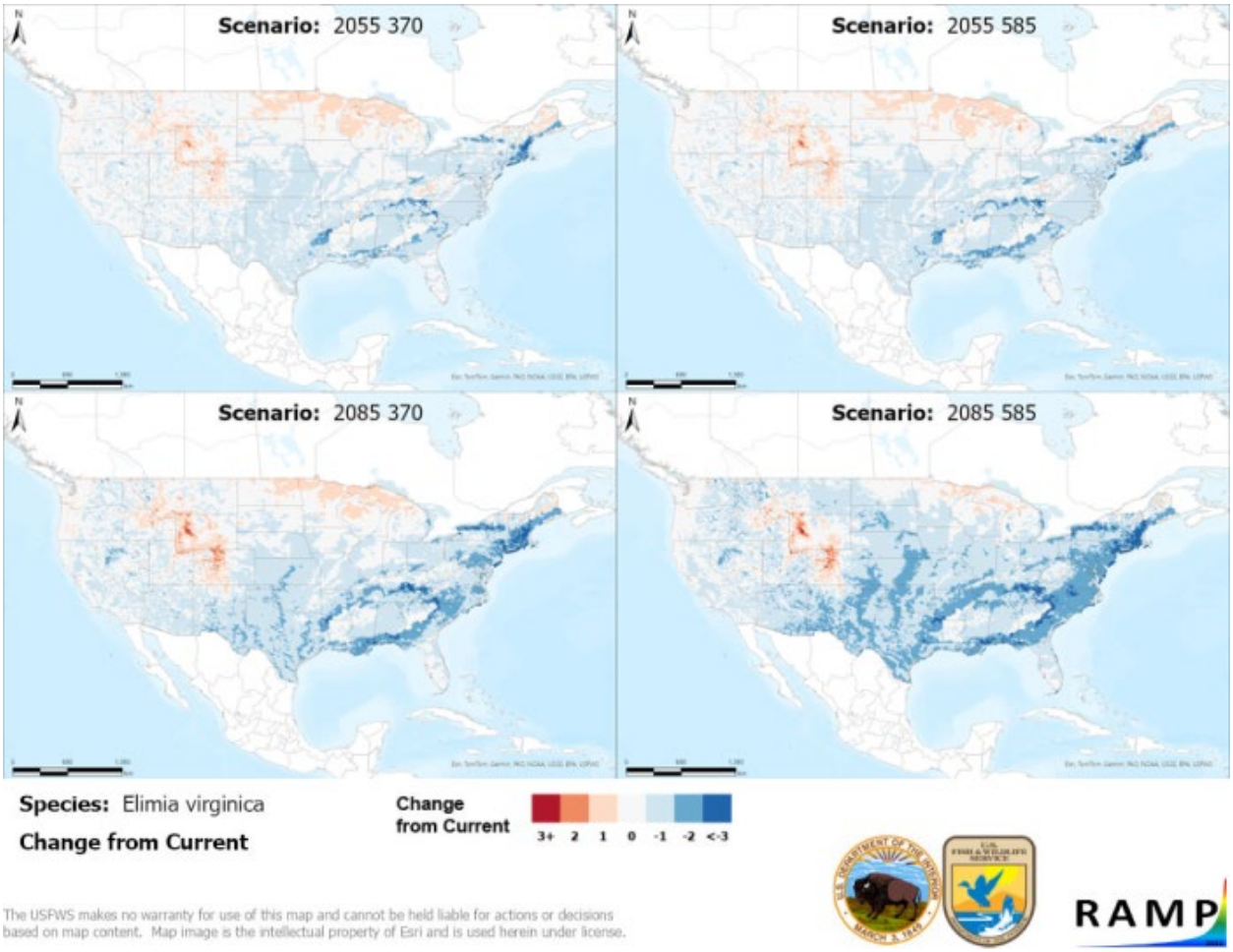

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Elimia virginica* based on source locations reported by GBIF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