European Crayfish (*Astacus astacus*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, October 2023
Revised, January 2024
Web Version, 4/13/2026

Organism Type: Crustacean
Overall Risk Assessment Category: Uncertain

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1 Native Range and Status in the United States

Native Range

From Allen (2019):

"*A. astacus* is widely distributed in Europe, extending from France in the southeast [sic] to Russia in the east, and from Italy, Albania and Greece in the south to Scandinavia in the north (Cukerzis et al., 1988; Holdich et al., 1999)"

Allen (2019) lists the following countries as part of the native range of *Astacus astacus*: Albania, Austria, Belarus, Belgium, Bulgaria, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Sweden, and Switzerland.

Status in the United States

No records of *Astacus astacus* in the wild or in live trade in the United States were found.

Regulations

Astacus astacus is regulated as part of the genus *Astacus* in California (CDFW 2022). It is regulated at the family level (Astacidae) in Arizona (Arizona Game and Fish Commission 2022), Georgia (State of Georgia 2023), New Mexico (NMDGF 2023), Nevada (Nevada Board of Wildlife Commissioners 2022), Wisconsin (Wisconsin DNR 2022), and Utah (Utah DWR 2023). *A. astacus* is regulated under the common name 'crayfish' in Pennsylvania (PFBC 2022) and Minnesota (Minnesota DNR 2022) and as a crayfish species not indigenous to New Hampshire (NHFG 2022) or Rhode Island (Rhode Island DEM 2022). Please refer back to state agency regulatory documents for details on the regulations, including restrictions on activities involving this species. While effort was made to find all applicable regulations, this list may not be comprehensive. Notably, it does not include regulations that do not explicitly name this species or its genus or family, for example, when omitted from a list of authorized species with blanket regulation for all unnamed species.

Means of Introductions within the United States

No records of *Astacus astacus* in the wild in the United States were found.

Remarks

This ERSS was previously published in June 2015. Revisions were completed to incorporate new information and conform to updated standards.

Other common names applied to this species include Noble Crayfish, Red-footed Crayfish, Broad-clawed Crayfish, and Red-clawed Crayfish (Boucher and Elgin 2023).

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 Malacostraca
Subclass Eumalacostraca
Superorder Eucarida
Order Decapoda
Suborder Pleocyemata
Infraorder Astacidea
Superfamily Astacoidea
Family Astacidae
Genus *Astacus*
Species *Astacus astacus* (Linnaeus, 1758)

According to DecaNet eds. (2023), *Astacus astacus* (Linnaeus, 1758) is the accepted name for this species.

Size, Weight, and Age Range

From Allen (2019):

"[*Astacus astacus*] are usually not more than 150 mm in total length (tip of rostrum to end of telson); however, specimens of 170 mm and 270 g have been reported (Westman et al., 1990)."

From Edsman et al. (2010):

"Anecdotal measures of longevity indicate this species may live for up to 20 years."

Environment

From Edsman et al. (2010):

"This species is found in rivers, lakes, ponds, and reservoirs, in both lowlands and hills, where shelter availability is high (Souty-Grosset et al. 2006). This includes stones, logs, roots and aquatic and marginal vegetation. This species prefers soft bottoms with some sand and is not usually found in water bodies with a muddy substrate. In addition, it prefers soft banks where it constructs simple burrows. The oxygen demands of this species can be quite high, leading to high mortality in shallow, eutrophic ponds during summer months (Souty-Grosset et al. 2006)."

"This species is capable of tolerating lower calcium levels, as low as 2-3 mgl^{-1} Ca, where other species of crayfish may be excluded. The optimum [water] temperature for best growth is between 16 and 24°C, although up to 28°C can generally be tolerated. In addition, oxygen content below 3-4 mgl^{-1} is deemed unsuitable for this species."

"Studies have shown (Jensen 1996) that this species of crayfish is particularly susceptible to increased levels of nitrite in aquatic systems, meaning input of excess amounts of this compound, particularly through agricultural fertilizer run-off, may pose a serious risk to this species."

Climate

No information on climatic tolerances was found for *Astacus astacus*.

Distribution Outside the United States

Native

From Allen (2019):

"*A. astacus* is widely distributed in Europe, extending from France in the southeast [sic] to Russia in the east, and from Italy, Albania and Greece in the south to Scandinavia in the north (Cukerzis et al., 1988; Holdich et al., 1999)"

Allen (2019) lists the following countries as part of the native range of *Astacus astacus*: Albania, Austria, Belarus, Belgium, Bulgaria, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Romania, Russia, Slovakia, Sweden, and Switzerland.

Introduced

From Edsman et al. (2010):

"A few recently introduced subpopulations are found outside Europe, for example Morocco. The occurrence of this species within Andorra, Cyprus, the UK, Liechtenstein, Luxembourg, Morocco and possibly Montenegro and Italy, is via introductions from neighbouring countries."

"Then on the Mediterranean side [of Montenegro], it is exotic, and people have introduced with success."

From Allen (2019):

"[*Astacus astacus*] has been introduced to England, Cyprus, Spain and Liechtenstein, and also the Siberian River Ob [central Russia] and to Morocco (Cukerzis et al., 1988; Holdich et al., 1999)."

Means of Introduction Outside the United States

From Boucher and Elgin (2023):

"Potential pathway(s) of introduction: Stocking/Planting or escape from recreational culture."

From Allen (2019):

"*Astacus astacus* is believed to have been an object of trade, commerce and zoological study in Europe since the 1800s (Skurdal and Taugbøl, 2002)."

FAO (2023) suggests *Astacus astacus* was introduced to Italy and Spain through aquaculture, to the United Kingdom through research, and to Morocco for fisheries purposes.

Short Description

From Boucher and Elgin (2023):

"Usually dark brown or black on the dorsal side, and olive-brown on the ventral side. The carapace is smooth but with small granular tubercles on the sides. The rostrum is 4 flat with two spines near the base. The claws are broad, with well-formed bases, red-brown on the ventral side and rough on the dorsal side."

From Allen (2019):

"It is possible to recognise mature males and females prior to the spawning period by observing the eggs and sperm by bending the tail and rostrum and observing the area in between."

Biology

From Allen (2019):

"They are sedentary, nocturnally-active and bound to particulate structures (Abrahamson, 1983; Cukerzis, 1984). Detritus, benthic macrophytes and epiphytic algae are the important food items in all habitats."

"The size at which *A. astacus* females reach sexual maturity depends on locality, ranging from 62 mm to 85 mm total length. This corresponds to an age of 3-5 years. Males become mature at 60-70 mm total length (Abrahamsson, 1966). Gonads mature between July and September (Lindqvist and Lahti, 1983) and mating takes place with the decline in temperature in autumn (September and October) (Huner and Lindqvist, 1986; Westin and Gydemo, 1986). Following the first maturation, males remature and mate every year; females are often reproductively inactive every second, or in some cases, every third year (Huner and Lindqvist, 1986; Taugbøl et al., 1988; Pursianinen et al., 1989). High temperatures delay the onset of mating. Males compete for females with one male able to mate with several females. The mating period lasts 2-3 weeks. Extrusion and fertilization of eggs occurs from a few hours to up to 6 weeks after mating. Egg development may last up to 8 months and is influenced by temperature. Increasing the temperature can substantially shorten the incubation period and the required sum of heat (day-degrees) needed for egg development (Cukerzis et al., 1979; Hessen et al., 1987)."

From Boucher and Elgin (2023):

"Noble Crayfish feed on worms, aquatic insects, molluscs and plants."

Human Uses

From Boucher and Elgin (2023):

"Noble Crayfish are a popular food source in their native range, and they are commonly cultured for stocking as well as consumption."

From Allen (2019):

"*Astacus astacus* is believed to have been an object of trade, commerce and zoological study in Europe since the 1800s (Skurdal and Taugbøl, 2002). They are economically important due to their status as a delicacy (Spitz, 1973; Brinck, 1975; Westman, 1991; Westman et al., 1992)."

"*A. astacus* are mainly cultured in the Nordic and Baltic countries and in the Alpine region; they are mainly produced for stocking, re-establishing lost stocks and to some extent for consumption, involving both the production of juveniles for stocking in natural waters and for the aquaculture industry, and the production of crayfish for consumption (Skurdal and Taugbøl, 2002)."

Diseases

***Astacus astacus* has been documented as susceptible to infection with *Aphanomyces astaci* (crayfish plague), a disease listed by the World Organisation for Animal Health (2023).**

Allen (2019) reports the following diseases and disorders of *Astacus astacus*: *Branchiobdella astaci, Branchiobdella parasitica, Branchiobdella pentadonta*, burn spot disease (fungus disease) of crayfish (caused by *Didymaria cambari*, *Fusarium, Ramularia astaci*), chitinolytic bacterial shell disease of crayfish, crayfish plague (caused by *Aphanomyces astaci*), infectious pancreatic necrosis, protozoan disease of European crayfish (caused by *Psorospermium haeckeli*), *Saprolegnia* spp. (fungus disease) of crayfish (including *Saprolegnia parasitica*), and thelohaniasis of crayfish (caused by *Thelohania contejeani*).

In addition to the diseases listed above, Poelen et al. (2014) lists the following as parasites or diseases of *Astacus astacus*: *Branchiobdella italica*, *Branchiobdella balcanica*, *Branchiobdella hexodonta*, *Saprolegnia australis*, *Saprolegnia litoralis*, *Epicoccum nigrum*, *Psorospermium haeckeli*, *Gibberella avenacea*, and *Saprolegnia ferax*.

In addition, DecaNet eds. (2023) states that *Astacus astacus* is the host to the following parasite: *Astacotrema cirrigerum*.

From Boucher and Elgin (2023):

"*Astacus astacus* are known to be an effective carrier of infectious pancreatic necrosis virus (IPNV); IPNV can cause mortalities in salmonid species. Noble Crayfish were able to transmit IPNV to rainbow trout fry and eggs in a laboratory setting (Halder and Ahne, 1988). […] However, there are no reports of *A. astacus* transmitting IPNV to salmonid species in the wild."

Threat to Humans

No information was found on threats to humans for *Astacus astacus*.

3 Impacts of Introductions

No information was found regarding impacts of introductions for *Astacus astacus*.

The importation, possession, or trade of *Astacus astacus* is regulated in Arizona (Arizona Game and Fish Commission 2022), California (CDFW 2021), Georgia (State of Georgia 2023), Minnesota (Minnesota DNR 2022), Nevada (Nevada Board of Wildlife Commissioners 2022), New Hampshire (NHFG 2022), Pennsylvania (PFBC 2022), New Mexico (NMDGF 2023), Rhode Island (Rhode Island DEM 2022), Wisconsin (Wisconsin DNR 2022), and Utah (Utah DWR 2023). See section 1.

4 History of Invasiveness

The History of Invasiveness for *Astacus astacus* is classified as Data Deficient. *Astacus astacus* has been introduced and become established beyond its native range but no information on impacts of its introductions were found.

5 Global Distribution

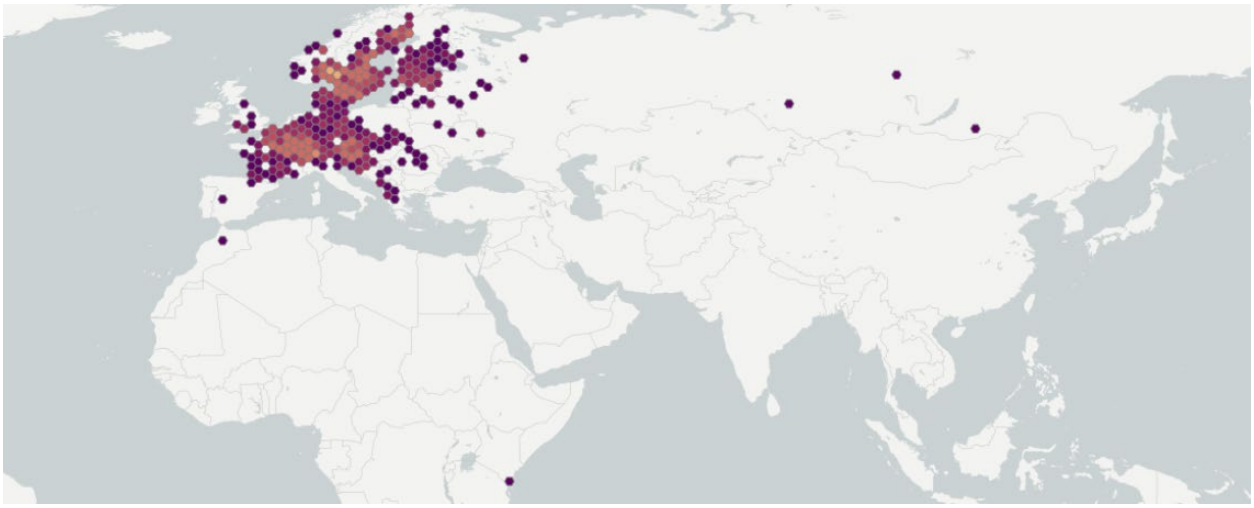

Figure 1. Reported global distribution of *Astacus astacus*. Map from GBIF Secretariat (2023). Observations are reported from Aland Islands, Albania, Austria, Belarus, Belgium, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Kenya, Kosovo, Latvia, Liechtenstein, Lithuania, Luxembourg, Montenegro, Morocco, the Netherlands, North Macedonia, Norway, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, and the United Kingdom. Observations in Kenya, Kosovo, Serbia, Slovenia, and Ukraine as well as the two easternmost observations in Russia could not be confirmed to represent established populations and were not included in the climate matching analysis.

No georeferenced observations were found to represent the native populations located in Bulgaria and introduced populations located in Andorra and Cyprus in the climate matching analysis.

6 Distribution Within the United States

No records of *Astacus astacus* in the wild in the United States were found.

7 Climate Matching

Summary of Climate Matching Analysis

The climate matching analysis for *Astacus astacus* to the contiguous United States found areas of high climate match in the Appalachian Range, Great Lakes, and Mid-Atlantic regions. There were scattered, small areas of high match in the Northeast and in the West. Areas of low match were found in patches in southern Florida, the Desert Southwest, and along the Gulf and Pacific Coasts. The rest of the contiguous United States had medium match. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.881, indicating that 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 *Astacus astacus* (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.

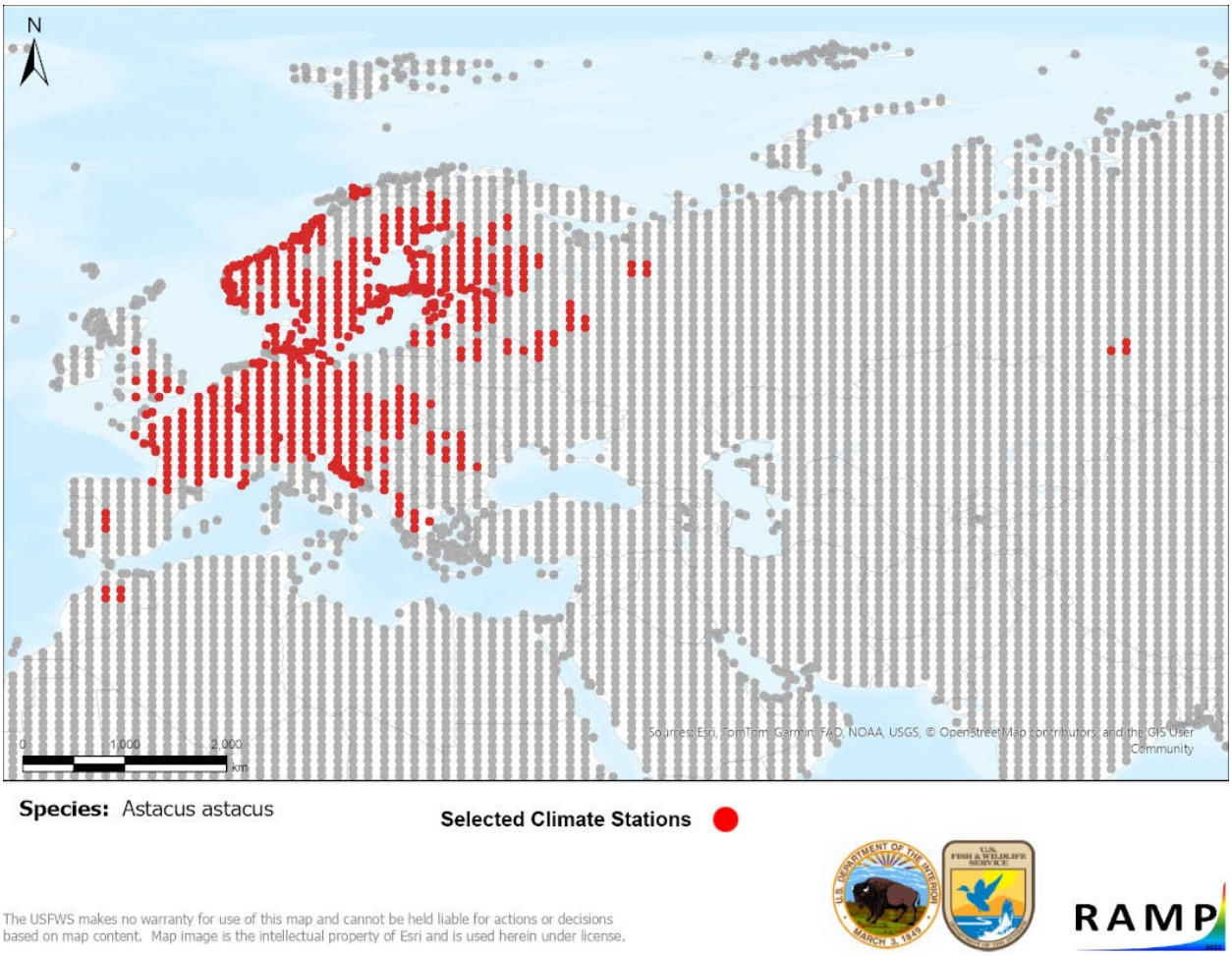

Figure 2. RAMP (Sanders et al. 2023) source map showing weather stations in Europe, northern Africa, and Russia selected as source locations (red; Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Jersey, Latvia, Liechtenstein, Lithuania, Luxembourg, Montenegro, Morocco, Netherlands, Norway, Poland, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, and United Kingdom) and non-source locations (gray) for *Astacus astacus* 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.

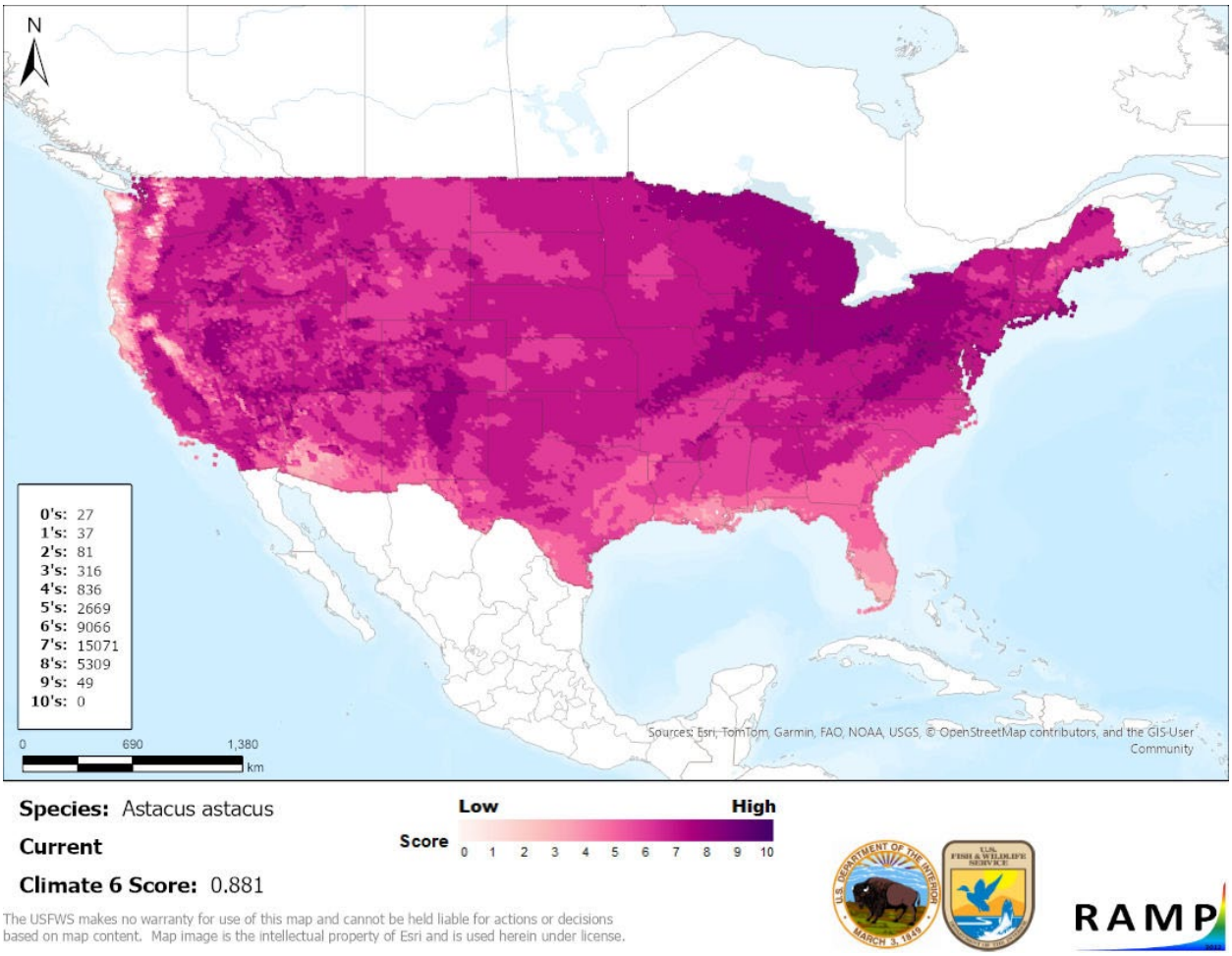

Figure 3. Map of RAMP (Sanders et al. 2023) climate matches for *Astacus astacus* in the contiguous United States based on source locations reported by GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Astacus astacus* is classified as Low. There was information available regarding the distribution, biology, and ecology of the species. There were records available of *A. astacus* introductions and resulting established populations, but there was no information regarding impacts of those introductions.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Astacus astacus, European Crayfish, is a crustacean that is native to much of Europe. This species is found in freshwater environments and temperate climates. *Astacus astacus* is a popular food source in its native range. *Astacus astacus* has been introduced outside of its native range to other parts of Europe, Morocco, and Russia, likely for research and aquaculture purposes. The History of Invasiveness for *Astacus astacus* is classified as Data Deficient due to a lack of

information about impacts from the introduced populations. The climate matching analysis for the contiguous United States indicates establishment concern for this species. High climate matches were found primarily in the Appalachian Range, Great Lakes, and Mid-Atlantic, with pockets of high match scattered throughout the West. The Certainty of Assessment for this ERSS is classified as Low due to the lack of data available on the impacts of introductions. The Overall Risk Assessment Category for *Astacus astacus* 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: Susceptible to infection with *Aphanomyces astaci* (crayfish plague), a disease listed by the World Organisation for Animal Health.**
- **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 *Astacus astacus* was projected to occur in the Great Lakes region of the contiguous United States. Areas of low climate match were projected to occur in Southern Florida. Under the 2085 time step, areas of low match occurred across the Southeast and Gulf Coast. The extent of the areas of low match was greater under SSP5 than SSP3. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.261 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.800 (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 (0.881, 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 multiple time step and climate scenarios, areas within the Southwest saw a moderate increase in the climate match relative to current conditions. No large increases were observed regardless of time step and climate scenarios. Primarily under SSP5, time step 2085, areas within the Appalachian Range, Colorado Plateau, Great Lakes, Gulf Coast, Mid-Atlantic, Southeast, Southern Plains, and Southwest saw a large decrease in the climate match relative to current conditions. Additionally, areas within California, the Great Basin, Northeast, Northern Plains, Southern Atlantic Coast, Southern Florida, 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).

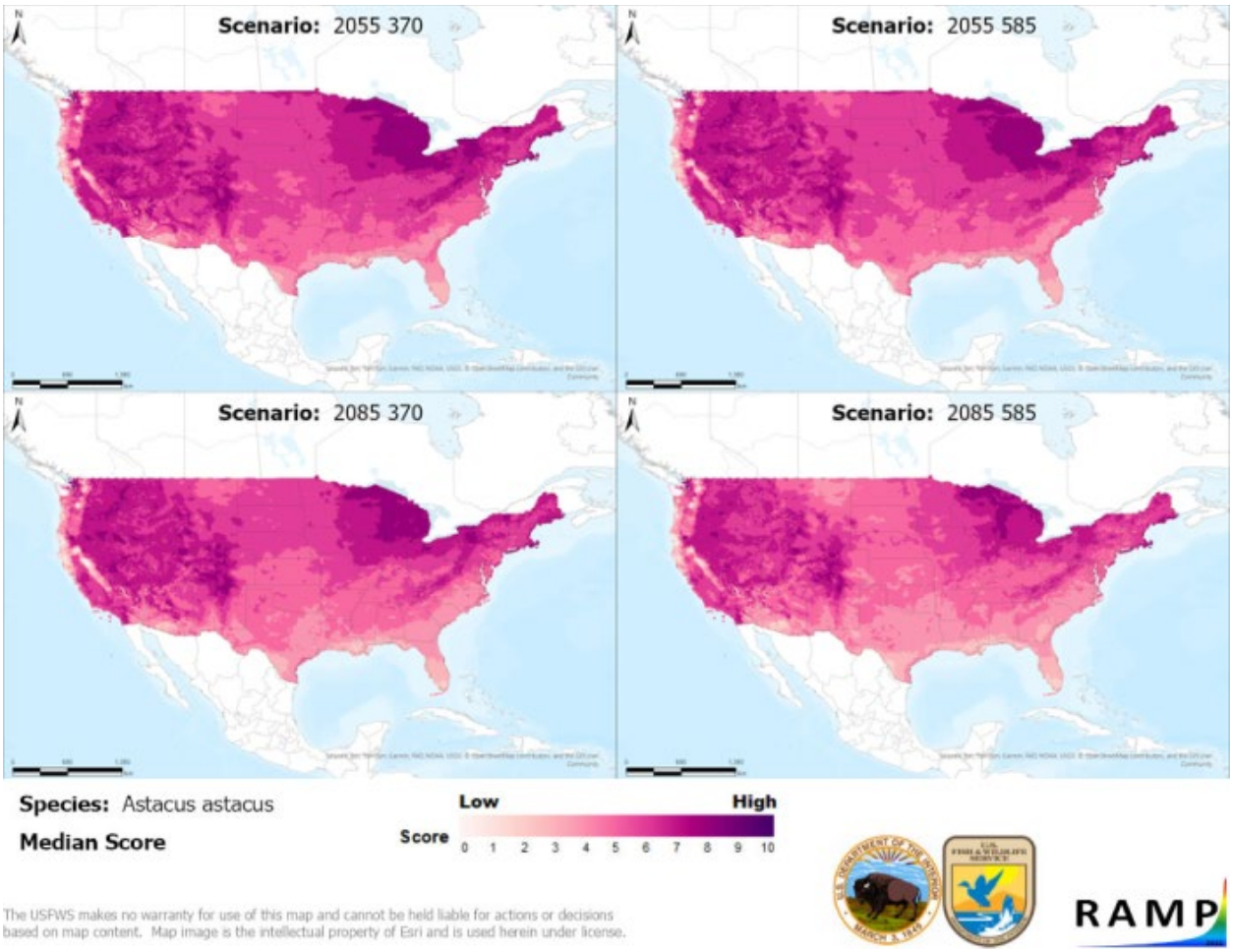

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Astacus astacus* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023). Shared Socioeconomic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

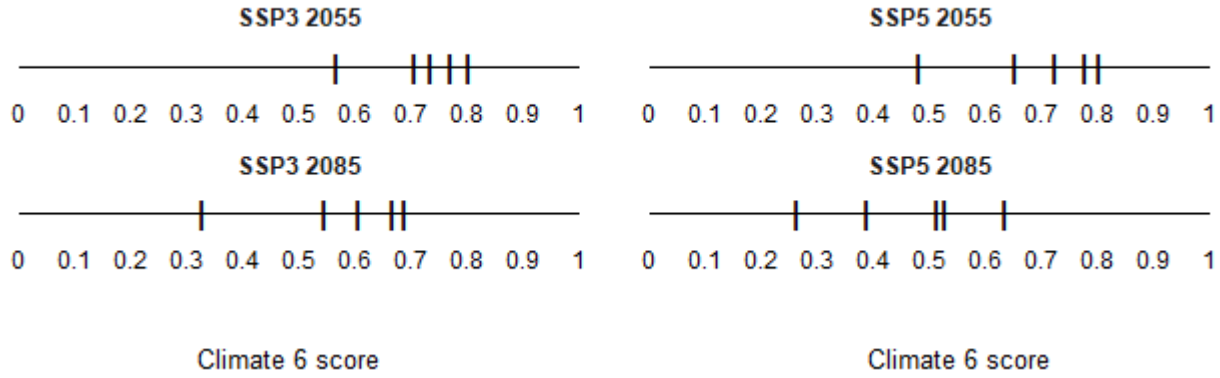

Figure A2. Comparison of projected future Climate 6 scores for *Astacus astacus* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC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

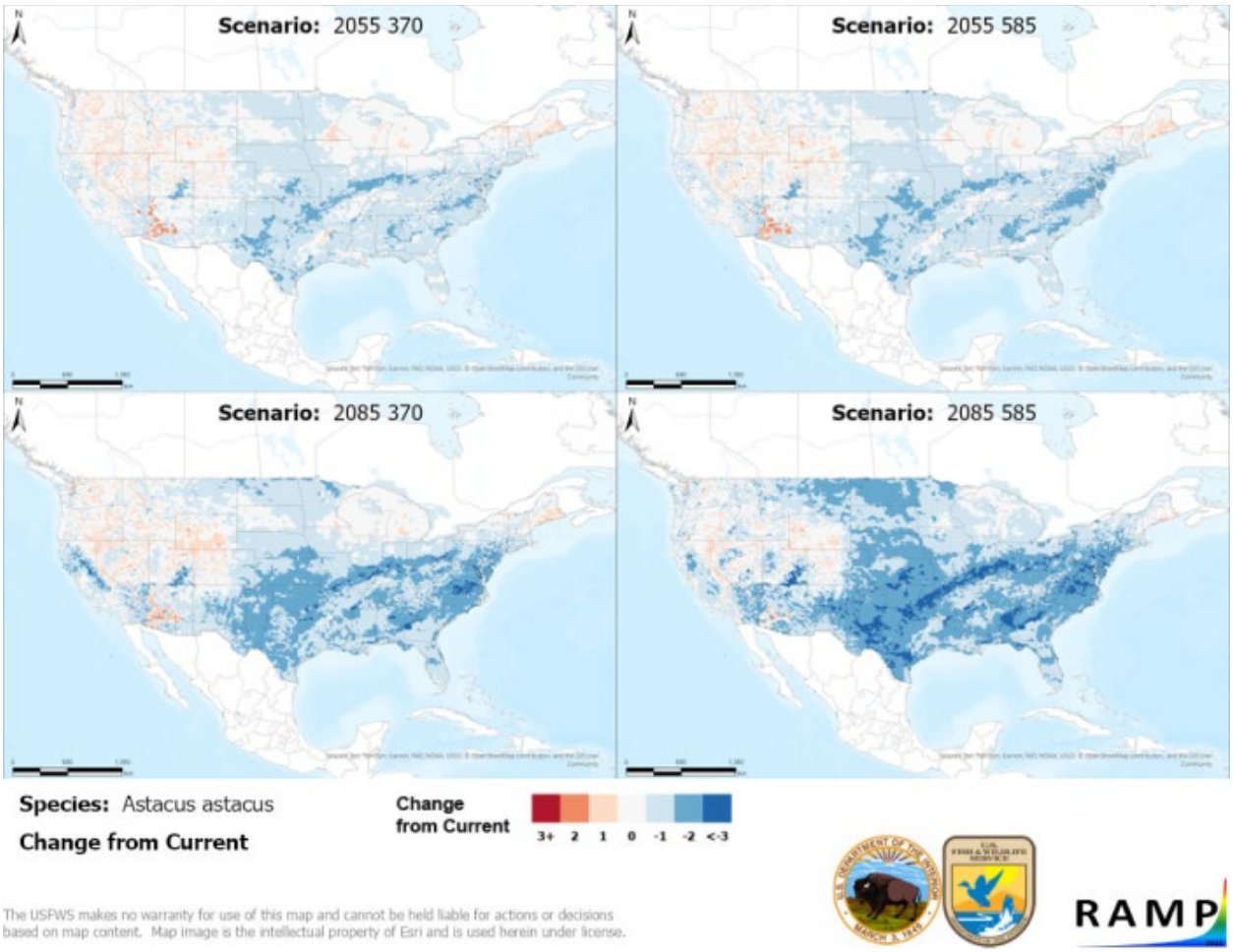

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 3) and the median target point score for future climate scenarios (figure A1) for *Astacus astacus* based on source locations reported by GBIF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