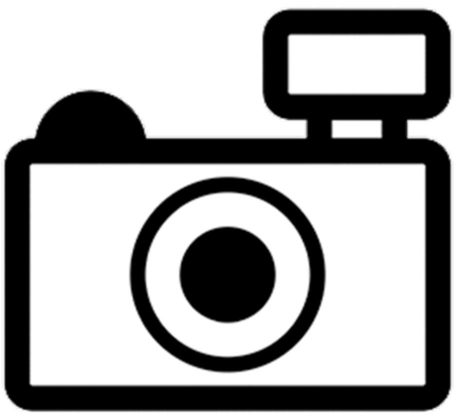
U.S. Fish & Wildlife Service

Moina micrura (a cladoceran, no common name)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, January 2023
Revised, February 2023
Web Version, 1/6/2025

Organism Type: Crustacean
Overall Risk Assessment Category: Uncertain



No Photo Available

1 Native Range and Status in the United States

Native Range

From Elías-Gutiérrez et al. (2019):

"*M. micrura*, presumably widely distributed in Europe, has been also recorded from all other continents except Antarctica."

"The geographical distribution of *M. micrura* s. str. remains unclear, but the available data (based on both genetic analyses and morphological comparisons) suggest that this species is restricted to Europe and the western part of the Palearctic. Apart from Central Europe, genetic data confirmed the presence of the same lineage also in the Middle East (Israel) and the Ponto Caspian region (Kazakhstan). Molecular analyses nevertheless showed that within Eurasia, numerous other lineages, presumably species, of the *M. micrura* complex reside (Bekker et al., 2016; this study), this is also true for Europe alone where genetically distinct lineages were detected in Hungary or Spain. Sequenced American (Elías-Gutiérrez et al., 2008; Prosser et al.,

2013) and Australian populations (Petrusek et al., 2004) compared with all Eurasian sequences indicate that they are all distinct species as well."

"We can conclude that *Moina micrura* s. str. is distributed at least from Central Europe (with terra typica in the Czech Republic) to the Ponto Caspian region and Middle East but it seems to overlap in distribution with other related species (as a genetically distinct lineage has been detected in Hungary). *Moina cf. micrura* from Albufera Lake in Spain and Sobrón reservoir possibly is another, not yet described species that requires further attention. Is [sic] clear that European *Moina micrura* s. str. is distinct from analyzed populations from North and South America, Australia, Africa, Korea or Russia."

Status in the United States

From Elías-Gutiérrez et al. (2019):

"The *M. micrura*-like populations from American continent are a complex of species, consisting of at least five distinct lineages that also require further, more detailed analyses."

Simpson et al. (2022) lists *Moina micrura* as introduced and established in Hawaii.

The following descriptions of *M. micrura* presence in the United States were published prior to or concurrently with the redescription of the species by Elías-Gutiérrez et al. (2019), and it is unclear whether the organisms described belong to *M. micrura* sensu stricto.

Moina micrura is present in Utah Lake, Utah (Richards 2019), Red Rock Reservoir, Iowa (Asch 1971), and Arizona (Kubly 1992).

From Van Guilder (2023):

"*M. micrura* is rarely found inhabiting the Great Lakes, though it has been found in Lake Michigan near Green Bay (Balcer et al., 1984)"

No records of *Moina micrura* 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 Petrusek et al. (2004):

"There is direct evidence that birds can serve as vectors for *Moina micrura* – viable eggs of this taxon (sensu lato) were recovered from the lower part of the digestive tract of mallard ducks (*Anas platyrhynchos*) (Proctor, 1964). The transport of resting stages by birds may ensure migration over a large scale of distances."

Remarks

From Elías-Gutiérrez et al. (2019):

"*Moina micrura* Kurz, 1875 (Anomopoda: Moinidae) belongs among the most poorly defined cladoceran species in the world. This species has been considered cosmopolitan and is widely used for laboratory experiments, ecotoxicology, physiology or as live food. Nevertheless, recent molecular analyses corroborated the idea that it is a diverse complex of closely related species."

From Petrusek et al. (2004):

"The original species description was not detailed enough, the type specimens have not been preserved and the type locality does not exist anymore. The morphological variability of populations of small-sized *Moina* was so high that seven other species names were synonymised with *M. micrura* […]"

The literature indicates that the full taxonomic understanding of *Moina micrura* is unclear and that it may be a single species or a complex of species. The species is cryptogenic and its native or introduced status in particular locations is unclear in most cases. Information contained in this report, particularly from older sources, may refer to either *M. micrura* sensu stricto (Elías-Gutiérrez et al. 2019) or to a species complex related to *M. micrura* sensu stricto.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From WoRMS (2023):

Animalia (Kingdom) > Arthropoda (Phylum) > Crustacea (Subphylum) > Allotriocarida (Superclass) > Branchiopoda (Class) > Phyllopoda (Subclass) > Diplostraca (Superorder) > Anomopoda (Order) > Moinidae (Family) > *Moina* (Genus) > *Moina micrura* (Species)

"Status accepted"

Size, Weight, and Age Range

From Van Guilder (2023):

"Approximately 0.5 mm in length […]"

"Adult longevity is approximately 12 days in the wild […]"

Environment

From Palomares and Pauly (2023):

"Pelagic; freshwater."

From Van Guilder (2023):

"It has been shown to inhabit temporary pools that are often highly eutrophic and have shallow depth (Crosetti and Margaritora, 1987). Relatively turbid lakes high in nutrients tend to encourage *M. micrura* habitation (Hart, 1990; Jana and Pal, 1985)."

From Petrusek et al. (2004):

"*M. micrura* has been recorded from virtually all types of limnetic habitats, including temperate permanent ponds, lakes, ephemeral desert pools, and tropical brackish fishponds."

Climate

From Petrusek et al. (2004):

"*Moina micrura* Kurz, 1874 (Crustacea: Anomopoda), commonly regarded as a cosmopolitan cladoceran species, can be found almost all over the world except for arctic and cold-temperate regions."

Distribution Outside the United States

Native

From Elías-Gutiérrez et al. (2019):

"*M. micrura*, presumably widely distributed in Europe, has been also recorded from all other continents except Antarctica."

"The geographical distribution of *M. micrura* s. str. remains unclear, but the available data (based on both genetic analyses and morphological comparisons) suggest that this species is restricted to Europe and the western part of the Palearctic. Apart from Central Europe, genetic data confirmed the presence of the same lineage also in the Middle East (Israel) and the Ponto Caspian region (Kazakhstan). Molecular analyses nevertheless showed that within Eurasia, numerous other lineages, presumably species, of the *M. micrura* complex reside (Bekker et al., 2016; this study), this is also true for Europe alone where genetically distinct lineages were detected in Hungary or Spain. Sequenced American (Elías-Gutiérrez et al., 2008; Prosser et al., 2013) and Australian populations (Petrusek et al., 2004) compared with all Eurasian sequences indicate that they are all distinct species as well."

"We can conclude that *Moina micrura* s. str. is distributed at least from Central Europe (with terra typica in the Czech Republic) to the Ponto Caspian region and Middle East but it seems to overlap in distribution with other related species (as a genetically distinct lineage has been detected in Hungary). *Moina cf. micrura* from Albufera Lake in Spain and Sobrón reservoir possibly is another, not yet described species that requires further attention. Is [sic] clear that European *Moina micrura* s. str. is distinct from analyzed populations from North and South America, Australia, Africa, Korea or Russia."

Introduced
From Semenova and Tchougounov (2018):

"The species *Moina micrura* Kurz, 1875 (Crustacea: Cladocera), which is new for the Vistula Lagoon of the Baltic Sea, was recorded there for the first time. Over the past years, the species has formed a stable opportunistic population, which may become dominant under optimal abiotic and trophic conditions. The continuing eutrophication of the Vistula Lagoon and local climate warming in recent decades are, apparently, the main reasons for the successful naturalization of the species in this water body."

"In the absence of holotype and before molecular phylogenetic analysis, it may be suggested that this population belongs to *Moina micrura* Kurz, 1875 sensu stricto, which is widespread in [sic] western Palaearctic according to the data of Adam Petrusek (Charles University, Prague, Czech Republic) and is genetically confirmed for Central Europe and Israel (Petrusek, personnel [sic] communication)."

Means of Introduction Outside the United States
From Petrusek et al. (2004):

"There is direct evidence that birds can serve as vectors for *Moina micrura* – viable eggs of this taxon (sensu lato) were recovered from the lower part of the digestive tract of mallard ducks (*Anas platyrhynchos*) (Proctor, 1964). The transport of resting stages by birds may ensure migration over a large scale of distances."

From Semenova and Tchougounov (2018):

"Latent eggs of *M. micrura* were detected in ballast waters and could be transported in such a way over large distances (Bailey et al., 2003; Alekseev et al., 2010)."

Short Description
From Elías-Gutiérrez et al. (2019):

"*M. micrura* s. str. has unique features in the posterior spinulation of the valves of the parthenogenetic female, and the ornamentation of the ephippium. In the male, spinules on the tip of the antennule and the hook on the first thoracopod are also unique."

From Van Guilder (2023):

"Approximately 0.5 mm in length, *Moina micrura* […] is relatively rounded in body shape, yet possesses a relatively large, distinct head (Balcer et al., 1984). The head is approximately ½ the length of the body and is curved or sloped ventrally […]. The first antennae are exposed (not covered by a beak), variable in length, flexible and are attached along the ventral surface of the head, rather than at the front […]. The tips of the antennae are blunt and exhibit short olfactory setae. The second antennae are large and used for swimming. The body is surrounded by a shell-like carapace which is open along the ventral surface and includes a notch-like cervical sinus (near the “nape”) on the dorsal surface of the body. The dorsal surface also includes a brood chamber to carry eggs […]. *Moina micrura* lacks a rear shell spine, rostrum and ocellus, or eye spot, though does exhibit a single large, median compound eye. *M. micrura* does exhibit a post-abdominal claw with pecten of uniform length […]. Dorsal to the postabdomen are two pairs of relatively long abdominal setae […] (Balcer et al., 1984).”

Biology

From Van Guilder (2023):

“*Moina micrura* are filtering grazers of small phytoplankton (Balcer et al., 1984). Feeding occurs when water is moved across the thoracic appendages. Food particles in the moving water are often brought into the carapace. Any floating phytoplankton is trapped by the setae on the thoracic legs and then moved to the mouth to be consumed. Food particles are most often algae, yet can also consist of bacteria, protozoa and organic detritus (Balcer et al., 1984).”

“*Moina micrura* individuals, like other cladocerans, molt in order to allow for body growth (Balcer et al., 1984). As the old shell is removed, water is taken in to increase body volume before the new exoskeleton hardens. Molting occurs many times throughout the life span of *M. micrura*. *M. micrura* exhibits cyclic parthenogenetic reproduction in which during favorable conditions, adult females produce unfertilized eggs which are deposited into the brood chamber following a molt. These eggs develop into juvenile females which are released from the brood chamber at the next molt. The free-swimming juveniles then molt and grow several times, ultimately reaching adulthood. When conditions become adverse, a female will produce special eggs that develop into males. Once these males reach maturity, the females will produce haploid eggs which are then fertilized by the males. The eggs are then released when the female molts and are encased in the carapace. This complex is called an ephippium and is resistant to adverse conditions. Once conditions are favorable, the fertilized eggs hatch to release parthenogenetic female offspring (Balcer et al., 1984; Martínez-Jerónimo et al., 2007). […] Adult longevity is approximately 12 days in the wild and reproductive peak occurs between five and ten days (Jana and Pal, 1985).”

Human Uses

From Punia (1988):

“Therefore, it is concluded from the present experiments that for commercial prawn and fish hatcheries, which require a regular supply of live feed the present culture technique of *Moina micrura* with the use of organic manures can be a dependable source of live feed. This technique is very simple and gives high production in short duration of time.”

From Wang et al. (2008):

“Therefore, live daphnia [*Moina micrura*] plus chlorella or microparticle diets will be cost-effective feeds in the loach seed production.”

From Rottmann et al. (2017):

"In Singapore, *Moina micrura* grown in ponds, fertilized with mostly chicken manure or, less frequently, with pig manure, are used as the sole food for fry of many ornamental tropical fish species, with a 95%–99% survival rate to ¾ inch (20 mm) in length quite common. Unfortunately, there is very little information concerning practical mass culture methods of *Moina*, and the available information is in mimeograph documents, foreign journals, or other scarce publications."

From Elías-Gutiérrez et al. (2019):

"This species has been considered cosmopolitan and is widely used for laboratory experiments, ecotoxicology, physiology or as live food."

Diseases

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

No information on diseases of *Moina micrura* was found.

Threat to Humans

No information was found on threats to humans from *Moina micrura*.

3 Impacts of Introductions

No information was available on impacts of the reported introductions.

4 History of Invasiveness

The History of Invasiveness for *Moina micrura* is classified as Data Deficient. *Moina micrura* is a cryptogenic species. Although the distribution was formerly reported to be cosmopolitan, recent redescription of the species has limited it to Central Europe, the Ponto-Caspian region, and the Middle East. The population recorded as nonnative in the Vistula Lagoon of the Baltic Sea is likely *M. micrura* sensu stricto, but no information is available regarding impacts or lack thereof for that population. The identity of other populations reported as introduced, such as those in the United States, is unknown following the redescription of *M. micrura* sensu stricto.

5 Global Distribution

Figure 1. Reported global distribution of *Moina micrura*. Map from GBIF Secretariat (2023). Observations are reported across every continent except Antarctica. Following the redescription of *M. micrura* by Elías-Gutiérrez et al. (2019), only occurrences reported from Central Europe, the Ponto Caspian region, and the Middle East are recognized as *M. micrura* sensu stricto. Other observations may represent undescribed species formerly identified as *M. micrura* and were not used in the climate match analysis (see section 7).

Additional georeferenced observations of *M. micrura* are available for the Vistula Lagoon of the Baltic Sea, adjacent to Kaliningrad (Semenova and Tchougounov 2018), and for western Bulgaria (Elías-Gutiérrez et al. 2019).

6 Distribution Within the United States

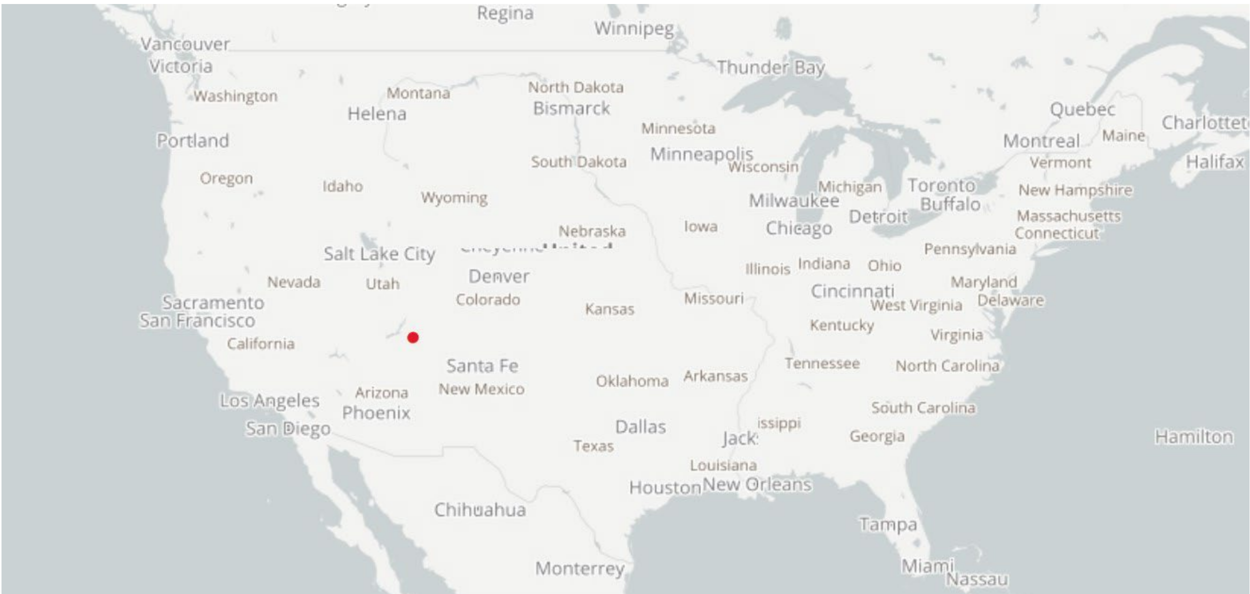


Figure 2. Reported distribution of *Moina micrura* in the United States. Map from GBIF-US (2023). Observations are reported from Monument Valley in Arizona. Following the redescription of *M. micrura* sensu stricto, this observation is not believed to represent an established population of *M. micrura* s. str. (Elías-Gutiérrez et al. 2019) and was not used in the climate match analysis (see section 7).

No georeferenced observations were available to represent the reported established population in Hawaii (Simpson et al. 2022), although it is also unclear whether this population is actually *M. micrura* s. str.

7 Climate Matching

Summary of Climate Matching Analysis

Most of the United States was a medium climate match for *Moina micrura.* High climate matches were found in the Great Lakes and Midwest, and in scattered locations within the Western Mountains, Colorado Plateau, and Great Basin. Areas of low climate match were found in the Pacific Northwest and south from there along the Sierra Nevada, as well as in southern Arizona and peninsular Florida. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.741, 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 *Moina micrura* (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.

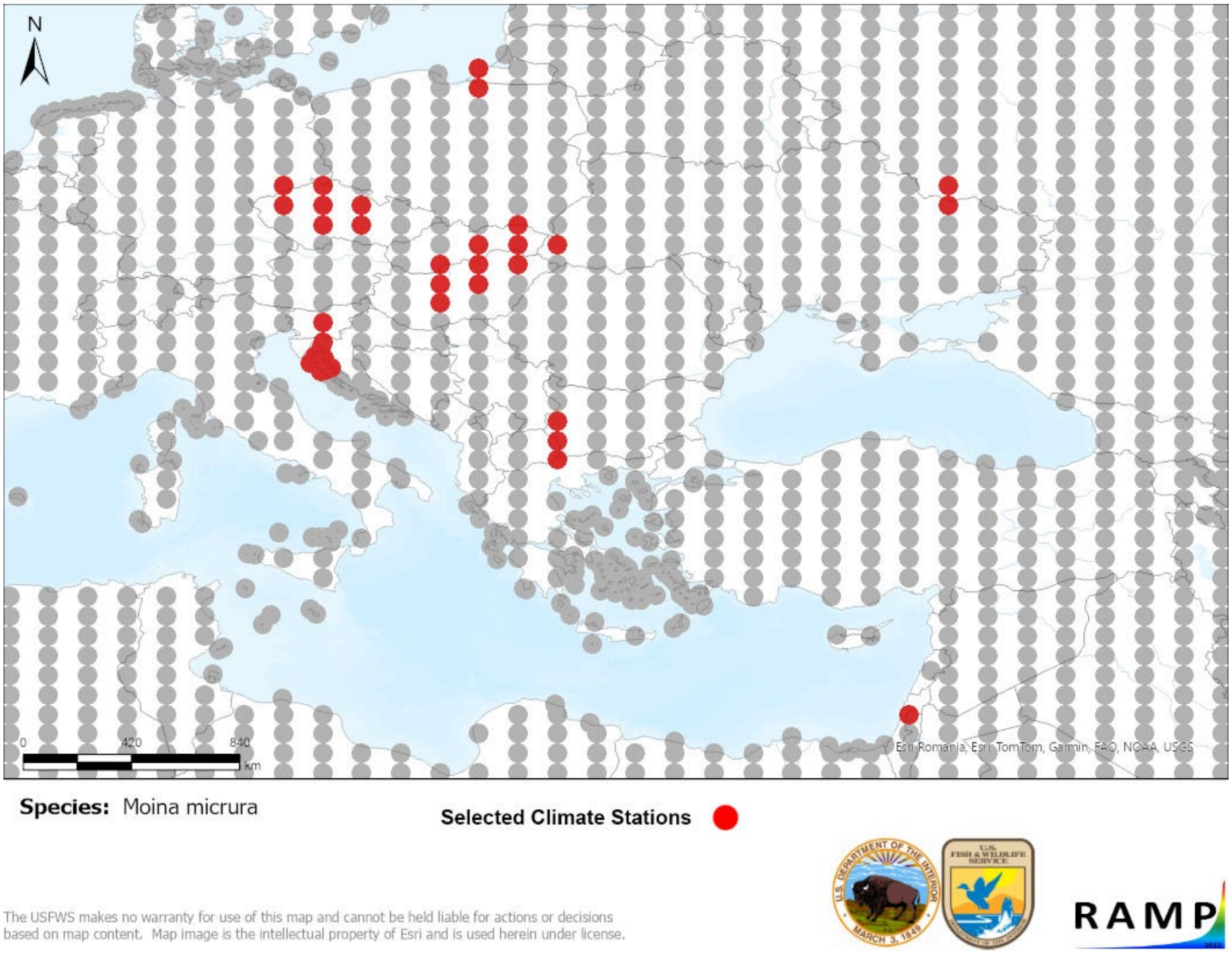


Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations in Europe and western Asia selected as source locations (red; Israel, Germany, Czech Republic, Slovakia, Slovenia, Croatia, Hungary, Bulgaria, Poland, Russia, Ukraine) and non-source locations (gray) for *Moina micrura* climate matching. Source locations from Semenova and Tchougounov (2018), Elías-Gutiérrez et al (2019), and 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.

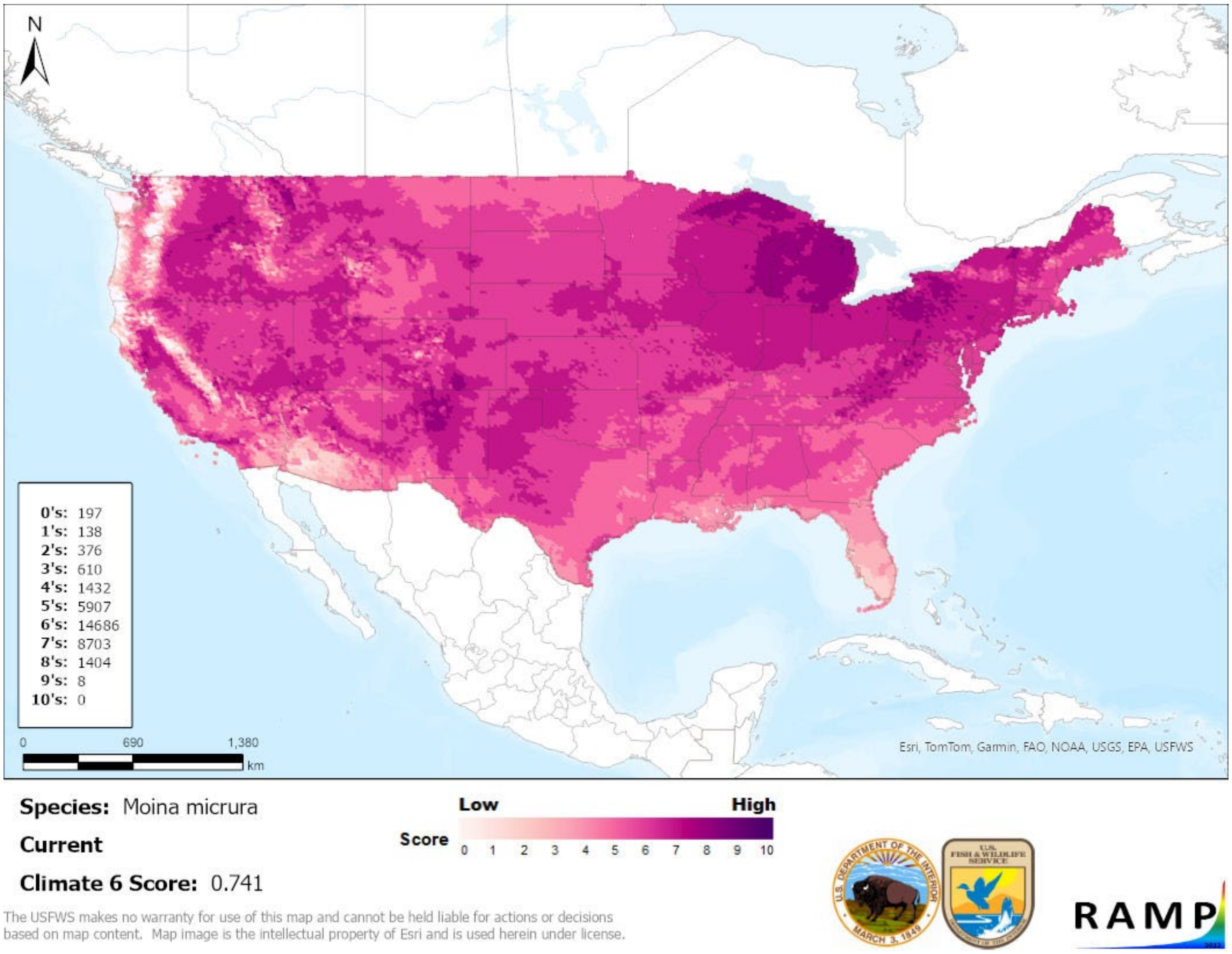


Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Moina micrura* in the contiguous United States based on source locations reported by Semenova and Tchougounov (2018), Elías-Gutiérrez et al (2019), and GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Moina micrura* is classified as Low. There is no information regarding the History of Invasiveness of *Moina micrura.* Most of the distribution information refers to *Moina micrura* as having a global distribution as this seems to be a cryptogenic species. Additionally, the taxonomic understanding of the species is not clear, adding further complexity to understanding the distribution and native or introduced status.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Moina micrura is a cladoceran that is globally distributed. *M. micrura* is a cryptogenic species and its complete native range is unknown. It is likely that *M. micrura* is a species complex and is poorly understood, although there are recent publications trying to resolve this. *M. micrura* is widely used in aquaculture to feed larval fish. The History of Invasiveness for *M. micrura* is classified as Data Deficient since there are known nonnative populations but no information on impacts was found. The climate matching analysis for the contiguous United States indicates establishment concern for this species. The highest match was found in the Great Lakes, Midwest, and in scattered locations in the interior West. The Certainty of Assessment for this ERSS is classified as Low due to the lack of information on information on impacts, taxonomic uncertainty, and complex and unclear distribution information. The Overall Risk Assessment Category for *Moina micrura* 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: Species is cryptogenic with taxonomic uncertainty.**
- **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 Semenova and Tchougounov (2018), Elías-Gutiérrez et al (2019), and GBIF Secretariat (2023).

Under the future climate scenarios (figure A1), no regions of the contiguous United States were projected to have a consistently high climate match for *Moina micrura*. Areas of low climate match were projected to occur in the Northern Pacific Coast and Southern Florida regions. The majority of the contiguous United States was projected to have medium climate match, with climate matches generally decreasing under the more extreme scenarios. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.154 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.641 (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 (0.741, 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 California, the Colorado Plateau, Southwest, 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, Colorado Plateau, Gulf Coast, Mid-Atlantic, Northeast, Southeast, Southern Plains, and Southwest saw a large decrease in the climate match relative to current conditions. Additionally, areas within the Great Basin, Great Lakes, Northern Plains, Southern Atlantic Coast, 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 magnitude of change was generally greater at the 2085 time step than at the 2055 time step, and under SSP5 compared to SSP3 at the 2085 time step.

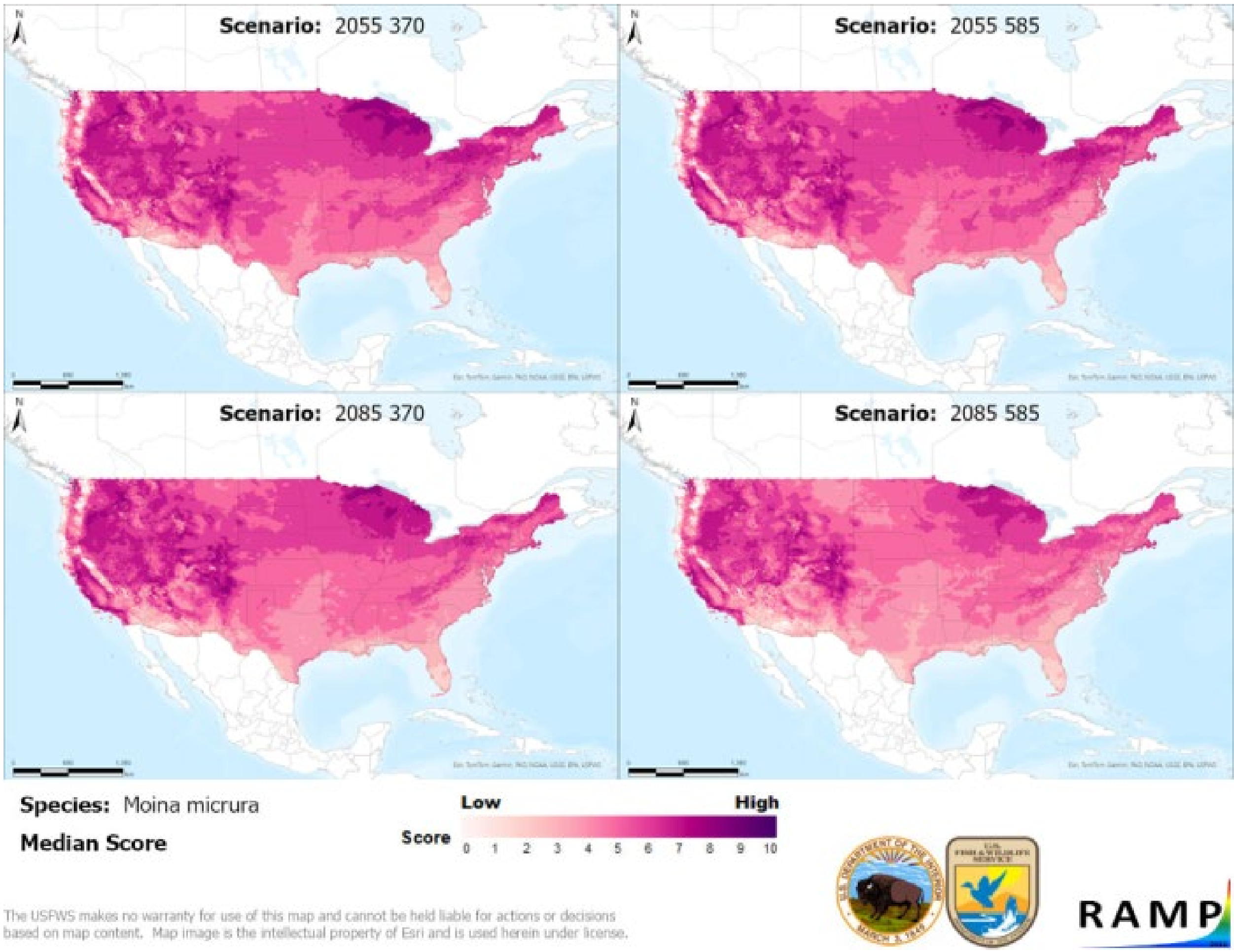

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Moina micrura* in the contiguous United States. Climate matching is based on source locations reported by Semenova and Tchougounov (2018), Elías-Gutiérrez et al (2019), and 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.

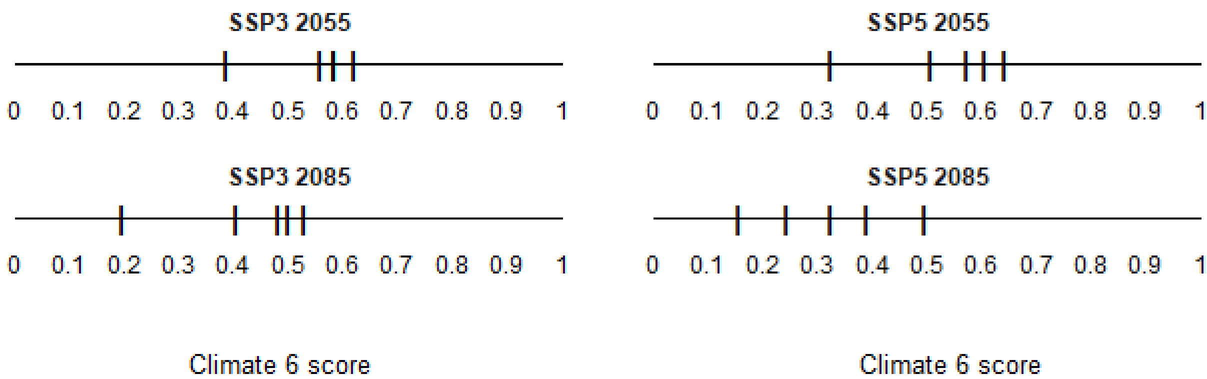

Figure A2. Comparison of projected future Climate 6 scores for *Moina micrura* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC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

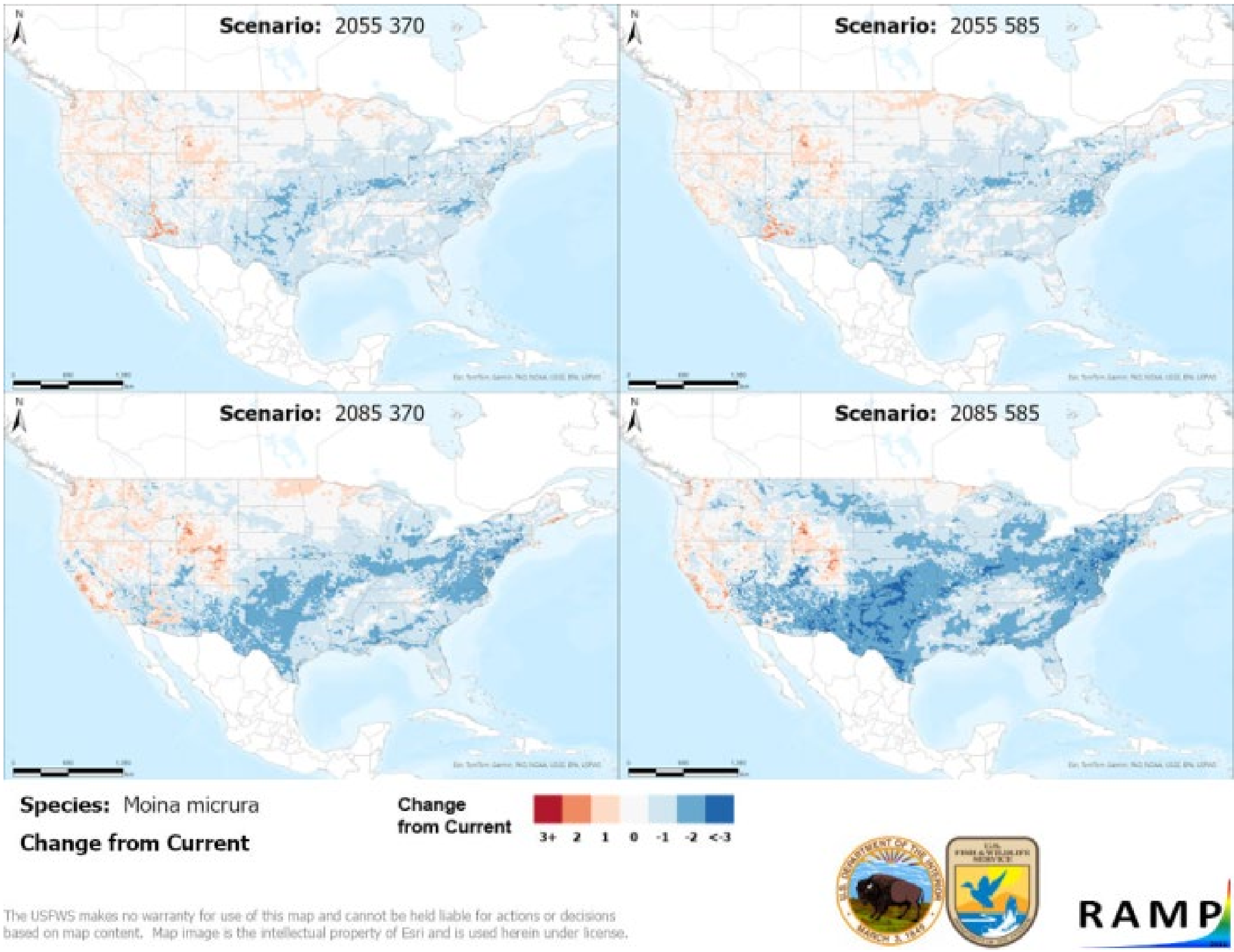

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Moina micrura* based on source locations reported by Semenova and Tchougounov (2018), Elías-Gutiérrez et al (2019), and 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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