Common Ball Waterflea (*Chydorus sphaericus*)
Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, February 2023
Revised, February 2023, June 2024
Web Version, December 2024

Organism Type: Crustacean
Overall Risk Assessment Category: Uncertain

Photo: Young R, Centre for Biodiversity Genomics. Licensed under CC BY 3.0. Available: http://bins.boldsystems.org/index.php/Public_RecordView?processid=CAISN916-13 (February 2023).

1 Native Range and Status in the United States

Native Range

Chydorus sphaericus sensu lato (s. l.) is a species complex with a cosmopolitan distribution (e.g., Belyaeva and Taylor 2009; Novichova 2016). Recently, work has been done to try to understand the phylogeny of the complex using both morphologic and genetic means (e.g., Frey 1980; Belyaeva and Taylor 2009). This has resulted in identification of many previously unknown species within that complex. The information presented below pertains to *Chydorus sphaericus* senso stricto (s. str.), under the newer understanding of species delineations. See Remarks, below, for more information.

From Belyaeva and Taylor (2009):

"*C. sphaericus* s. str. was restricted to sites in western Eurasia and Greenland."

Status in the United States

The *Chydorus sphaericus* s. l. species complex has a wide and uncertain global distribution, including records within the United States. More recent work has shown that *Chydorus sphaericus* s. str. may be geographically confined to western Eurasia and Greenland (Belyaeva and Taylor 2009). Records of *Chydorus sphaericus* s. l. in the United States are presented below, however, they were not used to select source points for the climate matching portion of this screening. There is no evidence to suggest *Chydorus sphaericus* s. str. is present in the United States. See Remarks, below, for further discussion of the species complex issue.

From Tash (1971):

"Tash and Armitage (1967) indicated that […] *Chydorus sphaericus* were ubiquitous in the various habitats sampled in the Cape Thompson area [Alaska] […]. In this study [of Noatak River area, Alaska] […] *Chydorus sphaericus* seemed ubiquitous to both pools and lakes."

From Siefert (1972):

"Yellow perch were taken from Park Lake, a relatively shallow eutrophic lake in Carlton County [Minnesota], and from Greenwood Lake, a deep oligotrophic lake in Cook County [Minnesota]. […] The cladoceran *Chydorus sphaericus* […] were found in relatively small numbers in the [digestive tracts of] larger fish [in Park Lake]."

From Campbell (1993):

"The most frequently occurring chydorid taxa in the Presque Isle [Lake Erie] collections were *C. sphaericus, Camptocercus rectirostris, Pleuroxus procurvus* and *Eurycercus longirostris*."

Grigorovich et al. (2003) report collection of *Chydorus sphaericus* in Lake Superior.

GBIF-US (2023) reports occurrences of *Chydorus sphaericus* in Alaska, Washington, California, Texas, Ohio, Rhode Island, Massachusetts, North Carolina, and South Carolina.

No records of *Chydorus sphaericus* 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

The *Chydorus sphaericus* s. l. species complex has a wide and uncertain global distribution. Recent work restricts *Chydorus sphaericus* s. str. to western Eurasia and Greenland, with no record of introduction to the United States. However, other species in the *Chydorus sphaericus* s. l. species complex are present within the United States.

Remarks

From Belyaeva and Taylor (2009):

"Like many other zooplankton taxa, *C. sphaericus* was previously regarded as a single cosmopolitan species, but detailed morphological studies revealed cryptic diversity and continental endemism. Even a new genus (*Ephemeroporus*) and a few *Chydorus* species were described from what was previously regarded as *C. sphaericus* (Frey, 1995). At least three potentially valid species are presently recognized within the complex: *C. sphaericus* s.str. (Palearctic distribution), *Chydorus biovatus* (northern Nearctic distribution), and *Chydorus brevilabris* (southern Nearctic distribution) (Frey, 1980, 1985). The taxonomic status of three recently described or redescribed taxa *Chydorus latus*, *Chydorus arcticus* and *Chydorus patagonicus* is unclear. […] Some morphotypes, which were previously regarded as separate species,— *Chydorus caelatus*, *Chydorus herrmanni*, *Chydorus mutilus* and *Chydorus rylovi*—are now synonymized with the *C. sphaericus* s.str. (Brancelj, 1996; Frey, 1980; Smirnov, 1996)."

"The *C. sphaericus* complex is a challenging group for taxonomists. Differences in morphology of parthenogenetic females between the species are subtle, while considerable within-species variation has been described (Belyaeva, 2003; Duigan and Murray, 1987; Flößner, 2000; Frey, 1980; Hann, 1975; Smirnov, 1971, 1996)."

WoRMS (2024a,b,c) considers *Chydorus biovatus* Frey, 1985 and *Chydorus brevilabris* Frey, 1980 to be valid species in addition to *Chydorus sphaericus*. Since the name *C. sphaericus* was used previously to refer to at least these three species, it is difficult to determine whether the information reported under the name *C. sphaericus* pertains to *C. sphaericus* s. str. This risk screening has been conducted with *Chydorus sphaericus* s. str. as the focal species but information contained in this report, particularly from older sources, may refer to the species complex.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2023):

Kingdom Animalia
  Subkingdom Bilateria
    Infrakingdom Protostomia
      Superphylum Ecdysozoa
        Phylum Arthropoda
          Subphylum Crustacea

Class Branchiopoda
Order Diplostraca
Suborder Cladocera
Infraorder Anomopoda
Family Chydoridae
Genus *Chydorus*
Species *Chydorus sphaericus* (O.F. Müller, 1776)

According to WoRMS (2024a), *Chydorus sphaericus* (O.F. Müller, 1776) is the current valid name for this species.

Size, Weight, and Age Range

From Basińska et al. (2014):

"*C. sphaericus* revealed a wide range in its body size in the present study (between 170 and 490 µm), which confirms the possible size range of this cladoceran between 300 and 490 µm as stated by several authors (e.g., Flössner, 1972; Amoros, 1984; Smirnov, 1996)."

Environment

From Basińska et al. (2014):

"*C. sphaericus* is described (e.g., Smirnov, 1996; Deneke, 2000) as cosmopolitan and very tolerant to pH (pH 3–10.2)."

"[…] this tolerant and well-adapted cladoceran species seemed to prefer small and eutrophic ponds, […]."

From Walseng (2018):

"*C. sphaericus* is a very tolerant species and is recorded from lakes varying in pH between 3.7 and 9.9 and conductivity between 0.4 and 957 mS/m (brackish water)."

Climate

No information on climatic requirements for *Chydorus sphaericus* s. str. was found.

Distribution Outside the United States

Native

Chydorus sphaericus sensu lato (s. l.) is a species complex with a cosmopolitan distribution (e.g., Belyaeva and Taylor 2009; Novichova 2016). Recently, work has been done to try to understand the phylogeny of the complex using both morphologic and genetic means (e.g., Frey 1980; Belyaeva and Taylor 2009). The information presented below pertains to *Chydorus sphaericus* senso stricto (s. str.), under the newer understanding of species delineations.

From Belyaeva and Taylor (2009):

"*C. sphaericus* s. str. was restricted to sites in western Eurasia and Greenland."

Introduced

From Sharma and Kotov (2014):

"Our genetic study of *C. sphaericus* from two large artificial water bodies in the Adelaide region of South Australia led us to conclude the taxon was introduced to Australia […]"

"The Australian haplotypes belong to *Chydorus sphaericus* s.str. and are definitively grouped with a small sub-clade Clade A of Belyaeva and Taylor (2009), containing haplotypes from Iceland and Greenland."

From Karbanov et al. (2022):

"The A1_3 subclade [of *Chydorus sphaericus* s. str.] (Moscow + South Korea) is a candidate for recent (anthropogenic) introduction within Eurasia. The exact direction of this invasion is unknown; this is a rare clade represented by a single population in each of two different, well-studied regions. We hypothesize that Korea was a donor of this invasion because the population in Moscow is found in the pond in the Botanical Garden of M.V. Lomonosov Moscow State University."

Means of Introduction Outside the United States

From Sharma and Kotov (2014):

"Our genetic study of *C. sphaericus* from two large artificial water bodies in the Adelaide region of South Australia led us to conclude the taxon was introduced to Australia from Europe by human activity, at least in the two studied water bodies. […] We speculate that it was related to a mass stocking of introduced species of fishes from Europe."

Short Description

From Walseng (2018):

"The morphology and size of *Chydorus sphaericus* varies a lot. However, populations of small individuals are most common. There is also a large amount of minor morphological variations between populations. To distinguish *C. sphaericus* from the close relative *C. ovalis* it has a less rounded outline of the posterior ventral corner. Postabdomen has 7–10 relatively small denticles with little variance in size. The colour varies with different variants of brown, but also with elements of green."

Biology

From Choi et al. (2020):

"*Chydorus sphaericus* (OF Müller) […] is highly sensitive to environmental changes such as water pollution, and continuously uses phytoplankton as a food source; […]. *Chydorus sphaericus* is often attributed to littoral areas where macrophytes are abundant (Ali et al. 2007; Choi et al. 2015), therefore, this species is probably better adapted to detrital food sources compared to large-bodied pelagic cladocerans (e.g., representatives of the *Bosmina* genus; Vijverberg and Boersma 1997). *Chydorus sphaericus* is very tolerant, not only to chemical changes such as dissolved oxygen, pH, and water temperature, but also to trophic level changes (Rybak and Błędzki 2010)."

From Vijverberg and Boersma (1997):

"The small-bodied *C. sphaericus* often appears as a common plankter in eutrophic waters where extensive Cyanobacteria blooms are prevalent (Gannon, 1972). […] *C. sphaericus* […] has two alternative ways of life. It can be found in the littoral zones of lakes among macrophyte vegetation and on bottom substrates that are rich in organic material (Goulden, 1971; Keen, 1973; Daggett & Davis, 1974; Whiteside, 1974; Williams, 1982), as well as in the water column in the open water zone of eutrophic lakes and ponds (Cummins et al., 1969; Franken & Franken, 1978; Pedros-Alio & Brock, 1985; Rognerud & Kjellberg, 1990; Vijverberg et al., 1990; Ewald, 1991)."

Human Uses

No information was found on human uses of *Chydorus sphaericus*.

Diseases

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

No information was found on diseases associated with *Chydorus sphaericus*.

Threat to Humans

No information was found on threats to humans from *Chydorus sphaericus*.

3 Impacts of Introductions

The following is a theorized, but not documented, impact of *Chydorus sphaericus* introduction.

From Karbanov et al. (2022):

"Our results indicate that cases of intercontinental dispersion of *C. sphaericus* are more numerous than previously believed, and these cases are recent or relatively recent. The consequences of such invasion for ecosystems are unknown and need to be studied in detail:

there is a chance that *C. sphaericus* replaced some native taxa (as it is very common in the temperate portion of Australia now)."

No U.S. State or federal regulations were found for this species.

4 History of Invasiveness

The History of Invasiveness for *Chydorus sphaericus* is classified as Data Deficient. Introductions of this species have been documented in the wild in South Australia and in a botanical garden in Moscow. The species has also been sampled in South Korea. The pathway of introduction is not clear but the literature indicated that at least one possibility was that it was introduced with an introduction of fish. No documented impacts from those introductions were found. One source indicated that it was possible *C. sphaericus* may have displaced native species but there was no evidence provided to support the claim.

5 Global Distribution

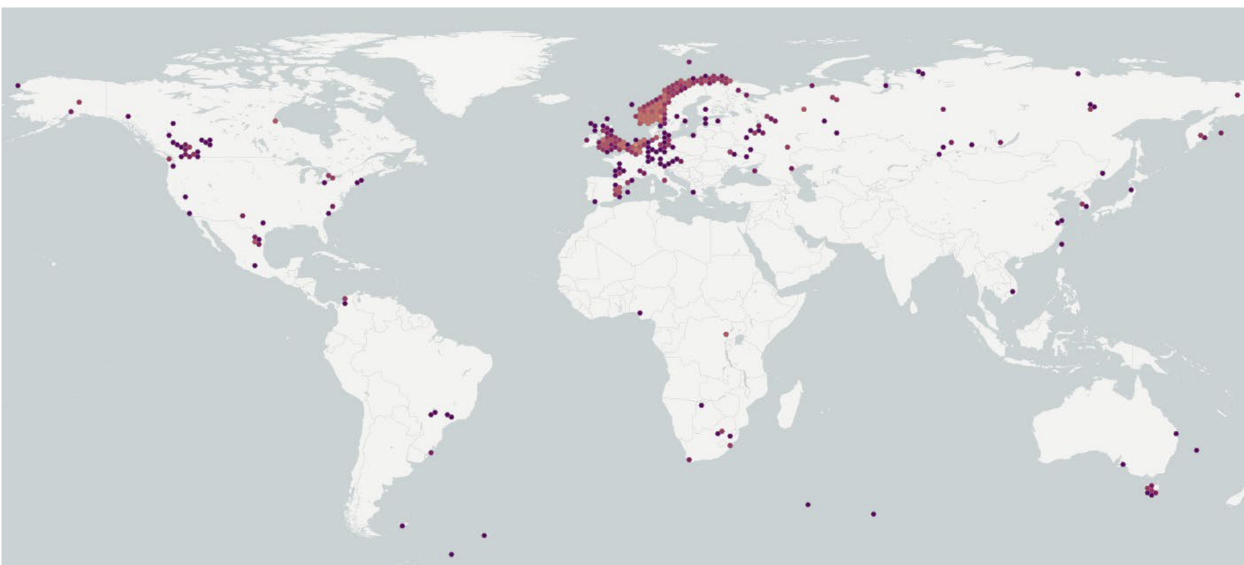

Figure 1. Reported global distribution of *Chydorus sphaericus*. Map from GBIF Secretariat (2023). This map represents records of the *Chydorus sphaericus* species complex. Only those locations corresponding to the current understanding of the distribution of *Chydorus sphaericus* s. str. were used for the climate matching (western Eurasia and Greenland, Belyaeva and Taylor 2009; southern Australia, Sharma and Kotov 2014).

Additional locations in Europe and Russia were given in Belyaeva and Taylor (2009), Basinska et al. (2014), Kotov et al. (2016), Novichkova (2016), and Karbanov et al. (2022).

6 Distribution Within the United States

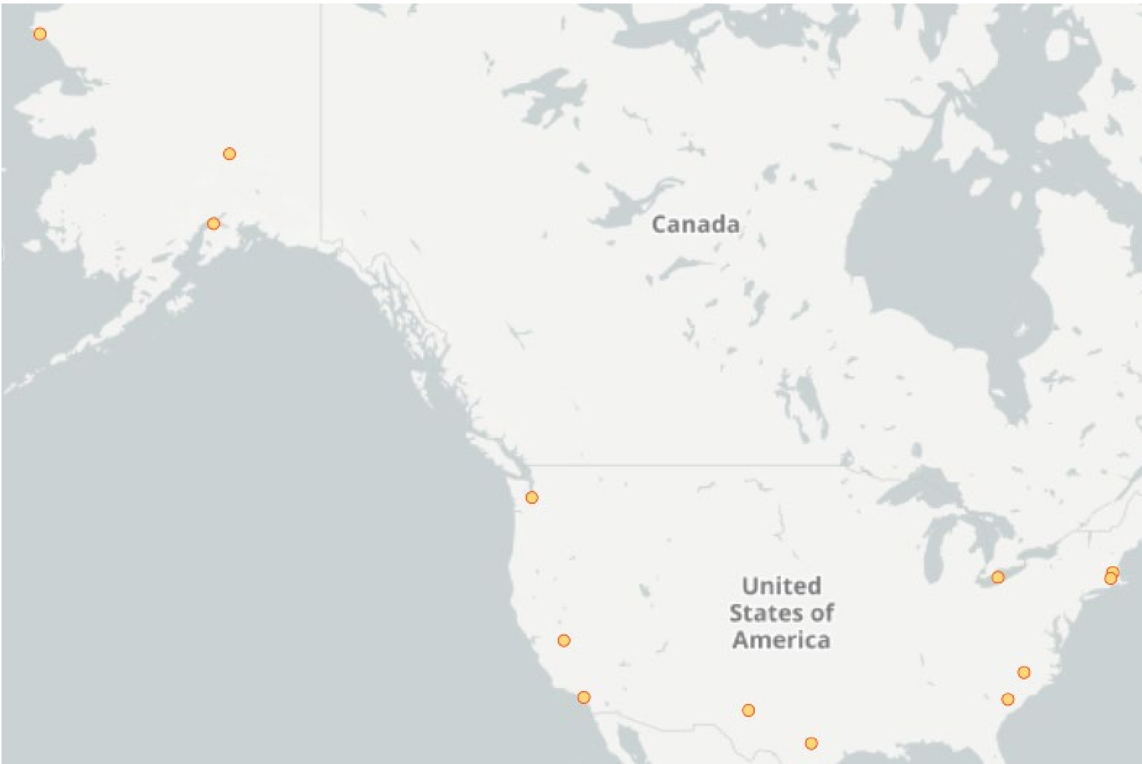

Figure 2. Reported distribution of *Chydorus sphaericus* species complex in the United States. Map from GBIF-US (2023). Observations are reported from Alaska, Washington, California, Texas, Ohio, Rhode Island, Massachusetts, North Carolina, and South Carolina. The observations within the United States are currently understood to belong to other species within the *Chydorus sphaericus* complex and not *Chydorus sphaericus* s. str. and were not used to select source points in the climate match.

7 Climate Matching

Summary of Climate Matching Analysis

Most of the contiguous United States had a medium climate match for *Chydorus sphaericus*. Areas of high match were found in the northern Great Lakes and Northern Plains, as well as in small areas in the Western Mountains. Areas of low match were found in the Gulf Coast, along the northern Pacific Coast and along the Cascade-Sierra Range. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.895, 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 *Chydorus sphaericus* (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.

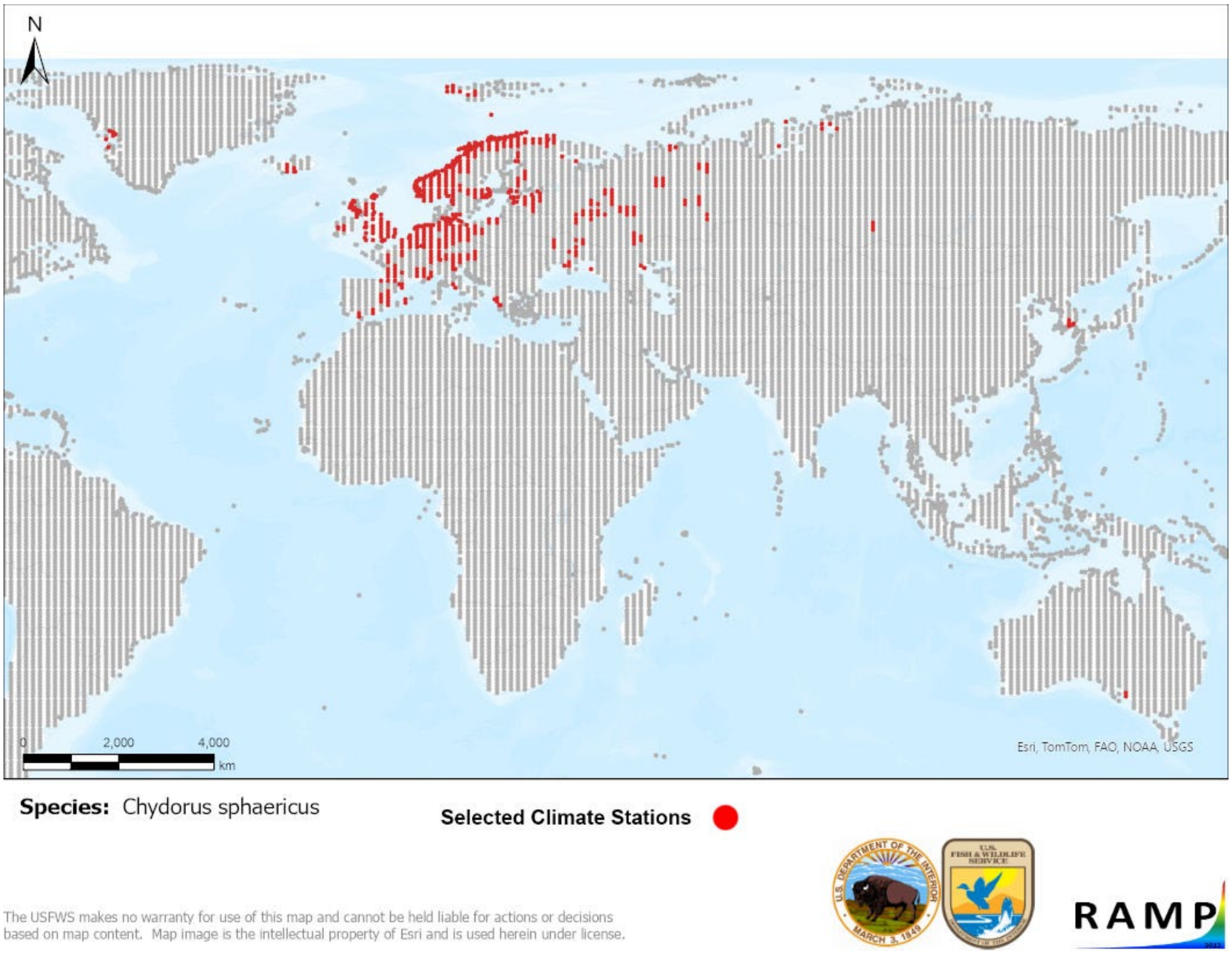

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations selected as source locations (red; the Americas, Europe, Africa, Asia, Australia) and non-source locations (gray) for *Chydorus sphaericus* climate matching. Source locations from Belyaeva and Taylor (2009), Basinska et al. (2014), Kotov et al. (2016), Novichkova (2016), Karbanov et al. (2022), 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.

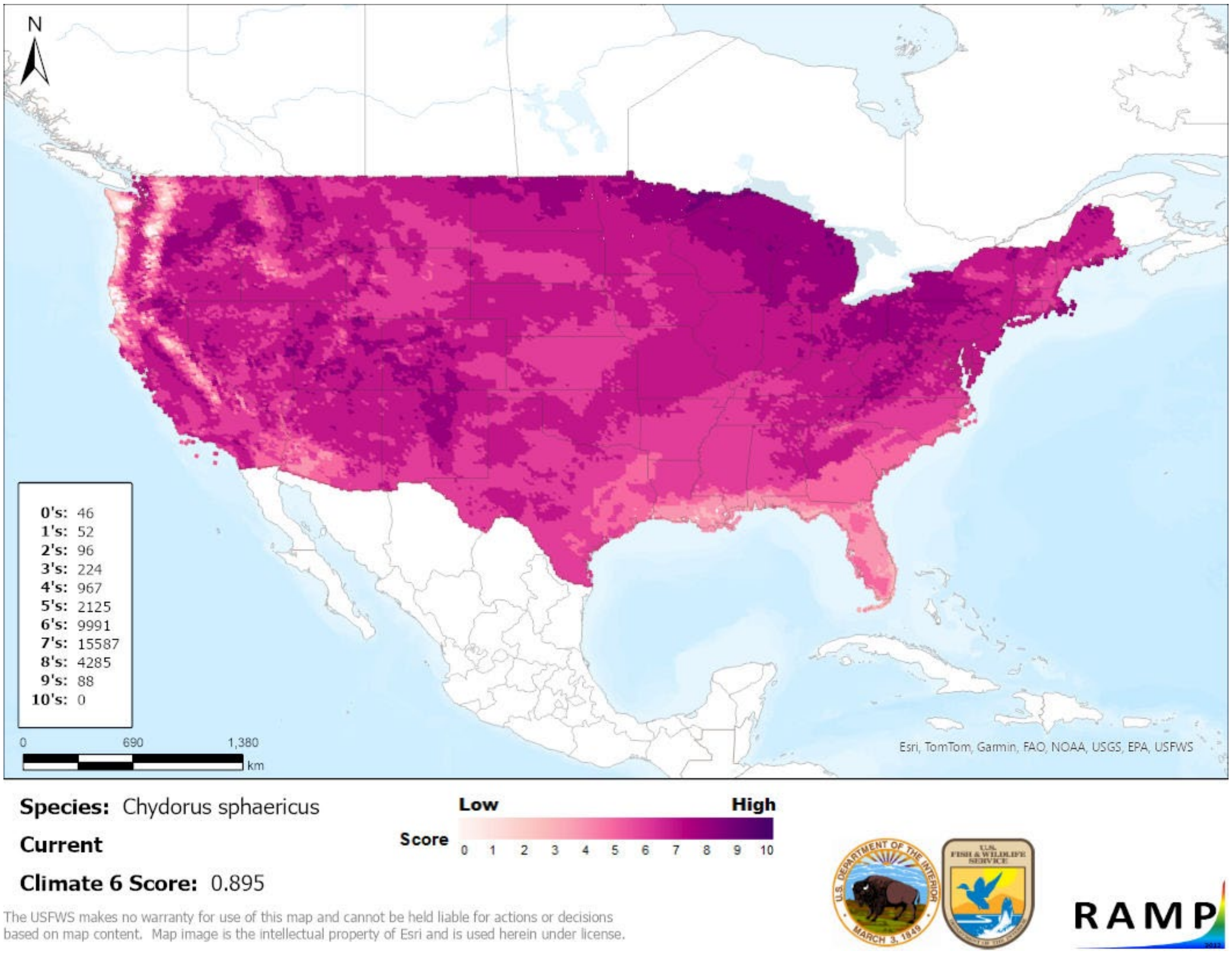

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Chydorus sphaericus* in the contiguous United States based on source locations reported by Belyaeva and Taylor (2009), Basinska et al. (2014), Kotov et al. (2016), Novichkova (2016), Karbanov et al. (2022), and GBIF Secretariat (2023). 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 *Chydorus sphaericus* is classified as Low. There is information about the biology, distribution, and habitat requirements of this species. *C. sphaericus* s. l. represents a species complex with newer work trying to define *C. sphaericus* s. str. and related species that were included in the complex. This history of taxonomic uncertainty makes it difficult to determine when available information pertains to *C. sphaericus* s. str. rather than another species from the complex. Records of *C. sphaericus* s. str. introductions were found but information regarding impacts was lacking.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Chydorus sphaericus s. str. is a cladoceran species that is native to western Eurasia and Greenland. *C. sphaericus* s. str. has been introduced to South Australia, perhaps through fish stocking programs, and in South Korea. No impacts of these introductions have been reported. The History of Invasiveness for *C. sphaericus* s. str. is classified as Data Deficient due to uncertainties in the species' range and the lack of documented impacts of its introduction. The climate matching analysis for the contiguous United States indicates establishment concern for this species. The climate match was mostly medium across the contiguous United States with areas of high match in the northern Great Lakes, Northern Plains, and Western Mountains. The Certainty of Assessment for this ERSS is classified as Low because of the lack of information regarding impacts of the introductions and the difficulty in interpreting available information and the history of taxonomic redescription. The Overall Risk Assessment Category for *C. sphaericus* 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: *C. sphaericus* s. l. is a species complex, *C. sphaericus* s. str. has been morphologically and genetically redefined recently.**
- **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 Belyaeva and Taylor (2009), Basinska et al. (2014), Kotov et al. (2016), Novichkova (2016), Karbanov et al. (2022), and GBIF Secretariat (2023).

Under the future climate scenarios (figure A1), no regions of the contiguous United States were projected to have a high climate match for *Chydorus sphaericus*. Areas of low climate match were projected to occur in the Southern Florida region and generally along the southeastern coastlines. Most scenarios and timesteps also had small areas of low match along the Pacific Northwest coast and in the Sierra and Cascade Mountains. In both scenarios in 2085, the area of low match in the Southeast expanded northward into the Southern Plains. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.284 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.799 (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 (0.895, 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, small areas within the Colorado Plateau and Northern Pacific Coast regions 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, Mid-Atlantic, Southeast, Southern Florida, and Southern Plains regions saw a large decrease in the climate match relative to current conditions. Additionally, areas within California, the Colorado Plateau, Great Basin, Great Lakes, Gulf Coast, Northeast, Northern Pacific Coast, Northern Plains, Southern Atlantic Coast, 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).

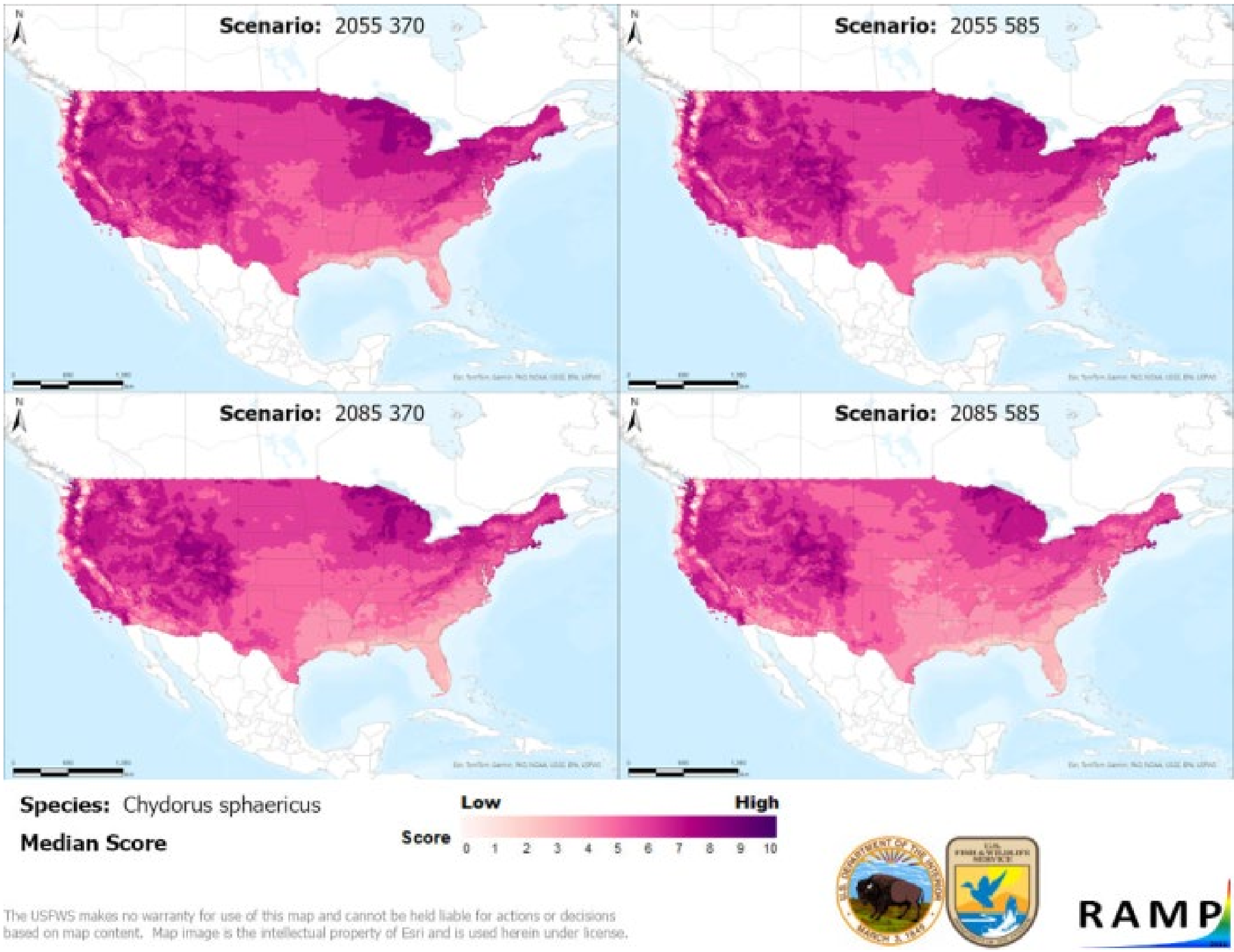

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Chydorus sphaericus* in the contiguous United States. Climate matching is based on source locations reported by Belyaeva and Taylor (2009), Basinska et al. (2014), Kotov et al. (2016), Novichkova (2016), Karbanov et al. (2022), 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.

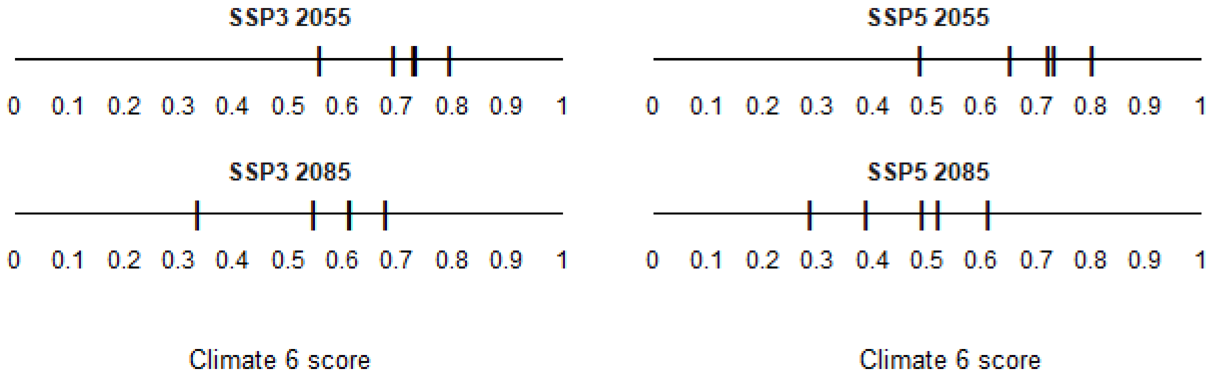

Figure A2. Comparison of projected future Climate 6 scores for Chydorus sphaericus in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018;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

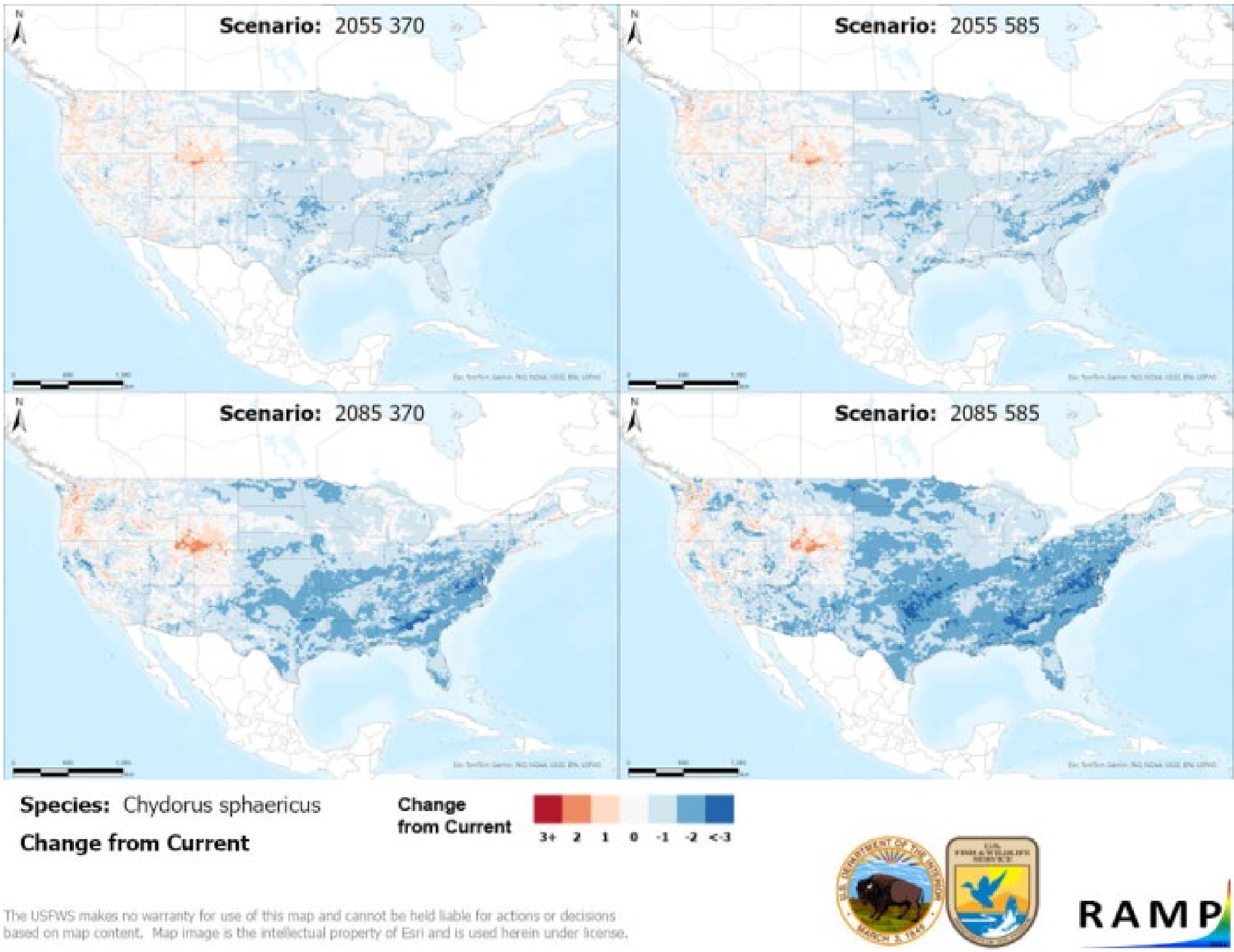

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Chydorus sphaericus* based on source locations reported by Belyaeva and Taylor (2009), Basinska et al. (2014), Kotov et al. (2016), Novichkova (2016), Karbanov et al. (2022), 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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