Caspian Mud Shrimp (*Chelicorophium curvispinum*)
Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, December 2022
Revised, June 2023
Web Version, 3/7/2025

Organism Type: Crustacean
Overall Risk Assessment Category: High

Photo: Naturalis - Zoology and Geology catalogues. Licensed under CC0 1.0 Universal Public Domain Dedication. Available: https://commons.wikimedia.org/wiki/File:Chelicorophium_curvispinum_007756447-RMNH.5012316_1.jpg (December 2022).

1 Native Range and Status in the United States

Native Range

From Baker et al. (2022):

"**Native Range:** *Chelicorophium curvispinum* originated in the Ponto-Caspian basin, and may have colonized the adjacent Black-Azov basin when they were connected in prehistory (Mordukhai-Boltovskoi 1964). It is native to large river systems discharging into the Black and Caspian Seas, including the lower reaches of the Volga, Dnieper, Dniester, and Danube (de Kluijver and Ingalsuo 1999; Bij de Vaate et al. 2002)."

Status in the United States

No records of *Chelicorophium curvispinum* in the wild or in trade in the United States were found.

Regulations

No species-specific regulations on possession or trade were found within the United States; however, there are water ballast regulations in place to prevent introductions of aquatic species into the Great Lakes and Hudson River.

From Baker et al. (2022):

"Ballast water regulations applicable to this species are currently in place to prevent the introduction of nonindigenous species to the Great Lakes via shipping. See Title 33: Code of Federal Regulations, Part 151, Subparts C and D (33 CFR 151 C) for the most recent federal ballast water regulations applying to the Great Lakes and Hudson River."

Means of Introductions within the United States

No records of *Chelicorophium curvispinum* in the wild in the United States were found.

Remarks

From Baker et al. (2022):

"*Chelicorophium curvispinum* often occurs in conjunction with *C. sowinskyi* (Ricciardi and Rasmussen 1998; [Borza et al. 2018]), which has a similar appearance. This can potentially make it difficult to distinguish between the two (Jazdzewski 1980; Jazdzewski and Konopacka 1996)."

From Mastitsky (2009):

"The most likely region to be invaded by this amphipod in the near future is North America (Ricciardi and Rasmussen, 1998)."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Horton et al. (2023):

Animalia (Kingdom) > Arthropoda (Phylum) > Crustacea (Subphylum) > Multicrustacea (Superclass) > Malacostraca (Class) > Eumalacostraca (Subclass) > Peracarida (Superorder) > Amphipoda (Order) > Senticaudata (Suborder) > Corophiida (Infraorder) > Corophiidira (Parvorder) > Corophioidea (Superfamily) > Corophiidae (Family) > Corophiinae (Subfamily) > Corophiini (Tribe) > *Chelicorophium* (Genus) > *Chelicorophium curvispinum* (Species)

According to Horton et al. (2023), *Chelicorophium curvispinum* is the current valid name for this species. This species was originally named *Corophium curvispinum* prior to being placed in the genus *Chelicorophium*.

Size, Weight, and Age Range

From Baker et al. (2022):

"Largest adults up to 8 mm long; overwintering population 2.4–4.5 mm; juveniles < 1.8 mm (van den Brink et al. 1993; Rajagopal et al. 1998)."

"The life span of *C. curvispinum* lasts no longer than 8 months (van der Velde et al. 2000)."

Environment

From Baker et al. (2022):

"*Chelicorophium curvispinum* is found in salt, brackish, and freshwater (de Kluijver and Ingalsuo 1999). It is originally a brackish water species occurring in salinities of less than 6 ppt (Romanova 1975), with the ability to tolerate very low salinities (Taylor and Harris 1986; Bayliss and Harris 1988; Harris and Bayliss 1990; van den Brink et al. 1993). In Black Sea lagoons and estuaries, its distribution follows the 1.5 ppt isohaline (Bortkevitch 1988). This species is most successful in waters with relatively high ionic content and requires a minimum sodium ion (Na+) concentration of 0.5 mM (Harris and Aladin 1997). The lethal minimum oxygen concentration for *C. curvispinum* is 0.300 mg O2/L (Dedyu 1980). *Chelicorophium curvispinum* is able to tolerate [water] temperatures from 7.0–31.8°C (Jazdzewski and Konopacka 1990). Populations of this amphipod remain unchanged or gain biomass under conditions of moderate eutrophication (Kotta et al. 2012). It is intolerant of heavy organic pollution levels (Jazdzewski 1980; Harris and Muskó 1999)."

Climate

From Palomares and Pauly (2023):

"Temperate"

Distribution Outside the United States

Native

From Baker et al. (2022):

"**Native Range:** *Chelicorophium curvispinum* originated in the Ponto-Caspian basin, and may have colonized the adjacent Black-Azov basin when they were connected in prehistory (Mordukhai-Boltovskoi 1964). It is native to large river systems discharging into the Black and Caspian Seas, including the lower reaches of the Volga, Dnieper, Dniester, and Danube (de Kluijver and Ingalsuo 1999; Bij de Vaate et al. 2002)."

Introduced

From Baker et al. (2022):

"**Nonindigenous occurrences:** *Chelicorophium curvispinum* is widespread in Europe and has invaded the upper reaches of the Volga, Dnieper, Dniester, and Danube Rivers (Bij de Vaate et al. 2002; Paunovic et al. 2015) and the North and Baltic Seas (Ojaveer and Kotta 2015; Casties et al. 2016). It is reported in the Sava River in Croatia (Žganec et al. 2009), throughout Great Britain (Moon 1970; Gallardo and Albridge 2015), the Netherlands (van den Brink et al. 1989), France (Bachman et al. 1997), and Sweden (Leppänen et al. 2017)."

From Mastitsky (2009):

"The earliest report of this species was in the Spree-Havel system near Berlin [Germany] in 1912; in 1920s it also was found in Poland where, probably, it had been established for some time (Jazdzewski and Konopacka, 2002; [bij de] Vaate et al., 2002). […] The most westerly current locality of the species is in Ireland where it was found in 2001 (Lucy et al., 2004). […] United Kingdom (Crawford, 1935), a country colonised by the species in the early 1930s […] Nowadays, *C. curvispinum* is widely distributed in Europe […] (Ricciari and Rasmussen, 1998). In addition to the distribution table records for Belarus [Pripyat River near Mozyr], *C. curvispinum* is also found in the Belarusian section of the Neman River (S Mastitsky, Belarusian State University, Russia, personal communication, 2009)."

"The first records of *C. curvospinum* in the middle Danube River (Hungary) were made as early as the beginning of the twentieth century (Muskó, 1994; Žganec et al., 2009)."

In addition to locations already mentioned, Mastitsky (2009) reports *Chelicorophium curvispinum* as introduced, present, and invasive in Belgium, Bosnia and Herzegovina, Estonia, northern Russia, Serbia, and Ukraine; and as introduced and present in Austria, Lithuania, and Switzerland. Other countries with reported introductions are Czechia (Pergl et al. 2020), Latvia (Balalaikins and Pagad 2020), Slovakia (Pagad 2022), and Luxembourg (Ries and Pagad 2020).

Means of Introduction Outside the United States

From Mastitsky (2009):

"Thus, there is no doubt that initially *C. curvispinum* colonized Europe through the Dnieper-Bug Canal. The second wave of its invasion in Europe occurred after re-opening of the Maine-Danube canal in 1992 ([bij de] Vaate et al., 2002; Jazdzewski and Konopacka, 2002; Karatayev et al., 2008). […] It is likely that *C. curvispinum* was transferred to Ireland with ships coming from the United Kingdom (Crawford, 1935), a country colonised by the species in the early 1930s due to ships that were sailing from northern Germany ports ([bij de] Vaate et al., 2002). Introduction of the species into Ireland from continental Europe is also possible."

"Its initial spread into the Baltic Sea and North Sea drainage systems likely occurred in the second half of the nineteenth century through the canals connecting the Dnieper, Vistula, Oder and Elbe basins ([bij de] Vaate et al., 2002; Jazdzewski and Konopacka, 2002; Karatayev et al., 2008). […] Through the Oginskiy Canal that linked the Dnieper River (Black Sea basin) with the Neman River (Baltic Sea basin), *C. curvispinum* dispersed to Lithuania, […]"

"Natural dispersal of *C. curvispinum* occurs by active migrations ([bij de] Vaate et al., 2002; Jazdzewski and Konopacka, 2002; Josens et al., 2005). The speed of active upstream range extension of *C. curvispinum* [sic] may reach up to 15 km/year (Josens et al., 2005)."

Short Description

From Baker et al. (2022):

"*Chelicorophium curvispinum* has a cylindrical, dorso-ventrally compressed, curled, grey-yellow body with unfused urosomal segments (with spines on uropods 1 and 2) and a small triangular rostrum. It has two pairs of antennae, the first pair slender and the second pair large and thick. The first segment of the first antennae has 3 or 4 spines along the ventral margin and 2 or 3 spines on the inner margin; antennae 1 in females is sparsely setose (hairy). The second antennae are moderately setose, with long hairs; distinguishing features of this species are that the fourth segment of these antennae bears a large curved spur and one or two smaller spurs on its ventrolateral tip, and the fifth segment bears a proximal triangular process on its ventral surface. Females and males differ in the presence of spines and spurs on the inner surface of the second antennae. This species has an evenly convex palm on its most anterior appendage (gnathopod 1), while teeth are present along the inner margin of the last segment (dactylus) of the second gnathopod (de Kluijver and Ingalsuo 1999)."

From Mastitsky (2009):

"As with other gammarids, *C. curvispinum* has a typical laterally compressed, arched, and grey-yellow body of up to 7 mm in length (Van den Brink et al., 1993). Prominent morphological features of this species include:

- very large antennae II, with one long, well developed, and 1-2 smaller spurs on the fourth segment
- 8-10 spines and 1-2 setae on the outer margin of the pedunculus of uropod I, and 4-6 spines on its inner margin

- a sharp triangular rostrum on the head (Eggers and Martens, 2001).

Juvenile individuals resemble adults, but are much smaller in size. […] Carausu (1943), Jazdzewski and Konopacka (1996), […] Konopacka (2004)."

Biology

From Baker et al. (2022):

"*Chelicorophium curvispinum* may aggregate on stones, wooden structures, dead and living shells (including those of Dressenid mussels), sandy sediments, clay sediment, and submerged aquatic vegetation (den Hartog et al. 1992; van den Brink et al. 1993; Czarnecka et al. 2014; Kurina and Seleznev 2019). It can also be found in association with the green alga Cladophora (Kotta et al. 2006). In European waters, *C. curvispinum* density has been extremely variable, with some studies observing 100,000–750,000 individuals/m2 (highest at 2–3 m depths) (den Hartog et al. 1992; van den Brink et al. 1993), and others observing much lower densities (13–50,000/m2) (Harris and Bayliss 1990; Schöll 1990; Kurina 2017; Barabashova et al. 2021). Average densities in more recently invaded territory (Gulf of Finland) were reported to be between 125–1425 individuals/m2 (Kotta et al. 2006)."

"*Chelicorophium curvispinum* is a tube-dwelling amphipod; it collects minerals and organic particles from the water column and secretes a 1–4 cm thick layer of muddy tubes on colonization surfaces (Paffen et al. 1994). Mud used to build these tubes has ranged from 61 to 609 grams dry weight/m2 stone surface, smothering previously established organisms (van der Velde et al. 1994). Oxygen consumption, and therefore metabolism, of individuals within tubes (39 µmol/g/h) is approximately twice as high as that by free swimming individuals (22 µmol/g/h) outside of tubes (Muskó et al. 1998; Harris and Muskó 1999)."

"This amphipod is a suspension feeder, filtering phytoplankton, especially diatoms, and other suspended matter from the water (van den Brink et al. 1993). This feeding strategy results in population densities being highest where current velocities are strongest (e.g., 1–1.23 m/s), allowing *C. curvispinum* to most efficiently filter the largest quantity of food and obtain the greatest amount of oxygen for metabolism (van den Brink et al. 1993; van der Velde et al. 2000). This species is an important food source for a variety of fish species, including sculpin, eels, perch, ruffe, and pike perch (van den Brink et al. 1993). Other predators include birds, crayfish, and other predatory macroinvertebrates (Biro 1974; Kelleher et al. 1998, 1999; Marguillier et al. 1998)."

"Reproduction in *C. curvispinum* occurs from May to October in the Black Sea (Bortkevitch 1988) and from April to September in the Baltic (van den Brink et al. 1993). These are the warmest periods of the year (water temperature 12–20°C). Sex ratios exhibit a female bias—females outnumber males at all times of year and at many times more than double the male population (van den Brink et al. 1993). Large females (5.00–6.30 mm) become ovigerous a few weeks before smaller individuals (3.80–4.75 mm). Three generations of offspring are produced each year, following an overwintering period—the first in April to May, the second in June to July, and the third in September to October (den Hartog et al. 1992). The progeny of the first generation of summer animals (generation 2), along with the late autumn brood (generation 3), make up the next overwintering generation (Rajagopal et al. 1998)."

"Brooded egg sizes range from 360 x 280 µm (Stage I) to 520 x 440 µm (Stage IV). The number of eggs carried by females and total female body length are correlated, ranging in the Rhine from 3 to 34 eggs (mean = 12) (van den Brink et al. 1993) and in Lake Balaton from 1 to 25 (mean = 6) (Muskó 1990). These differences in clutch size are thought to be due to differences in food availability. Both average clutch size (Rajagopal et al. 1998) and growth rate (Rajagopal et al. 1997) have been positively correlated with the availability of chlorophyll a, which leads to increased planktonic development and greater food availability. Embryonic development lasts about two weeks and larval development takes approximately four weeks. Most rapid growth rates occur from May to August, when water temperatures range from 15–20°C (van den Brink et al. 1993)."

Human Uses

No information was found on human uses of *Chelicorophium curvispinum*.

Diseases

No information was found associating *Chelicorophium curvispinum* with any diseases listed by the World Organisation for Animal Health (2022).

From Mastitsky (2009):

"In its introduced range, *C. curvispinum* has been documented to host a microsporidian parasite (Prokop et al., 2006) and an acanthocephalan parasite (Van Riel et al., 2003). The latter acanthocephalan species, *Pomphorhynchus* sp., has been suspected to be responsible for the recent decline of *C. curvispinum* in two Dutch rivers (Van Riel et al., 2003)."

Poelen et al. (2014) list *Amphilina foliacea* as a parasite of *Chelicorophium curvispinum*.

Threat to Humans

No information was found on threats to humans from *Chelicorophium curvispinum*.

3 Impacts of Introductions

From van der Velde et al. (1998):

"Monitoring data on artificial substrates over the years have shown that the macroinvertebrate species richness was reduced at the highest densities of *C. curvispinum* […]. According to Kinzelbach (1997), *C. curvispinum* also outcompetes the freshwater isopod *Asellus aquaticus* and several species of chironomid larvae. As a result, the numbers of their predators, like leeches, have decreased."

From Mastitsky (2009):

"*C. curvispinum* is also known as an ecological engineer due to its ability to build mud tubes on hard substrates. For example, in 1989, the population density of this amphipod in the middle and lower sections of the River Rhine was so high that its silty tubes covered all available hard surfaces. In addition, these surfaces became totally covered by fine matter removed by the animals from the water column as a result of their filtering activity. This chain of events affected other epilithic species, which became devoid of a substrate to colonize. The zebra mussel, *Dreissena polymorpha*, [also introduced in this location] was one of the most affected species as the mud tubes of *C. curvispinum* impaired larval settlement of this mollusc (Van den Brink et al., 1991; Van der Velde et al., 1998; Haas et al., 2002). Nevertheless, some epifaunal species may benefit from the presence of the mud tubes of *C. curvispinum*. In the Dnieper River reservoirs, the inter-tube spaces are particularly suitable for the development of communities composed of gammarids (including invasive *Dikerogammarus haemobaphes* and *Dikerogammarus villosus*), oligochaetes, leeches, molluscs, and chironomids (Lubyanov, 1967)."

No species-specific regulations on possession or trade were found within the United States; however, there are water ballast regulations in place to prevent introductions of aquatic species into the Great Lakes and Hudson River.

4 History of Invasiveness

Chelicorophium curvispinum has established nonnative populations through much of Europe. *C. curvispinum* has been found to outcompete native macroinvertebrate species and reduce macroinvertebrate species richness. This has led to changes in native species abundance at other trophic levels. It has also been documented to alter the substrate and therefore the development of the community of organisms using the substrate. The history of invasiveness for *C. curvispinum* is classified as High due to the impacts on native macroinvertebrate species.

5 Global Distribution

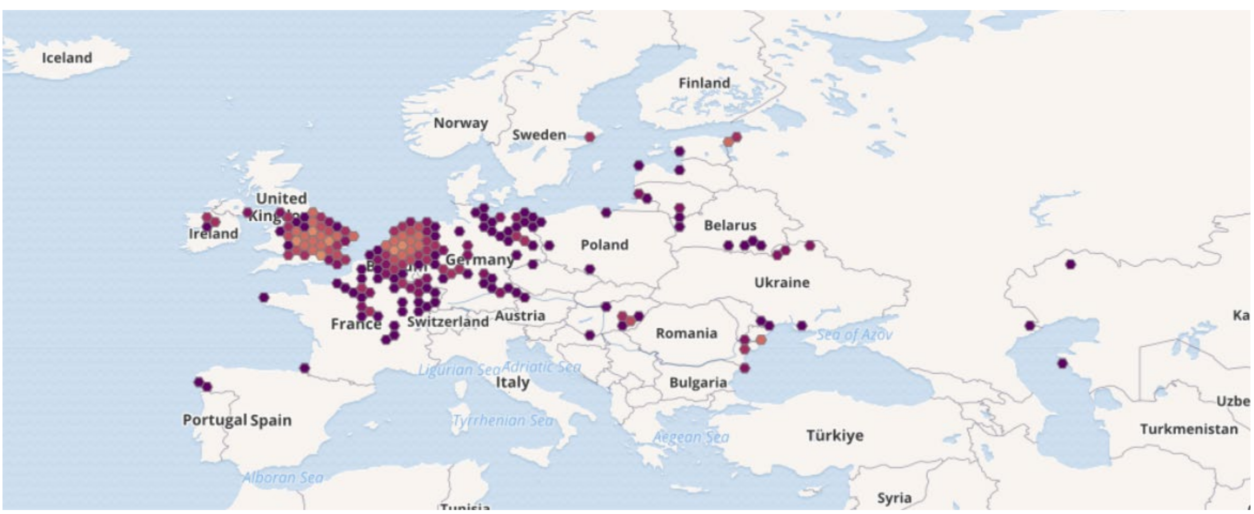

Figure 1. Reported global distribution of *Chelicorophium curvispinum*. Map from GBIF Secretariat (2022). Observations are reported from Eurasia, spanning from Ireland to southern Russia. The points in Spain and the western coast of France were not used to select source points for the climate matching analysis as they do not represent established populations.

Mastitsky (2009) gave specific locations of known established populations in Belarus, Croatia, Estonia, Ireland, and Ukraine.

Georeferenced observations representing populations across much of the described native range of the "large river systems discharging into the Black and Caspian Seas" (Baker et al. 2022) were not found.

6 Distribution Within the United States

No records of *Chelicorophium curvispinum* in the wild in the United States were found.

7 Climate Matching

Summary of Climate Matching Analysis

Chelicorophium curvispinum had a medium climate match across much of the contiguous United States. Areas of high match occurred around the Great Lakes, Appalachian Mountain range, throughout the Midwest, as well as scattered areas throughout the Great Basin and Colorado Plateau. Areas of low match were found along the West Coast, including the Sierra-Nevada Range, and along the Gulf Coast and Florida. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.772, indicating that Yes, there is establishment concern for this species. The Climate 6 score is calculated as: (count of target points with scores $\geq$ 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 *Chelicorophium curvispinum* (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.

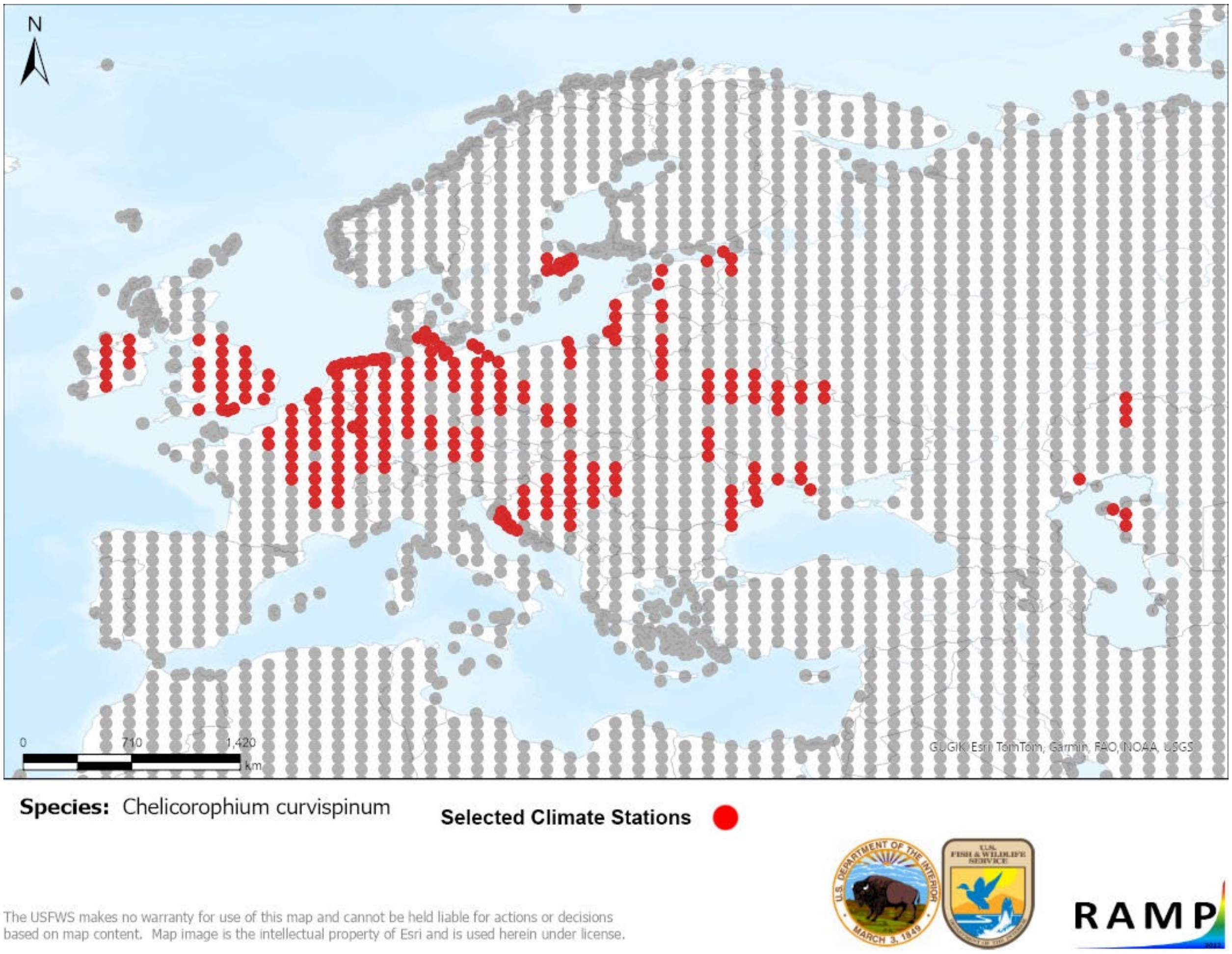

Figure 2. RAMP (Sanders et al. 2023) source map showing weather stations in Eurasia selected as source locations (red; Russia, Kazakhstan, Ukraine, Estonia, Belarus, Romania, Poland, Germany, Czechia, Denmark, Sweden, Netherlands, Belgium, France, Switzerland, United Kingdom, Ireland, Croatia, Bosnia Herzegovina, Hungary, Lithuania, Austria) and non-source locations (gray) for *Chelicorophium curvispinum* climate matching. Source locations from Mastitsky (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.

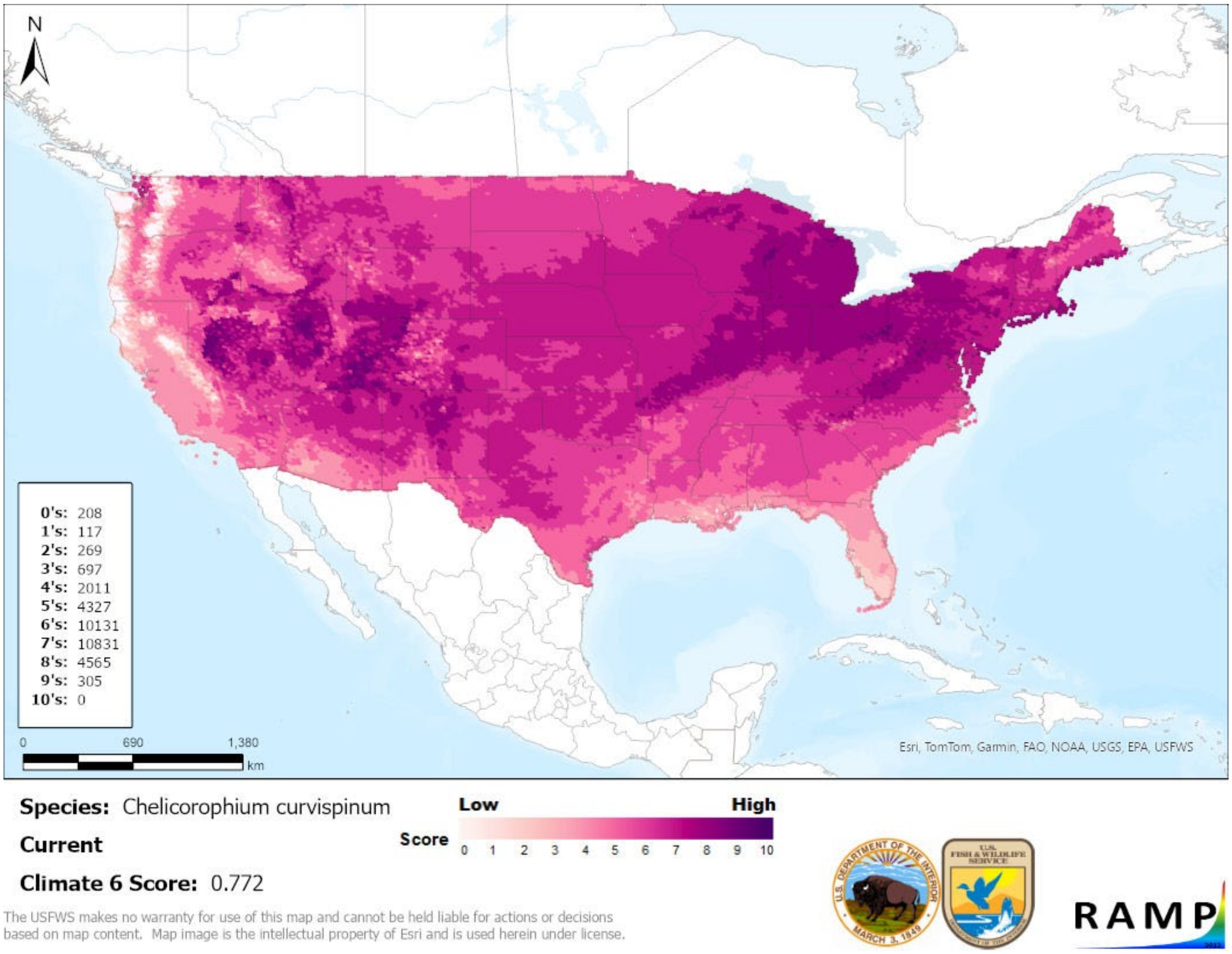

Figure 3. Map of RAMP (Sanders et al. 2023) climate matches for *Chelicorophium curvispinum* in the contiguous United States based on source locations reported by GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Chelicorophium curvispinum* is classified as High. Records of introduction and establishment were available. Information on impacts from introduced established populations was found; however, much of that information focused on impacts to another introduced species. The distribution of the species is well represented in the source points of the climate match except for some areas potentially within the native range of the species. However, it is not thought that this is enough to impact the result of the climate matching analysis that *C. curvispinum* is a concern for establishment in the contiguous United States.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Chelicorophium curvispinum, Caspian Mud Shrimp, is an amphipod crustacean that is native to lower reaches of the large rivers that drain into the Black and Caspian Seas. This shrimp can be found in salt, brackish, and fresh water. *C. curvispinum* has been introduced throughout Europe from the release of ballast water and sediment as well as natural dispersal through European canal systems. *C. curvispinum* has been found to outcompete native macroinvertebrate species and reduce macroinvertebrate species richness. This has led to changes in abundance of native species at other trophic levels. The History of Invasiveness for *Chelicorophium curvispinum* is classified as High due to the impacts to native macroinvertebrates. The climate matching analysis for the contiguous United States indicates establishment concern for this species. Areas of high match were found around the Great Lakes region and areas of the Great Basin and Colorado Plateau. Much of the remainder of the contiguous United States was found to have a medium match. The Certainty of Assessment is classified as High. The Overall Risk Assessment Category for *Chelicorophium curvispinum* in the contiguous United States is High.

Assessment Elements

- **History of Invasiveness (see section 4): High**
- **Establishment Concern (see section 7): Yes**
- **Certainty of Assessment (see section 8): High**
- **Remarks, Important additional information: No additional remarks.**
- **Overall Risk Assessment Category: High**

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 Mastitsky (2009) and GBIF Secretariat (2022).

Under the future climate scenarios (figure A1), on average, high climate match for *Chelicorophium curvispinum* was projected to occur in the Great Lakes region of the contiguous United States. There were also areas of high match in the Great Basin and Colorado Plateau under most scenarios. Areas of low climate match were projected to occur in the Northern Pacific Coast region and Southern Florida as well as the Sierra Nevada range. In time step 2085 areas of low match were also found along the Gulf Coast. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.204 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.703 (model: MPI-ESM1-2-HR, 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 (0.772, figure 3) 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 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, Great Basin, Great Lakes, Gulf Coast, Mid-Atlantic, Southeast, Southern Atlantic Coast, Southern Plains, and Southwest saw a large decrease in the climate match relative to current conditions. Additionally, areas within California, The ortheast, and Northern Plains 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).

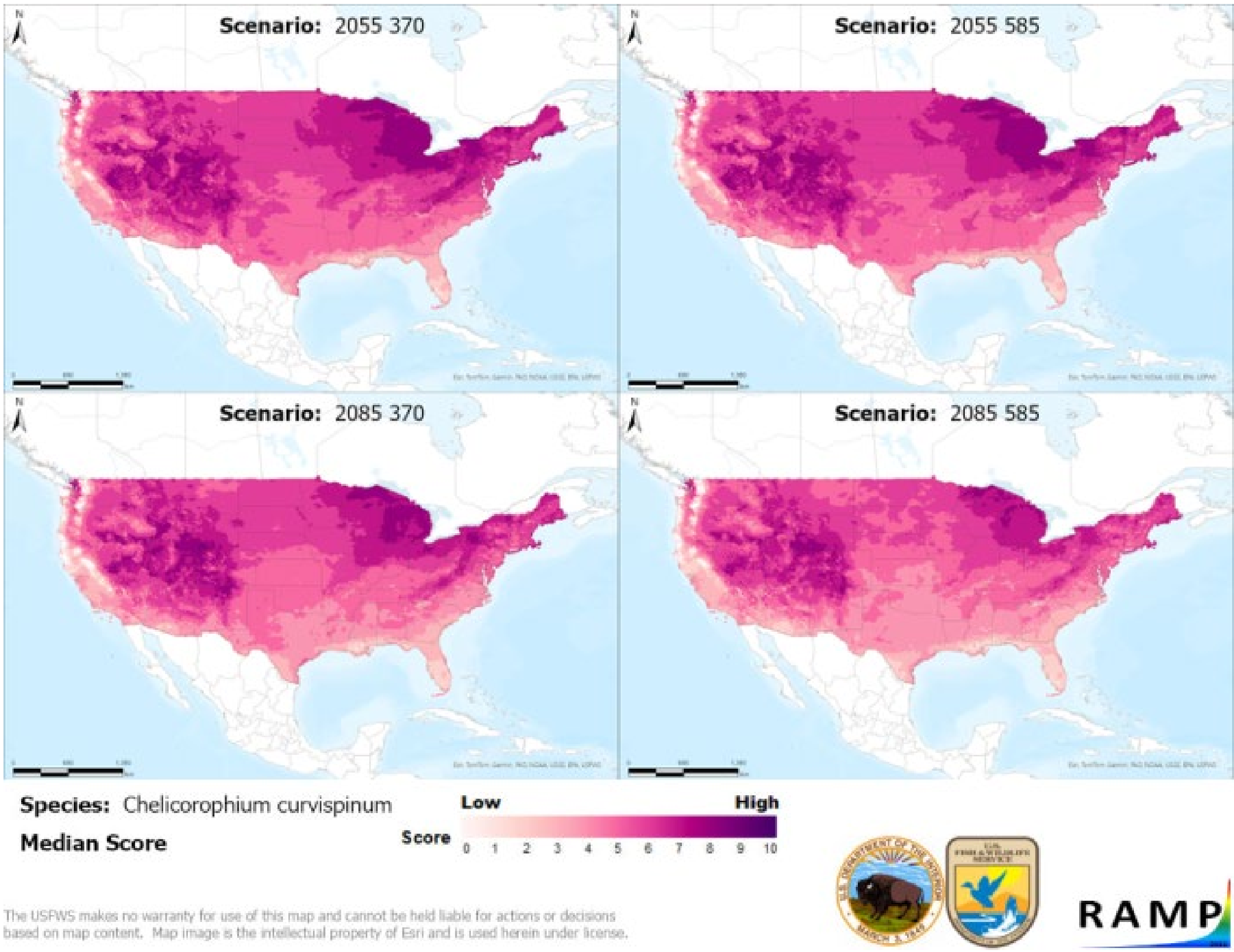

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Chelicorophium curvispinum* in the contiguous United States. Climate matching is based on source locations reported by Mastitsky (2009) and GBIF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

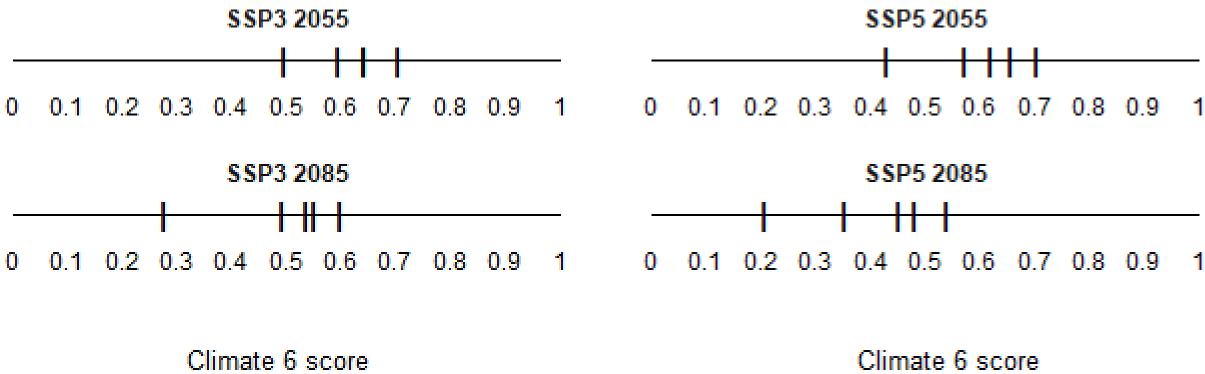

Figure A2. Comparison of projected future Climate 6 scores for *Chelicorophium curvispinum* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017,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

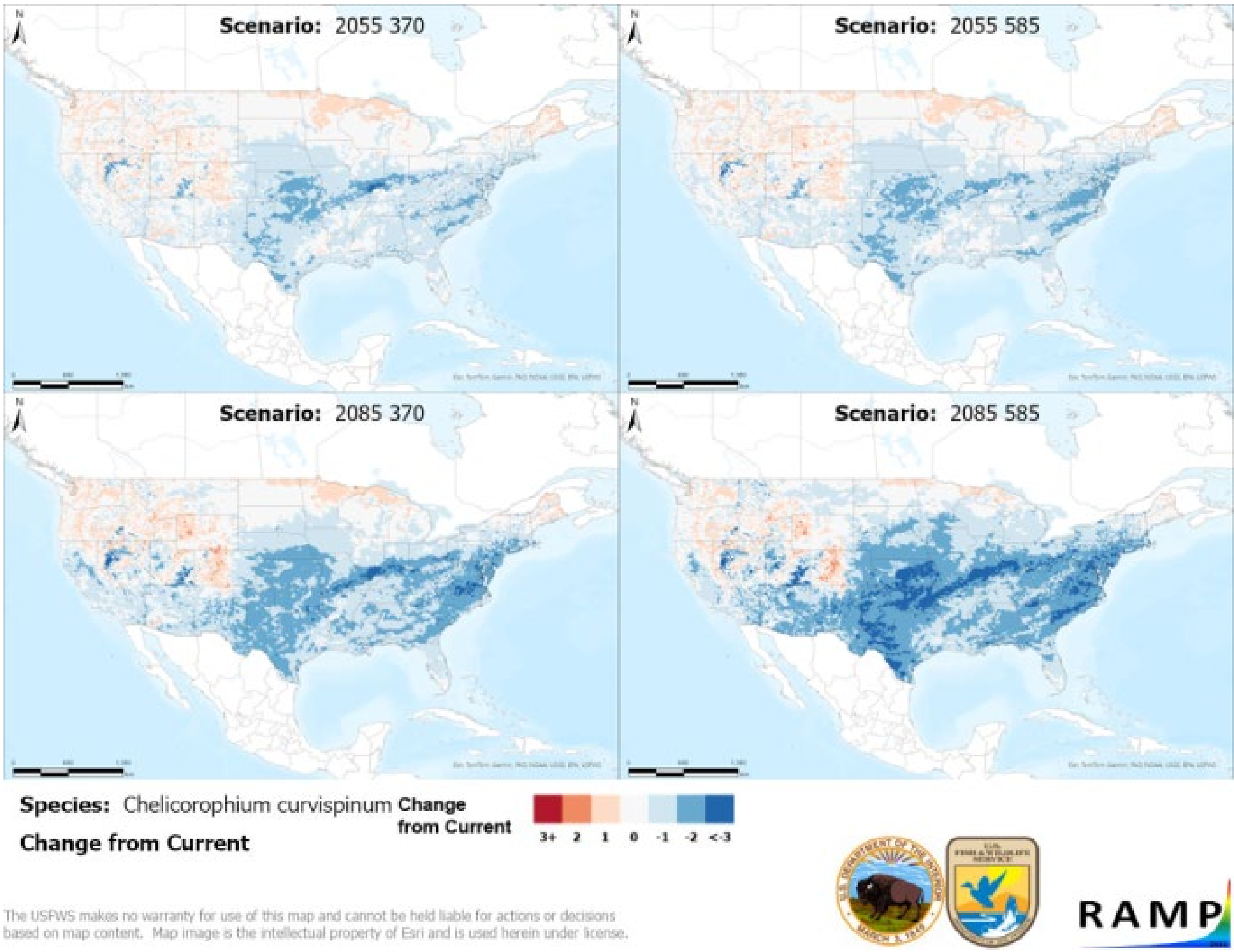

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 3) and the median target point score for future climate scenarios (figure A1) for *Chelicorophium curvispinum* based on source locations reported by Mastitsky (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.

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