

Spiny-Cheek Crayfish (*Faxonius limosus*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, November 2023

Revised, December 2023

Web Version, 6/23/2026

Organism Type: Crayfish

Overall Risk Assessment Category: High



Photo: Astacoides. Licensed under Creative Commons Attribution-Share Alike 3.0 Unported. Available: https://commons.wikimedia.org/wiki/File:Kamberkrebs_spiny-cheek_crayfish_Orconectes_limosus_male.jpg (November 2023).

1 Native Range and Status in the United States

Native Range

From Filipová et al. (2011):

“Originally, *O. limosus* [a synonym of *Faxonius limosus*] is thought to have inhabited the Piedmont and Coastal Plain Physiographic Provinces from Virginia northward to New Jersey (Ortmann 1906, Bouchard et al. 2007), but considerable uncertainty exists regarding the native range of the species (Ortmann 1906, Crocker 1979, Bouchard et al. 2007). Ortmann (1906) observed that the range of *O. limosus* did not seem to reach far north in Pennsylvania at the beginning of the 20th century [...]”

Status in the United States

From Filipová et al. (2011):

“Originally, *O. limosus* is thought to have inhabited the Piedmont and Coastal Plain Physiographic Provinces from Virginia northward to New Jersey (Ortmann 1906, Bouchard et al. 2007), but considerable uncertainty exists regarding the native range of the species (Ortmann 1906, Crocker 1979, Bouchard et al. 2007). Ortmann (1906) observed that the range of *O. limosus* did not seem to reach far north in Pennsylvania at the beginning of the 20th century and speculated, as did Bouchard et al. (2007), that the species may have spread north and west of its range in southeastern Pennsylvania through artificial canals or with the assistance of humans. Bouchard et al. (2007) also hypothesized that *O. limosus* could have reached the Upper Delaware River system from the north via the Delaware and Hudson Canal in southeastern New York and northeastern Pennsylvania, a scenario that may explain the apparent absence of the species in the central part of the river (Ortmann 1906, Bouchard et al. 2007).”

“Further north (New England [...]), *O. limosus* is thought to have been introduced to some areas. Maine [is] considered to have been colonized recently (McAlpine et al. 1991, Souty-Grosset et al. 2006, Lambert et al. 2007).”

According to Filipová et al. (2011), *Faxonius limosus* has been introduced or probably introduced to portions of the following States: Maine, Vermont, New York, and Pennsylvania.

From Loughman and Welsh (2010):

“One species, *Orconectes limosus* (Spinycheek Crayfish) is considered extirpated [in West Virginia] within the past decade.”

No records of *Faxonius limosus* in trade in the United States were found.

Regulations

Faxonius limosus is regulated at the family (Cambaridae) level in Arizona (Arizona Game and Fish Commission 2022), California (CDFW 2021), New Mexico (NMDGF 2023), Nevada (Nevada Board of Wildlife Commissioners 2022), Oregon (ODFW 2022), Utah (Utah DWR 2023), Washington (WDFW 2022), and Wisconsin (Wisconsin DNR 2022). All species of crayfish are regulated in Pennsylvania (PFBC 2022) and Minnesota (Minnesota DNR 2022), and species not indigenous to New Hampshire (NHFG 2022) and Rhode Island (Rhode Island DEM 2022) are regulated in those respective States. 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

From Filipová et al. (2011):

“Ortmann (1906) observed that the range of *O. limosus* did not seem to reach far north in Pennsylvania at the beginning of the 20th century and speculated, as did Bouchard et al. (2007), that the species may have spread north and west of its range in southeastern Pennsylvania through artificial canals or with the assistance of humans. Bouchard et al. (2007) also hypothesized that *O. limosus* could have reached the Upper Delaware River system from the north via the Delaware and Hudson Canal in southeastern New York and northeastern Pennsylvania, a scenario that may explain the apparent absence of the species in the central part of the river (Ortmann 1906, Bouchard et al. 2007).”

Remarks

This ERSS was previously published June 2015 under the name *Orconectes limosus*. Revisions were completed to incorporate new information and conform to updated standards.

There is some uncertainty regarding the northern extent of the native range for this species in North America. While some sources report a smaller native range within coastal drainages of the Mid-Atlantic and occurrences in northern New England representing introductions (e.g., Filipová et al. 2011), other sources express uncertainty if detections at the northern end of the range are introductions or just previously unrecorded native populations (e.g., McApline et al. 1991). This assessment follows the native and introduced ranges described by Filipová et al. (2011; see Status in the United States, above).

From Filipová et al. (2011):

“Most individuals from the single population sampled in Nova Scotia shared haplotype A3 with individuals found much further south in several brooks in northern Maryland, in the lower Delaware River, and in some smaller watercourses in Pennsylvania [...] The conspicuous sharing of the dominant haplotype between invaded areas in Europe and North America suggests that the individuals that originally invaded those areas may have come from the same general source area.”

“The construction of artificial canals connecting watersheds and human introductions could explain the recent spread of the species from its original range and some of the patterns of haplotype distribution (e.g., lower genetic diversity to the north). However, these patterns also could reflect more ancient processes, in particular, recolonization after the last ice age. Ortmann (1906) and Rhoades (1962) suggested that *O. limosus* could have persisted during the Wisconsin glaciation in a refuge in the lower Delaware River and Chesapeake Bay. The adjacent southeastern part of the Piedmont plateau in Pennsylvania and Maryland also is thought to be the last remnant of its former range in the Piedmont (Bouchard et al. 2007). The higher number of haplotypes detected in that area may support this view because regions in which a species has persisted for a long time are more likely to host high genetic diversity than are recently colonized regions.”

From McAlpine et al. (1991):

“Reid (1970) suggested that *O. limosus* may be still expanding its range in Maine, and noted that the species is secretive and difficult to trap. It is not possible to determine whether the crayfish records reported here [from New Brunswick] represent a recent range expansion into New Brunswick or are simply the result of previous inadequate sampling.”

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 Cambaridae
Genus *Faxonius*
Species *Faxonius limosus*

According to DecaNet (2023), *Faxonius limosus* is the current valid name for this species.

The following synonyms of *Faxonius limosus* from DecaNet (2023) were used to search for information for this report: *Orconectes limosus*.

Size, Weight, and Age Range

From Tricarico (2022):

“Total length can be up to 12 cm, but it is usually 10 cm (without claws).”

“The size at maturity is 25-35 mm cephalothorax length (Hamr, 2002).”

“The life span of *Faxonius limosus* is usually 2-3 years, but it can live for up to 4 years (Hamr, 2002; Alekhnovich and Buřič, 2017).”

Environment

From Tricarico (2022):

“Hamr (2002) states that ‘in North America, the species inhabits soft-bottomed, silty, turbid waters such as found in large rivers, wide streams and lakes with abundant vegetation, although in Canada it has been found occupying stony streams with a moderate current’. In Europe, it occupies a wider range of habitats including cool, fast waters, predominantly occurring in larger watercourses, but preferring lentic, warm, deep waters such as ponds and lakes with shallow bottoms having a layer of sediment (Buřič et al., 2009b), in which it digs burrows (Kouba et al., 2016). It can inhabit water bodies that are organically or inorganically polluted (Holdich et al., 2006). Although it is usually found in lowland waters, in Morocco (North Africa), introduced populations have become established at altitudes between 1400 and 2078 m above sea level (Holdich et al., 2006).”

“It is tolerant to deoxygenated, eutrophic or polluted water (Holdich and Black, 2007; Alekhovich and Buřič, 2017). In Austria, it has been reported to reach a high density in a waterbody that is oily and muddy, with other aquatic fauna excluded, indicating low water quality (Pöckl, 1999). It can tolerate drying conditions for many weeks (Laurent, 1988; Holdich et al., 2006). It has been showed to reproduce successfully at salinity values up to 7 ‰ (Jaszczołt and Szaniawska, 2011), with individuals having been found also in brackish waters with salinity of up to 10 ‰.”

“*Faxonius limosus* is most active from spring to autumn (May to October) at temperatures above 3°C, but it is known to be active under ice in France during the winter (Baldry, 2007), and many have been observed in the UK from November to January (water temperature: 6-7°C; Holdich and Black, 2007).”

Climate

No information was found regarding climatic requirements for *Faxonius limosus*.

Distribution Outside the United States

Native

The native range of *Faxonius limosus* is thought to be entirely within the United States, see Native Range in Section 1.

Introduced

From McAlpine et al. (1991):

“In 1982, Couture and Savignac (1984) reliably documented *O. limosus* in Canada. They reported that *O. limosus* constituted 84% of 1149 crayfish captures in the St. Lawrence River in an area from Sorel to Quebec City, Quebec.”

“Here we report the first records of the crayfish *Orconectes limosus* from New Brunswick. These records also represent only the second substantiated occurrence of this crayfish in Canada, [...]”

From Tricarico (2022):

“It is the most introduced crayfish in Europe, where it is reported in 24 territories (Kouba et al., 2014; Trichkova et al., 2015; Govedič, 2017), including Corsica (Kouba et al., 2014) and the UK (Holdich and Black, 2007), and is particularly widespread in Germany, Poland and France.”

From Filipová et al. (2011):

“During the century after its introduction to Europe, *O. limosus* spread rapidly to various regions, both naturally and by secondary human-mediated introductions (Souty-Grosset et al. 2006). Currently, it can be found in >20 European countries, and it has recently invaded, via the Danube River, Slovakia (Janský and Kautman 2007) and Romania (Pârvulescu et al. 2009).”

From Aldridge (2011):

“A few populations of spiny-cheek crayfish have become established across scattered locations in England.”

From Madzivanzira et al. (2020):

“The first successful introduction [of *Faxonius limosus* in Morocco] was in 1940 into Lake Ifrah, where it soon established. [...] As a result of intentional introductions and natural spread, *F. limosus* is now widely established in Morocco, particularly at altitudes between 1000 and 2200m, where it has successfully established in several natural lakes in the Middle Atlas region (Holdich and Black 2007; Melhaoui Unpublished data; Moroccan Farmer Unpublished data; Tabib Unpublished data).”

Means of Introduction Outside the United States

From Tricarico (2022):

“Initial spread of *Faxonius limosus* has been mainly as a result of human activity: in Europe it was first introduced in 1890 in Poland for aquaculture to replace the local native crayfish *Astacus astacus* which was experiencing a severe decrease (Hamr, 2002; Holdich and Black, 2007). It was later introduced in several European states for the same reason (e.g. Germany in 1895; France unsuccessfully in 1896 and successfully in 1911-13; Hungary in 1959; Austria in 1969). It can be introduced also as live bait or as an aquarium species (as probably occurred in the UK: Holdich and Black, 2007) or as contaminant of fish stocking (e.g. in Italy; Aquiloni et al., 2010), or by other accidental means such as being caught up in fishing nets (Holdich et al., 2006). It has also spread naturally through rivers and canals (as happened within France, Poland and Germany; in Belarus from Poland; and in Croatia, Serbia, Slovenia, Romania and Bulgaria along the Danube River system).”

“In the Czech Republic, the species showed a high dispersal rate with no directional preference during summer (up to 15 m/day: Buřič et al., 2009a, b). In Lake Constance, radio-tracked individuals moved distances of up to 1200 m within 4 days, mostly remaining within the littoral zone at less than 3 m depth (Hirsch et al., 2016). In Croatia, the rate of upstream dispersal in the

Drava River has been reported to be less than 2.5 km/year (Hudina et al., 2009). In the River Danube, in Hungary, the speed of colonization has been estimated to be more than 13 km/year (Puky and Schád, 2006). In Belarus, since 1997, it has spread 177 km upstream along the course of the Neman River from the Grodno region (Akhnovich and Razlutskiy, 2013)."

Short Description

From Tricarico (2022):

"*Faxonius limosus* has an anterior cephalothorax, comprising the head and the thorax, with two pairs of antennae, claws, mouth, and walking legs, and a posterior abdomen with appendages, used mainly by females for incubating eggs, and the "fan" tail. It has a pale or dark brown or olive-green body (the colour depends partly on the environment where it lives) with a typical transverse brown-red band in each abdominal segment. The carapace is relatively smooth, but it has prominent spines on each side (hence the common name in English). The claws are generally small with rows of pits on the surface, smooth to touch; their tips are orange with black bands. Females have a seminal receptacle (annulus ventralis) at the bases of the posterior walking legs; males have the first and second appendages of abdomen (gonopods) modified for copulation. The reproductive Form I males have harder gonopods, and a more robust exoskeleton than Form II males which are the non-reproductive form. Sexually active males have grasping hooks on the ischium of the 2nd pair of walking legs."

Biology

From Tricarico (2022):

"A detailed description of the reproductive biology of *Faxonius limosus* is provided by Hamr (2002). As in other cambarid species, males transfer sperm into the annulus ventralis (a seminal receptacle) of females; males show cyclic dimorphism, alternating between the reproductively active form I and the reproductively inactive form II (Buřič et al., 2010). The species mates in autumn and spring. In both North America and Europe, reproduction can occur once or twice per year, depending on the area. Females mated in autumn store the sperm until spring (late April or May) in the annulus ventralis; eggs are laid as water temperatures begin to increase (Hamr, 2002; Holdich and Black, 2007). Females can lay from 30 to 440 eggs, which are carried under the abdomen (Hamr, 2002), but the usual range is between 50 and 300 (Akhnovich and Buřič, 2017). On average, eggs hatch after 40 to 50 days (Hamr, 2002; Kozák et al., 2006). Young crayfish are similar to adults and become free-living and actively feeding at the third development stage (after 10 days). Maturity is usually reached during the second year (15-16 months; Hamr, 2002; Akhnovich and Buřič, 2017), but some juveniles can mature and reproduce within the first year (Kozák et al., 2007). The size at maturity is 25-35 mm cephalothorax length (Hamr, 2002). Under laboratory conditions, females have been shown to reproduce by facultative parthenogenesis and to store sperm (Buřič et al., 2011, 2013)."

"*Faxonius limosus* is capable of moving across land (Puky, 2014), even in winter (Holdich and Black, 2007). Males can be more nomadic during the reproductive period, when they are searching for mates, while females may move less when they bear eggs and more after hatching (Buřič et al., 2009a)."

“*Faxonius limosus* is generally considered a tertiary burrower, i.e. it builds burrows only for reproduction or to escape extreme conditions (Thoma, 2015). It has been found to burrow extensively in England but not in other European countries or in North America (Holdich and Black, 2007; Aldridge, 2011). Short burrows have been observed in France (Holdich and Black, 2007) and in the laboratory under drought conditions (Kouba et al., 2016). More complex burrows have been reported in the Czech Republic in soft substrata (Holdich and Black, 2007).”

“Depending on the environment and period of life cycle, it can be active both by day or by night (Musil et al., 2010), or more during the day (during the breeding season; Buřič et al., 2009a).”

Human Uses

From Tricarico (2022):

“[...] *Faxonius limosus* is abundant and common, and has been used for food (Hamr, 2002), [...] It can be used as live bait or as an aquarium species (Holdich and Black, 2007), or as a research model (Tricarico and Aquiloni, 2016).”

Diseases

***Faxonius limosus* has been documented as a host of *Aphanomyces astaci* (causative agent of crayfish plague), a disease listed by the World Organisation for Animal Health (2023).**

From Pârvulescu et al. (2012):

“Our study clearly showed that *Orconectes limosus* is [...] infected by the crayfish plague pathogen *Aphanomyces astaci*.”

From Longshaw (2011):

“Declines of the spiny-cheek crayfish *Orconectes limosus* in Germany were associated with several *Saprolegnia* spp., found both on external surfaces and more deeply within abdominal tissues (Hirsch et al., 2008).”

“The parasite [*Thelohania contejeani*] caused mass mortalities of crayfish in Europe; it infects *A. astacus*, *A. leptodactylus*, *A. pallipes*, *P. leniusculus* and *Orconectes (Faxonius) limosus* (Dunn et al., 2009; Edgerton et al., [2002]).”

“To date only five species of acanthocephalans have been reported from crayfish, including [...] *P[olymorphus]. minutus* (= *boschadia*) in *Orconectes (Faxonius) limosus* (originally reported as *Cambarus affinis*) by Golvan (1961), [...]”

According to Tricarico (2022), *Faxonius limosus* is susceptible to the following additional diseases and parasites: burn spot disease (fungus disease) of crayfish, *Didymaria cambari*, *Fusarium*, *Proteus*, *Proteus aeruginosa*, *Proteus morganii*, *Proteus* or *Pseudomonas* bacterial septicaemia of crayfish, *Proteus putrida*, *Proteus vulgaris*, protozoan disease of European crayfish, *Pseudomonas fluorescens*, *Psorospermium haeckeli*, and *Ramularia astaci*.

Threat to Humans

From Tricarico (2022):

“*Faxonius limosus* “does not appear to have caused much social or other harm in North America. However, it has affected those whose livelihoods depend on harvesting native crayfish in continental Europe, even [though] a quantification has never been performed” (Souty-Grosset et al., 2006; Aldridge, 2011).”

3 Impacts of Introductions

From Pârvulescu et al. (2012):

“Our study clearly showed that *Orconectes limosus* is rapidly spreading downstream in the Romanian stretch of the Danube, and that its populations are infected by the crayfish plague pathogen *Aphanomyces astaci*. We also demonstrated that *A. astaci* had been transferred to local populations of the native narrow-clawed crayfish *Astacus leptodactylus*, which strongly declined in coexistence with *O. limosus*. Furthermore, the pathogen was detected in an *A. leptodactylus* population well in advance of the main invasion front of the invasive species.”

From Aklehnovich and Razlutskiy (2013):

“The habitats of both spiny-cheek and narrow-clawed crayfish *A. leptodactylus* are known to overlap (Schulz and Smietana 2001), but both species were never caught at the same site during this research in Belarus.”

From Tricarico (2022):

“Being an omnivorous species, it can cause a decrease in macrophyte cover, macroinvertebrate abundance and diversity, altering the ecosystem function (Vojtkovská et al., 2014; Šidagytė et al., 2017). Generally, in Europe its population density appears much higher than of the native species and has been reported to be equivalent to much or most of the biomass of macroinvertebrates and fish (Haertel-Borer et al., 2005).”

“*Faxonius limosus* “[...] has affected those whose livelihoods depend on harvesting native crayfish in continental Europe, even [though] a quantification has never been performed” (Souty-Grosset et al., 2006; Aldridge, 2011).”

“*Faxonius limosus* [...] appears to have displaced *F. virilis* in the lower St Lawrence River (Hamr, 2002). Since its introduction to continental Europe, it has proved to be extremely invasive, active and aggressive (Holdich, 2002; Souty-Grosset et al., 2006; Lozan, 2000; Musil et al., 2010; Kouba et al., 2014), displacing native crayfish populations through competition for resources and the transmission of crayfish plague caused by the oomycete *Aphanomyces astaci* (Holdich et al., 2006; Kozubíková et al., 2006; Holdich and Black, 2007; Kozák et al., 2007; Musil et al., 2010; Pârvulescu et al., 2012). In the 1990s, the main catch in Hungary was the native *Astacus astacus*, but *F. limosus* is now the most abundant crayfish (Holdich et al., 2006). It is almost impossible to restock native crayfish where it is present (Souty-Grosset et al., 2006).”

The following information comes from laboratory and mesocosm experiments studying causal mechanisms for observed impacts.

From Tricarico (2022):

“In experimental flumes, Statzner et al. (2000, 2003) showed that *Faxonius limosus* at a fixed biomass (174 g/m²) significantly affected sand and gravel erosion. Its effect as a bioturbator varied as a function of the presence of refugia and aggression. Bioturbation by crayfish was found to change bedform roughness, physical particle consolidation, the proportion of sand in gravel interstices, sand cover by gravel, and the cover of filamentous algae. Such changes may in turn affect the abundance and structure of the entire benthic community, e.g., by modifying the substrate or by reducing algae and biofilm available for grazers. Also, sand reduction among gravel might alter the egg survival of gravel-breeding fish, like salmonids. Recent experiments conducted in seminatural conditions in the USA confirmed that the species is a bioturbator and can alter surface and subsurface gravel arrangement and bed topography (Albertson and Daniels, 2018).”

“Using mesocosm experiments, Hirsch and Fischer (2008) found that the invasive *Faxonius limosus* successfully repelled native young-of-year [YOY] burbot *Lota lota* from their preferred daytime shelters into alternative, previously unselected shelters. They also affected the nocturnal behaviour of YOY burbot by eliciting avoidance behavior, and caused an increase in the plasma cortisol levels. However, they did not change adult burbot behaviour.”

“*Faxonius limosus* is omnivorous and, being able to reach high densities, can impact native macroinvertebrates and macrophytes. Detritus and plant materials (including roots) were found to be the main component of its diet (Vojtkovská et al., 2014); combining laboratory and field approaches, Šidagytė et al. (2017) found that, compared to the European *Astacus leptodactylus* (*Pontastacus leptodactylus*), it has a more diverse predatory diet, being less selective, and can thus have a stronger effect on macroinvertebrate taxa sensitive to disturbances, possibly altering macroinvertebrate assemblages and compromising conventional ecological assessment.”

The following States regulate possession of crayfish within the family Cambaridae, which includes *Faxonius limosus*: Arizona (Arizona Game and Fish Commission 2022), California (CDFW 2021), Minnesota (Minnesota DNR 2022), Nevada (Nevada Board of Wildlife Commissioners 2022), New Hampshire (NHFG 2022), Oregon (ODFW 2022), Pennsylvania (PFBC 2022), Rhode Island (Rhode Island DEM 2022), Utah (Utah DWR 2020), Washington (Revised Code of Washington 2022), and Wisconsin (Wisconsin DNR 2022). See section 1.

4 History of Invasiveness

The History of Invasiveness for *Faxonius limosus* is classified as High. This species is established outside its native range in North America, Europe, and Africa. Several sources were found that provide clear, convincing, and reliable documentation of negative impacts. *F. limosus* is a host of *Aphanomyces astaci*, the causative agent of crayfish plague that is lethal to native

crayfish populations in Europe, can modify habitats, and is an omnivorous species that feeds on aquatic vegetation, fish eggs, and invertebrates thus affecting biodiversity.

5 Global Distribution

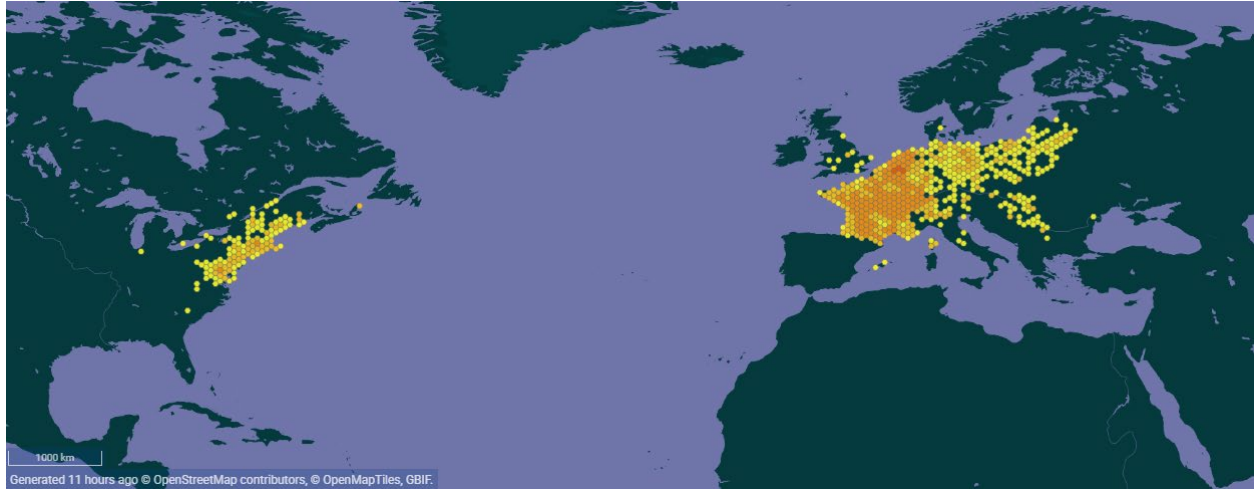


Figure 1. Reported global distribution of *Faxonius limosus*. Map from GBIF Secretariat (2023). Observations are reported from Europe and eastern North America. Some locations in the United States (see section 6) were not used in the climate matching analysis due to not representing established populations.

Locations of established populations of *Faxonius limosus* in Morocco were given in Madzivanzira et al. (2020).

6 Distribution Within the United States

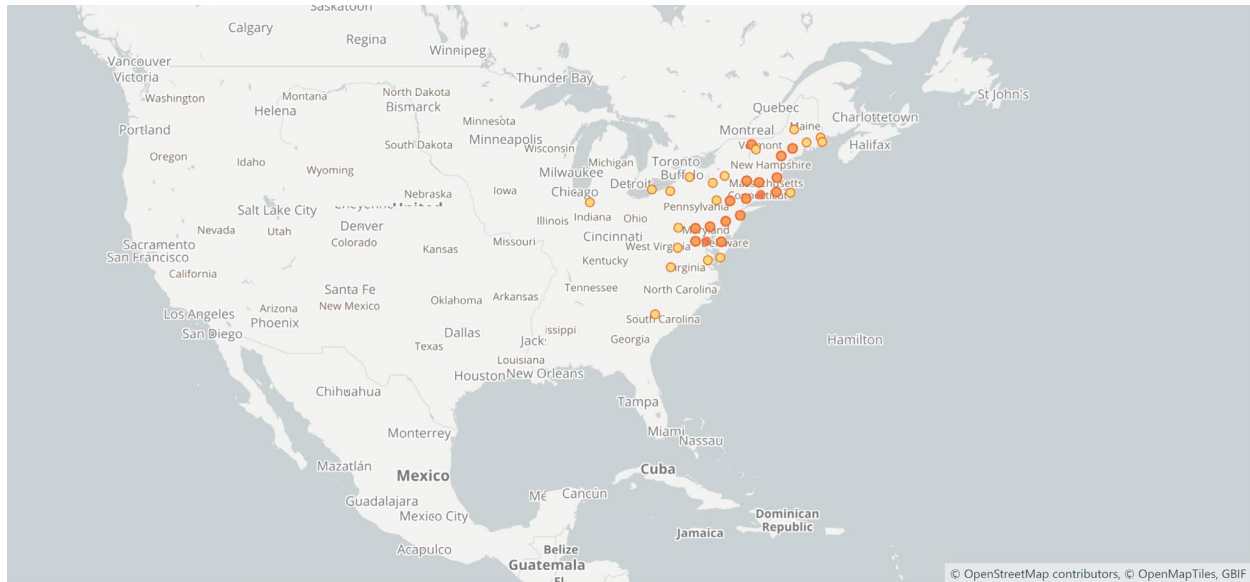


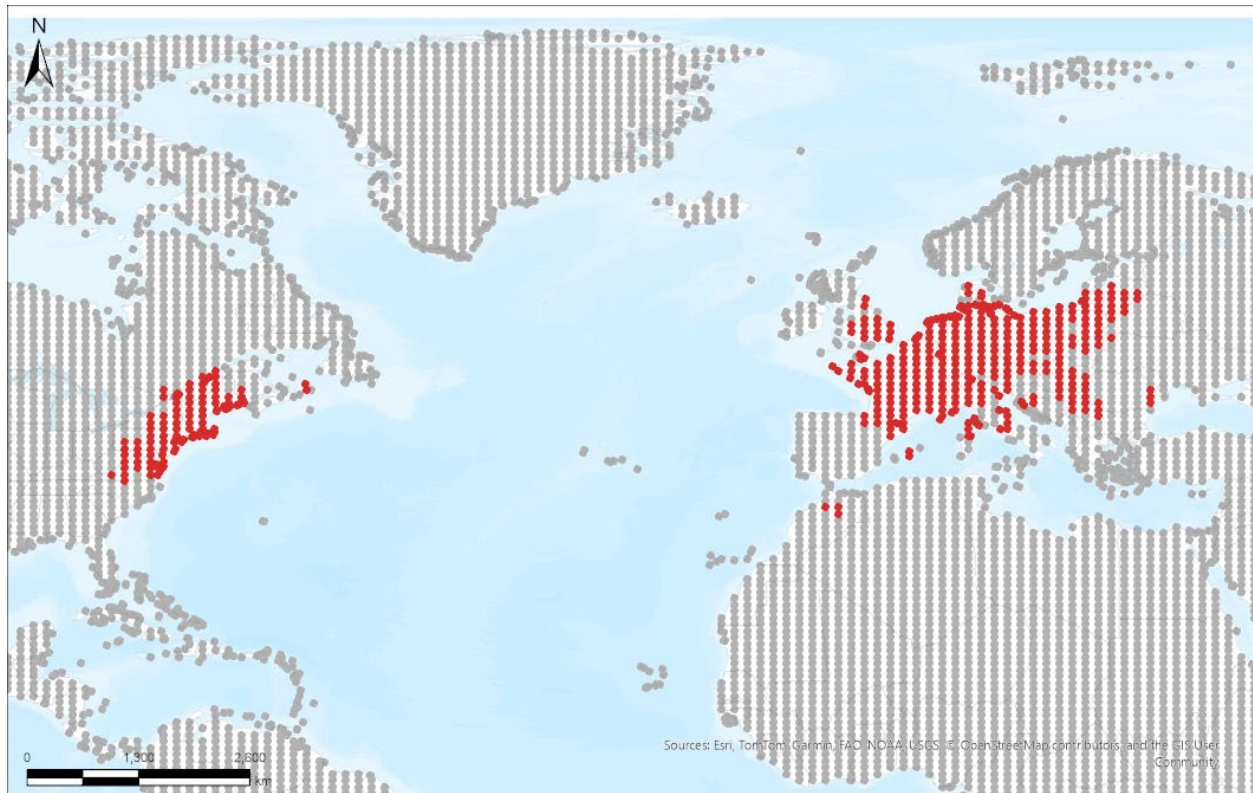
Figure 2. Reported distribution of *Faxonius limosus* in the United States. Map from GBIF-US (2023). Locations in Indiana, South Carolina, western New York, and western Pennsylvania were not used in the climate matching analysis because they could not be determined to represent established populations.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Faxonius limosus* in the contiguous United States was highest in the Mid-Atlantic and Northeast where this species is native. Areas of high match also extended into the Midwest and coastal Southeast. The rest of the climate match was generally medium, except for areas of low match in southern Florida and in the Pacific Northwest, primarily along the coast and in the Cascade and Sierra Ranges. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.888, indicating that Yes, there is establishment concern for this species outside its native range. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024).

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



Species: *Faxonius limosus*

Selected Climate Stations ●



RAMP

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Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations in the United States, Canada, and Europe selected as source locations (red) and non-source locations (gray) for *Faxonius limosus* climate matching. Source locations from Madzivanzira et al. (2020) 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.

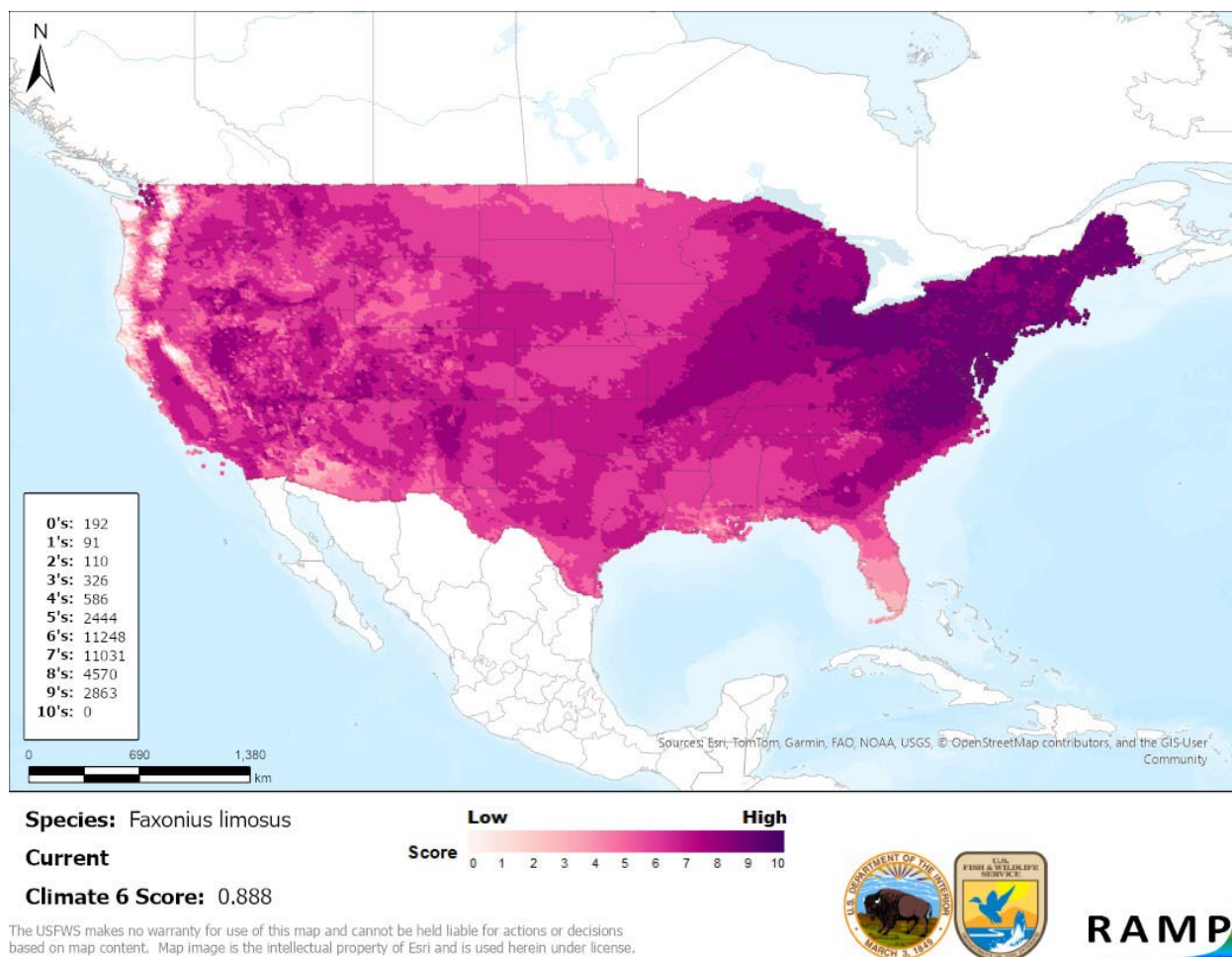


Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Faxonius limosus* in the contiguous United States based on source locations reported by Madzivanzira et al. (2020) and GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Faxonius limosus* is classified as High. Although there is uncertainty regarding the northern extent of the native range for this species in North America, records of introduction and establishment were available from other continents. Information was available from reliable sources regarding negative impacts.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Faxonius limosus, the Spiny-cheek Crayfish is native to Mid-Atlantic coastal drainages in the United States. *F. limosus* was introduced to Europe in 1890 has successfully spread to numerous countries. It has also been introduced to and become established in Canada and Morocco. This crayfish has been reported to occupy a wide range of habitats; reproduction can occur twice a year where females that mate in fall can store sperm until spring. Additionally, in a laboratory

setting females have reproduced through facultative parthenogenesis. *F. limosus* is reportedly used as live bait, in aquariums, and for human consumption. Although no States provide regulations specific to *F. limosus*, at least 11 States regulate either crayfish within the family Cambaridae, which includes *F. limosus*, or non-native crayfish in general. The History of Invasiveness for *F. limosus* is classified as High due to established populations outside its native range with confirmed negative environmental and social-economic impacts. The climate matching analysis for the contiguous United States indicates establishment concern exists for this species outside its native range, particularly in the Northeast, Midwest, and coastal Southeast. The Certainty of Assessment for this ERSS is classified as High. The Overall Risk Assessment Category for *F. limosus* 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: Uncertain native range. Documented as a host of *Aphanomyces astaci* (crayfish plague), a disease listed by the World Organisation for Animal Health (2023).**
- **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.

Aklehnovich A, Razlutskiy V. 2013. Distribution and spread of spiny-cheek crayfish *Orconectes limosus* (Rafinesque, 1817) in Belarus. *BioInvasions Records* 2(3):221–225.

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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 Madzivanzira et al. (2020) and GBIF Secretariat (2023).

Under the future climate scenarios (figure A1), on average, high climate match for *Faxonius limosus* was projected to occur in the Great Lakes, Mid-Atlantic, and Northeast regions of the contiguous United States. The areas of high and medium match in the eastern half of the contiguous United States contract northward over time, particularly under the SSP5 2085 scenario. Areas of low climate match were projected to occur in the Northern Pacific Coast and Southern Florida regions. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.327 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.838 (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 outside of the native range under future climate scenarios. The Climate 6 score for the current climate match (0.888, figure 4) falls above the range of scores for future projections. The time step and climate scenario with the most change relative to current conditions was SSP5, 2085, the most extreme climate change scenario. Under one or more time step and climate scenarios, areas within the Colorado Plateau and 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 the SSP5 2085 scenario, areas within the Appalachian Range, Colorado Plateau, Gulf Coast, Mid-Atlantic, Northeast, Southeast, Southern Atlantic Coast, and Southern Plains saw a large decrease in the climate match relative to current conditions. Additionally, under one or more time step and climate scenarios, areas within California, the Great Basin, Great Lakes, Northern Plains, Southern Florida, 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).

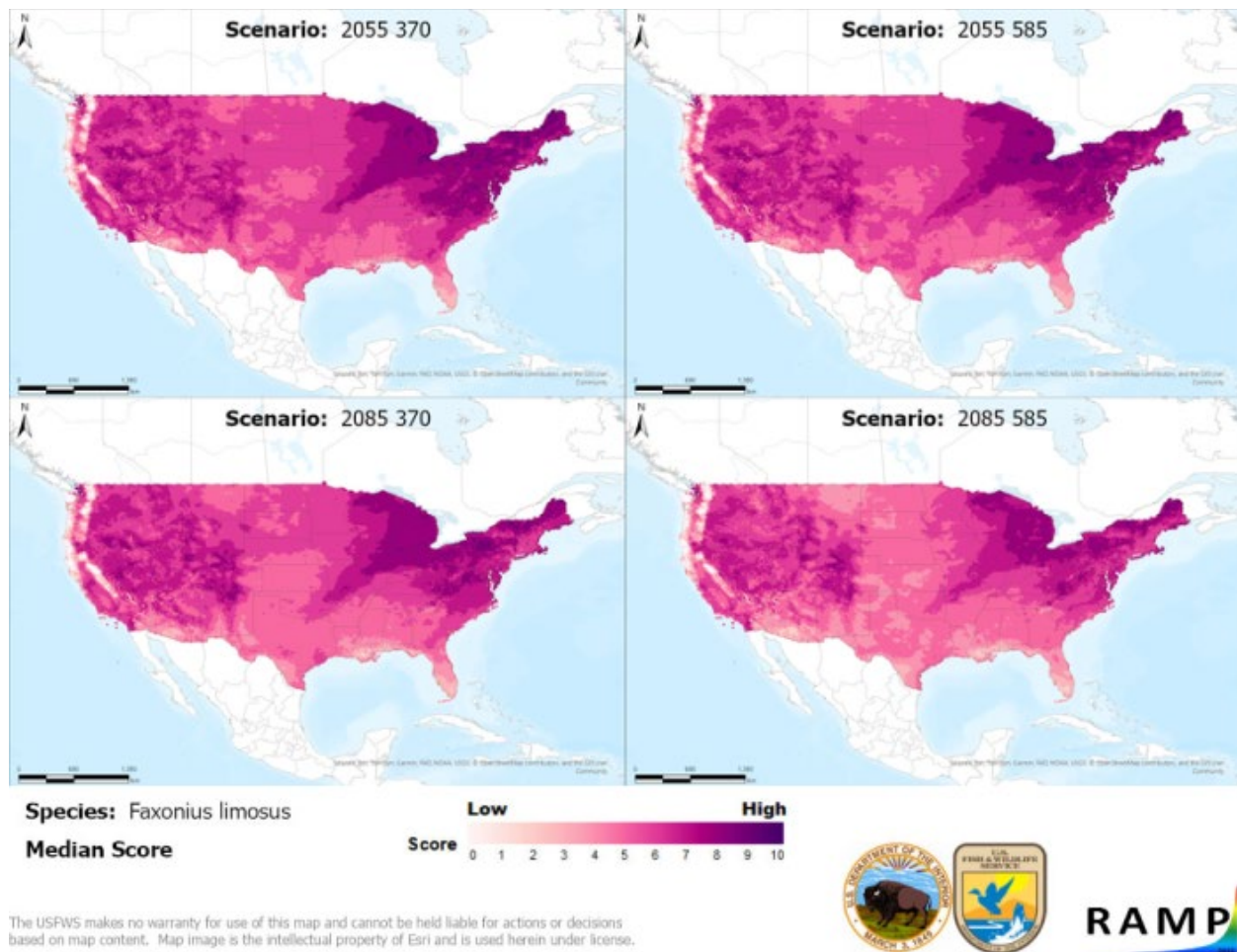


Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Faxonius limosus* in the contiguous United States. Climate matching is based on source locations reported by Madzivanzira et al. (2020) and GBIF 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.

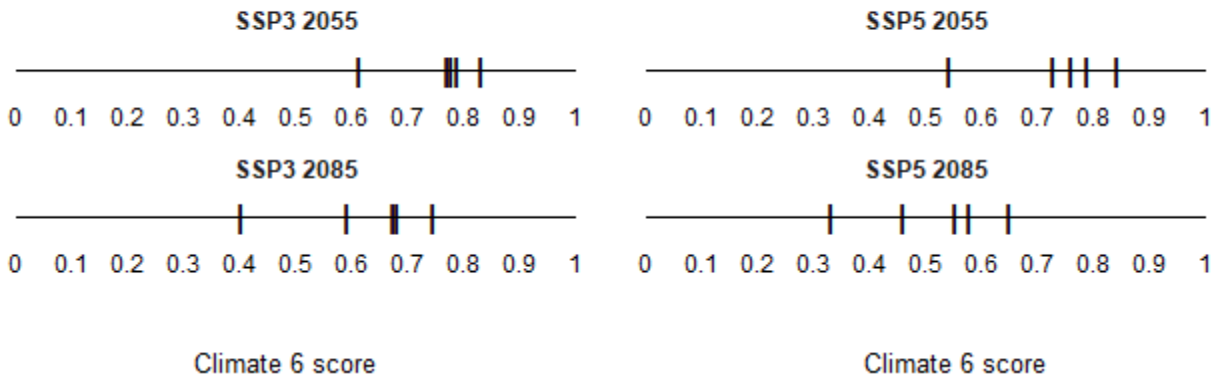


Figure A2. Comparison of projected future Climate 6 scores for *Faxonius limosus* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC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

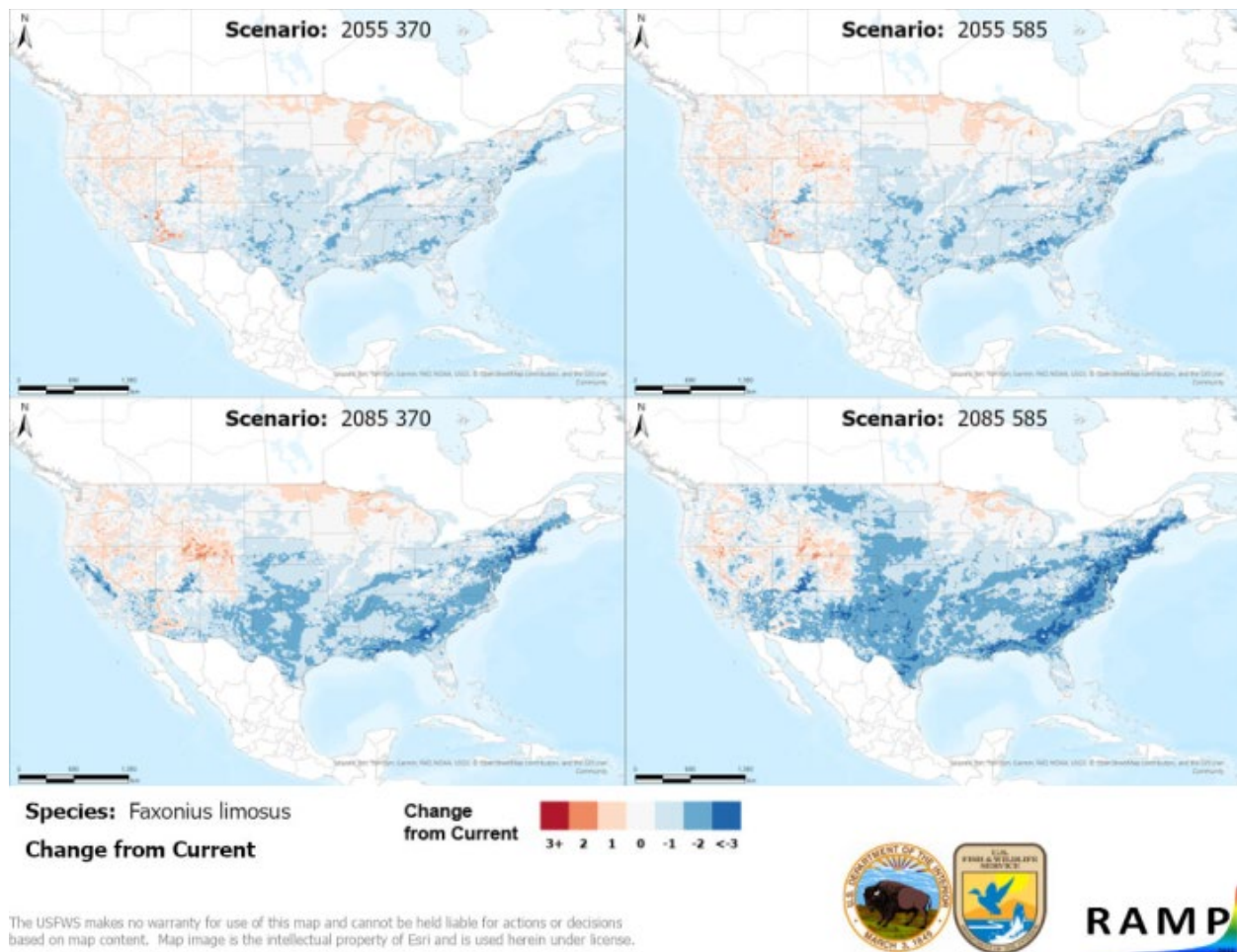


Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Faxonius limosus* based on source locations reported by Madzivanzira et al. (2020) 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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