Calico Crayfish (*Faxonius immunis*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, November 2023
Revised, November 2023
Web Version, 6/15/2026

Organism Type: Crustacean
Overall Risk Assessment Category: High



Photo: Astacoides. Licensed under CC BY-SA 3.0. Available: https://commons.wikimedia.org/wiki/File:Orconectes_immunis_Kalikokrebs_calico_crayfish.JPG (February 2020).

1 Native Range and Status in the United States

Native Range

From Hosabettu and Daniel (2023a):

"Native Range: Lakes Erie, Ontario, Huron, and Southern Lake Michigan, lower Ohio, and upper Mississippi drainages. Massachusetts to Wyoming and Alabama to Ontario, Canada (Hobbs, 1974)."

“This species extends as far east as Maine and Connecticut, and as far west as eastern Colorado and Wyoming. It's [sic] northernmost range includes southern Manitoba, Ontario and Quebec; It's [sic] southernmost range extends to Kentucky (Adams et al. 2010).”

Status in the United States

From Hosabettu and Daniel (2023a):

“Native Range: Lakes Erie, Ontario, Huron, and Southern Lake Michigan, lower Ohio, and upper Mississippi drainages. Massachusetts to Wyoming and Alabama […] (Hobbs, 1974).”

According to Hosabettu and Daniel (2026), *Faxonius immunis* is established outside its native range in Idaho, Pennsylvania, and Wisconsin. They also report occurrences of *F. immunis* outside its native range in Colorado, Connecticut, Iowa, Kentucky, Minnesota, Mississippi, Missouri, Nebraska, New York, South Dakota, and Wyoming.

From NatureServe (2023):

“Although Hobbs (1989) listed Alabama, no recent specimens have been found there. In Kentucky, it occurs commonly across the western half in the lower Ohio, Green, Cumberland, and Tennessee River drainages and in several Mississippi River tributaries but is most common in the lower Green River drainage (Taylor and Schuster, 2004). In Missouri, it occurs exclusively in teh [sic] Prairie Faunal Region and on the flood plains of the Missouri and upper Mississippi Rivers (Pflieger, 1996). In Kansas, it occurs in northeastern Kansas in the eastern Kansas and Marais des Cygnes River basins (Ghedotti, 1998). Populations have recently been found in Colorado in the Colorado River (Rogers, 2005). In New England, where scattered (occasionally large) populations are known from every major drainage system except the eastern coastal drainage systems, occurrences are likely the result of early introductions (Smith, 2000). Occurrences in the Lower Monongahela drainage in Pennsylvania were reported to USGS as introductions. In Ohio, it occurs widely, but spottily in the Lake Erie basin in the northern and northwetern [sic] part of the state (Thoma and Jezerinac, 2000). It occurs statewide in Indiana with the greatest abundance in southwest Indiana (Simon et al., 2005).”

From Adams et al. (2010):

“This species is widely used as bait in the United States […] (Taylor et al. 2005). Roughly 175 metric tonnes of crayfish are cultivated for the bait industry annually (Taylor et al. 2005). This species is not only cultivated but also harvested from the wild (Taylor et al. 2005).”

Faulkes (2015a) reports *F. immunis* (as *Orconectes immunis*) as traded online within the North American pet trade.

Regulations

Faxonius immunis is regulated under the common name “Calico Crayfish” in Colorado (CPW 2023). It is regulated as a member of the family Cambaridae in Arizona (Arizona Game and Fish Commission 2022), California (CDFW 2021), Georgia (State of Georgia 2023), Hawaii (HDOA

2019), Nevada (Nevada Board of Wildlife Commissioners 2022), New Mexico (NMDGF 2023), Oregon (ODFW 2022), Utah (Utah DWR 2023), and Washington (WDFW 2022). All crayfish species are regulated in Minnesota (Minnesota DNR 2022) and Pennsylvania (PFBC 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

Hosabettu and Daniel (2026) report "released aquarium" and "released bait" as potential pathways for reported *F. immunis* introductions.

Remarks

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

The following common names of *Faxonius immunis* were used to search for information for this report: paper shell crayfish, calico crayfish (Hosabettu and Daniel 2023a).

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to DecaNet editors (2026), *Faxonius immunis* (Hagen, 1870) is the accepted scientific name for this species.

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 immunis* (Hagen, 1870)

The following synonyms of *Faxonius immunis* from DecaNet editors (2026) were used to search for information for this report: *Orconectes immunis, Cambarus immunis, Cambarus signifier, Cambarus immunis spinirostris, Faxonius immunis pedianus*.

Size, Weight, and Age Range

From Hosabettu and Daniel (2023a):

"Size: 1.7 - 3.5 inches total length (Pflieger, 1987)"

Environment

From Adams et al. (2010):

"This is a generalist species often found in roadside ditches, as well as ponds, flood plains, drainage ditches and small sluggish streams. It also occurs in higher gradient gravel bedded streams (Pflieger 1996, Williams 1954). The substrate in the habitats of this species is generally soft mud or clay with abundant aquatic vegetation (Crocker and Barr 1968, Berrill 1978). […] Although this species has a broad ecological niche it is unable to colonize fast flowing streams of more than 26 cms^{-1} which restricts its distribution (Taylor et al. 2005)."

From Hosabettu and Daniel (2023a):

"[…] can tolerate high turbidity; […]"

From Wetzel and Brown (1993):

"*Orconectes immunis* has been shown to exhibit a preference for a [water] temperature of 21.5 C (Crawshaw 1983)."

From NatureServe (2023):

"It can sometimes be found in caves such as Blue Spring and Pless Caves in Indiana (Hobbs, 1976)."

Climate

From Palomares and Pauly (2020):

"Temperate"

Distribution Outside the United States

Native

From Hosabettu and Daniel (2023a):

"Native Range: […] It's [sic] northernmost range includes southern Manitoba, Ontario and Quebec […]"

Part of the native range for this species is within the United States, see section 1 for a complete description of the native range.

Introduced

From Adams et al. (2010):

"Since this species was introduced into Europe in the early 1990s is has steadily spread along the Rhine in Germany (Gelmar 2006)."

From Collas et al. (2012):

"The calico crayfish (*Orconectes immunis*) was thus first observed in France in 2010, in the Bas-Rhin department, in the basin of the Moder."

From NatureServe (2023):

"It also occurs in the northern portion Lake of the Woods, Ontario, Canada (Jansen et al., 2009) where it is considered invasive."

Means of Introduction Outside the United States

From Hosabettu and Daniel (2023a):

"Outside the United States, introduction is unclear; Schrimpf et al. (2013) suggests this species has spread via pet trades as well as bait bucket releases."

Short Description

From Hosabettu and Daniel (2023a):

"The calico crayfish is a plain, grey-green species characterized by a pale zone in the middle of the carapace and abdomen. Their chelipeds (pincers) have orange tips, with the exception of male chelipids that usually display a pale purple tint as breeding regalia (Smith 2013)."

Biology

From Adams et al. (2010):

"This species is also not an obligate burrower and so can also travel across dry ground, especially in wet weather and is thus able to move from pond to pond (Crocker and Barr 1968). This species is found to occur with other crayfish species such as *Cambarus bartonii, Fallicambarus fodiens, Orconectes propinquus, Orconectes rusticus rusticus, Orconectes virilis* and *Orconectes obscurus* (Berrill 1978, David et al. 1996, Hamr unpublished data)."

From Nature Serve (2023):

"Food Comments: Opportunistic but mostly detritus. Has been observed scraping algal growth from stones (Crocker [and Barr] 1968)."

"Reproduction Comments: Data suggest amplexus [mating behavior] anytime, brooding year-round but with late winter/early sping [sic] being principal brooding."

Human Uses

From Adams et al. (2010):

"This species is widely used as bait in the United States and Canada (Taylor et al. 2005). Roughly 175 metric tonnes of crayfish are cultivated for the bait industry annually (Taylor et al. 2005). This species is not only cultivated but also harvested from the wild (Taylor et al. 2005). This species is not thought to be commercially viable, however Taylor et al. (2005) have noted that it does grow to a suitable size."

Faulkes (2015b) reports *F. immunis* (as *Orconectes immunis*) as present in the pet trade in United States and Germany.

Diseases

***Faxonius immunis* has been documented as a carrier of crayfish plague, a disease listed by the World Organisation for Animal Health (2023).**

From Hosabettu and Daniel (2023b):

"*Faxonius immunis* are a known carrier of the crayfish plague; Schrimpf et al. (2013), found that *F. immunis* were able to spread crayfish plague to other species of crayfish co-existing with them."

Threat to Humans

From Hosabettu and Daniel (2023b):

"*F. immunis* are not known to pose a hazard or threat to human health."

3 Impacts of Introductions

From Herrmann et al. (2022):

"It [*F. immunis*] can build high population densities in ponds and oxbows (Goellner 1943; Crocker and Barr 1968; Chucholl 2012), changing the habitat drastically by reducing aquatic macrophytes to a minimum and increasing turbidity of the waterbody (Martens 2016)."

"The present study [of *F. immunis* invaded ponds in Germany] clearly shows strong impacts of *Faxonius immunis* on the studied macroinvertebrate communities. The decrease in

macroinvertebrate abundances, Shannon biodiversity indices and α-diversity along a crayfish-density gradient and the resulting increase in its dominance is clearly visible."

"The macroinvertebrate communities from ponds with high *F. immunis* densities in the present study were characterized by very low abundances in macrophyte-associated taxa, especially Odonata larvae and Mollusca. Even Ephemeroptera larvae, such as *Cloeon dipterum*, a species which was expected to be unaffected by the crayfish, had very low abundances in samples from high-density ponds. The effect on Odonata and Mollusca was most radical in pond A, which was monitored for dragonflies and molluscs in 2015, one year after its creation. It was documented as a very suitable habitat for dragonflies with eleven reproducing species (Schiel 2015). In 2019, after the *F. immunis* invasion, only two specimens derived from one species were present within the samples from pond A. In contrast to the seven recorded aquatic mollusc species in 2015 (Groh and Richling 2015), none was found again in the present study."

"As aquatic macrophytes and Characeae are reduced by *F. immunis*, mud becomes the dominant microhabitat structure in ponds with high crayfish densities. The increase in muddy character of a pond and the reduction of aquatic macrophytes is therefore one of the main indirect effects caused by this invasive crayfish."

The following information pertains to **potential** impacts from introduction of *Faxonius immunis*.

From Hosabettu and Daniel (2023b):

"*Faxonius immunis* are a known carrier of the crayfish plague; Schrimpf et al. (2013), found that *F. immunis* were able to spread crayfish plague to other species of crayfish co-existing with them. They are also considered a strong competitor; in a laboratory study, they were found to be dominant over size matched *Faxonius limosus*. Despite little information on *F. immunis* as an invasive species, Chucholl (2012) claimed that they had high potential effects on native biota and ecosystems because of their omnivorous diet, extensive burrowing, and high abundance."

Faxonius immunis is regulated in Arizona (Arizona Game and Fish Commission 2022), California (CDFW 2021), Colorado (CPW 2023), Georgia (State of Georgia 2023), Hawaii (HDOA 2019), Minnesota (Minnesota DNR 2022), Nevada (Nevada Board of Wildlife Commissioners 2022), New Mexico (NMDGF 2023), Oregon (ODFW 2022), Pennsylvania (PFBC 2022), Utah (Utah DWR 2023), and Washington (WDFW 2022). See section 1.

4 History of Invasiveness

The History of Invasiveness for *Faxonius immunis* is classified as High. There are records of nonnative introductions of *Faxonius immunis* that resulted in established populations in Germany as well as outside its native range within the United States. There is information on the impacts of *Faxonius immunis* introductions in Germany including significant changes to macroinvertebrate communities. The crayfish also have an impact on the habitat structure and macrophyte composition.

5 Global Distribution

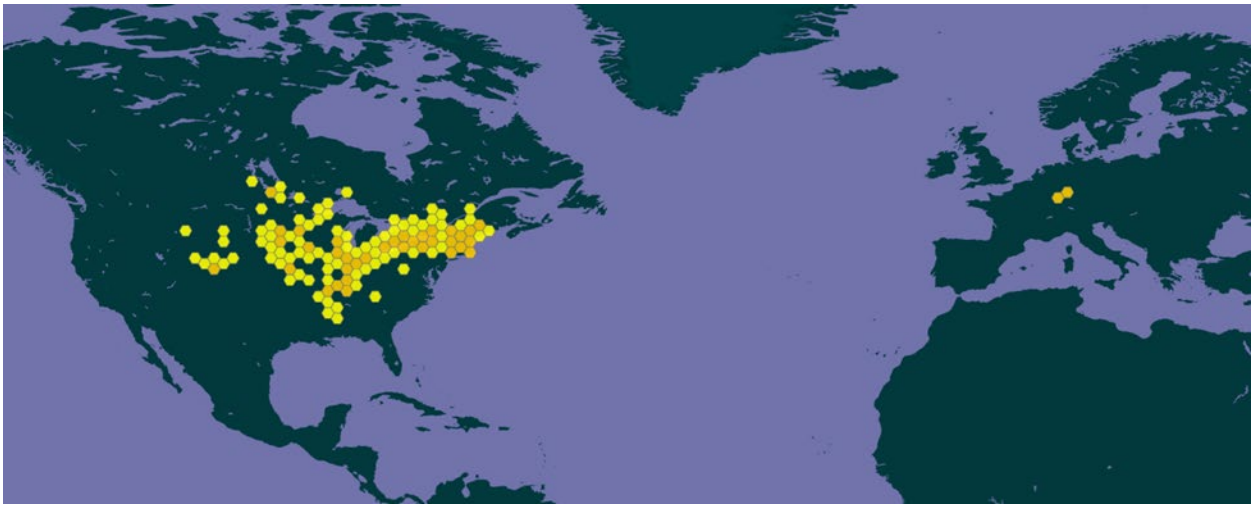


Figure 1. Reported global distribution of *Faxonius immunis*. Map from GBIF Secretariat (2023). Observations are reported from the United States, Canada, France, and Germany. The reported observations in western Colorado, Mississippi, northern Ontario, and eastern Tennessee were not included in the climate matching analysis because they are not known to represent established populations.

6 Distribution Within the United States



Figure 2. Reported distribution of *Faxonius immunis* in the United States. Map from Hosabettu and Daniel (2026). Yellow points indicate established populations. Orange points indicate other reported nonnative occurrences. The orange polygon indicates the native range of the species. Only established populations and points within the native range were used to select source locations for the climate matching analysis.

7 Climate Matching

Summary of Climate Matching Analysis

Areas of high climate match for *Faxonius immunis* in the contiguous United States include the Northeast, Great Lakes, and Great Plains regions. This area includes the native range of the species. High match also extended beyond the native range into the inland Southeast and west into the Great Basin. Areas of low climate match included the Pacific Coast, southwestern Arizona, extreme southern Texas, and the southern portion of the Florida Peninsula. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.878, 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 immunis* (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.

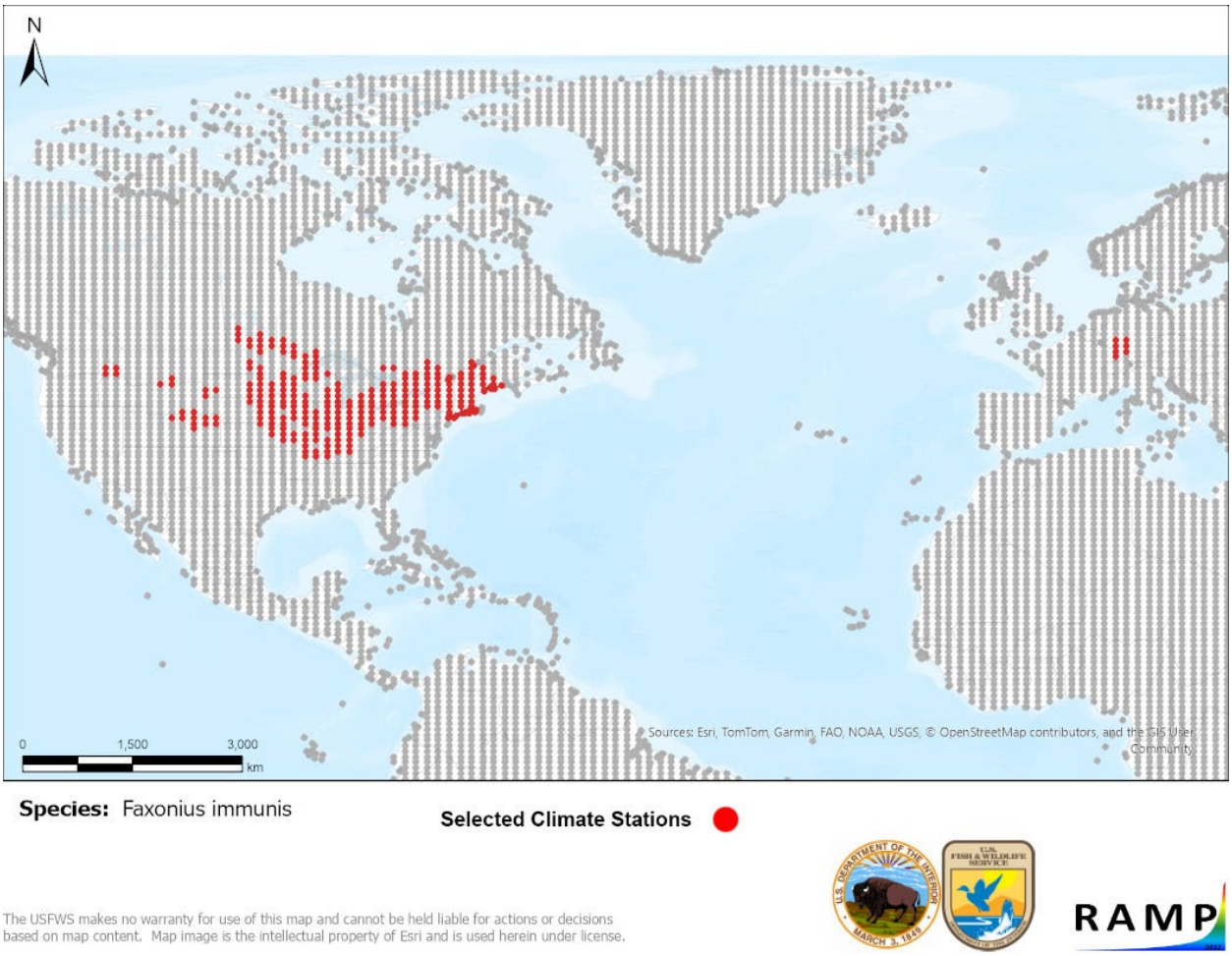


Figure 3. RAMP (Sanders et al. 2023) source map showing weather selected as source locations (red; United States, Canada, France, and Germany) and non-source locations (gray) for *Faxonius immunis* climate matching. Source locations from GBIF Secretariat (2023) and Hosabettu and Daniel (2026). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

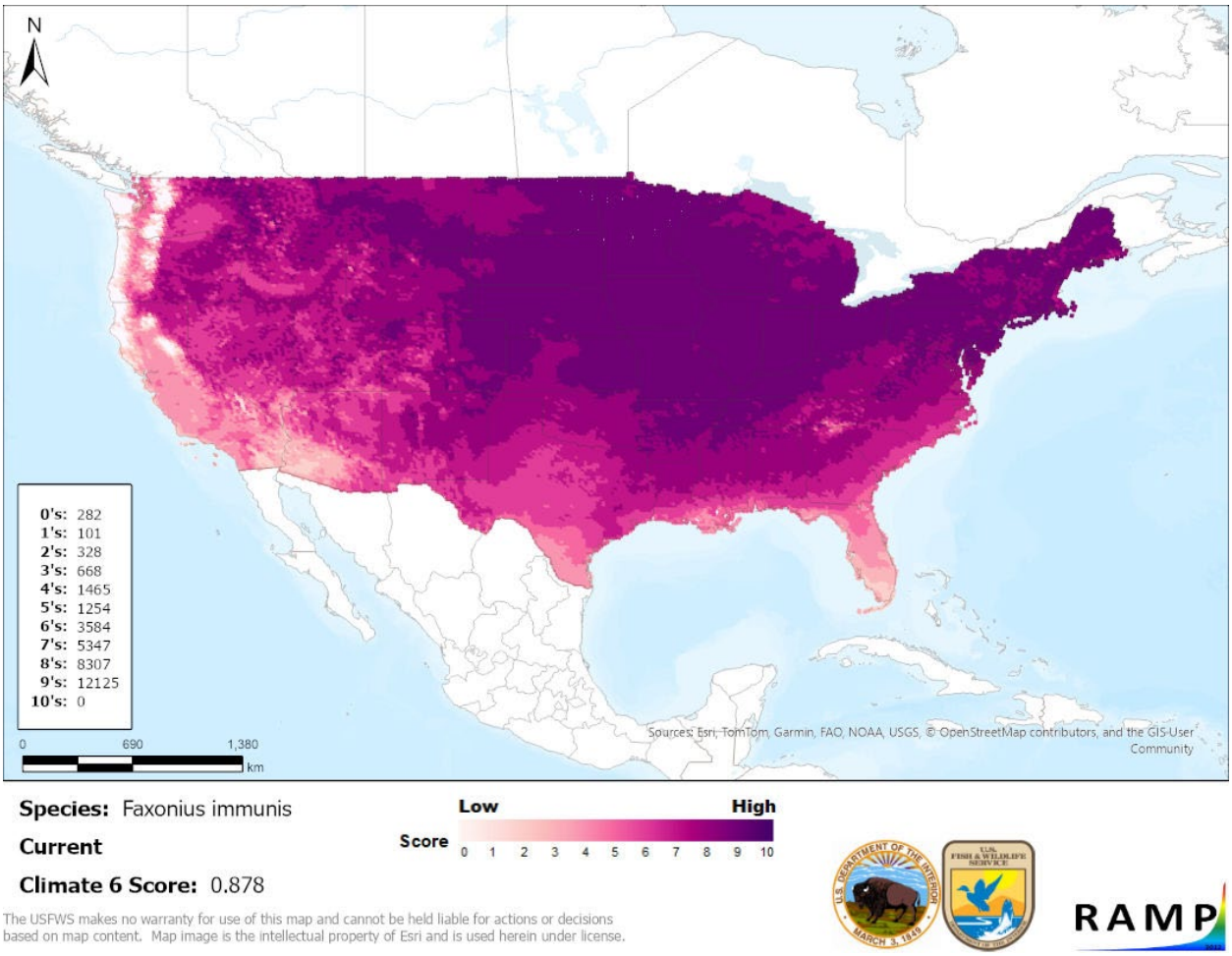


Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Faxonius immunis* in the contiguous United States based on source locations reported by GBIF Secretariat (2023) and Hosabettu and Daniel (2026). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

There is abundant and clear information about the biology and distribution of *Faxonius immunis.* There is credible information documenting establishment outside of the native range with negative impacts on local aquatic fauna and flora. Due to the credible information on impacts from introductions and known non-native establishment, the Certainty of Assessment for *Faxonius immunis* is classified as High.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Faxonius immunis, the Calico Crayfish, is a crustacean that is native to the midwestern and northeastern United States, and southeastern Canada. It is a generalist species that is commonly used as bait, but it also occurs in the pet trade in the United States and Germany. It has established populations along the Rhine River in France and Germany, as well as outside the

boundaries of its native range within the United States and Canada. Impacts of the established populations in Germany include significant changes to macroinvertebrate communities, and changes to habitat structure and macrophyte communities. This species is a known carrier of the crayfish plague. *F. immunis* is regulated in nine U.S. states. The History of Invasiveness for *Faxonius immunis* is classified as High due to the known nonnative population establishment and negative impacts of introduction. The climate matching analysis for the contiguous United States indicates establishment concern for this species outside its native range. High climate matches were concentrated in and around the native range but also extended west into the Great Basin and south into the inland Southeast. The Certainty of Assessment for this ERSS is classified as High because there was quality information available for each aspect of the assessment. The Overall Risk Assessment Category for *Faxonius immunis* 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: Carrier of crayfish plague, a disease listed by the World Organisation for Animal Health.**
- **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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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) and Hosabettu and Daniel (2026).

Under the future climate scenarios (figure A1), on average, high climate match for *Faxonius immunis* was projected to occur in the Appalachian Range, Great Lakes, Northeast, and Northern Plains regions of the contiguous United States. The areas of high match contracted north and east from time step 2055 to time step 2085 and from SSP3 to SSP5. Areas of low climate match were projected to occur in California, the Northern Pacific Coast, and Southern Florida regions, and these areas appeared relatively stable between scenarios. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.463 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.822 (model: GFDL-ESM4, 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 (0.878, 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 all time step and climate scenarios only minor or no increases in the climate match relative to the current match were observed. Primarily under SSP5, 2085, areas within the Appalachian Range, California, Colorado Plateau, Great Basin, Mid-Atlantic, Northeast, Northern Plains, Southeast, and Southern Plains saw a large decrease in the climate match relative to current conditions. Additionally, areas within the Great Lakes, Gulf Coast, Northern Pacific Coast, Southern Atlantic Coast, Southwest, and Western Mountains saw a moderate decrease in the climate match relative to current conditions under one or both of the scenarios at time step 2085. Additional very small areas of large or moderate change may be visible on the maps (figure A3).

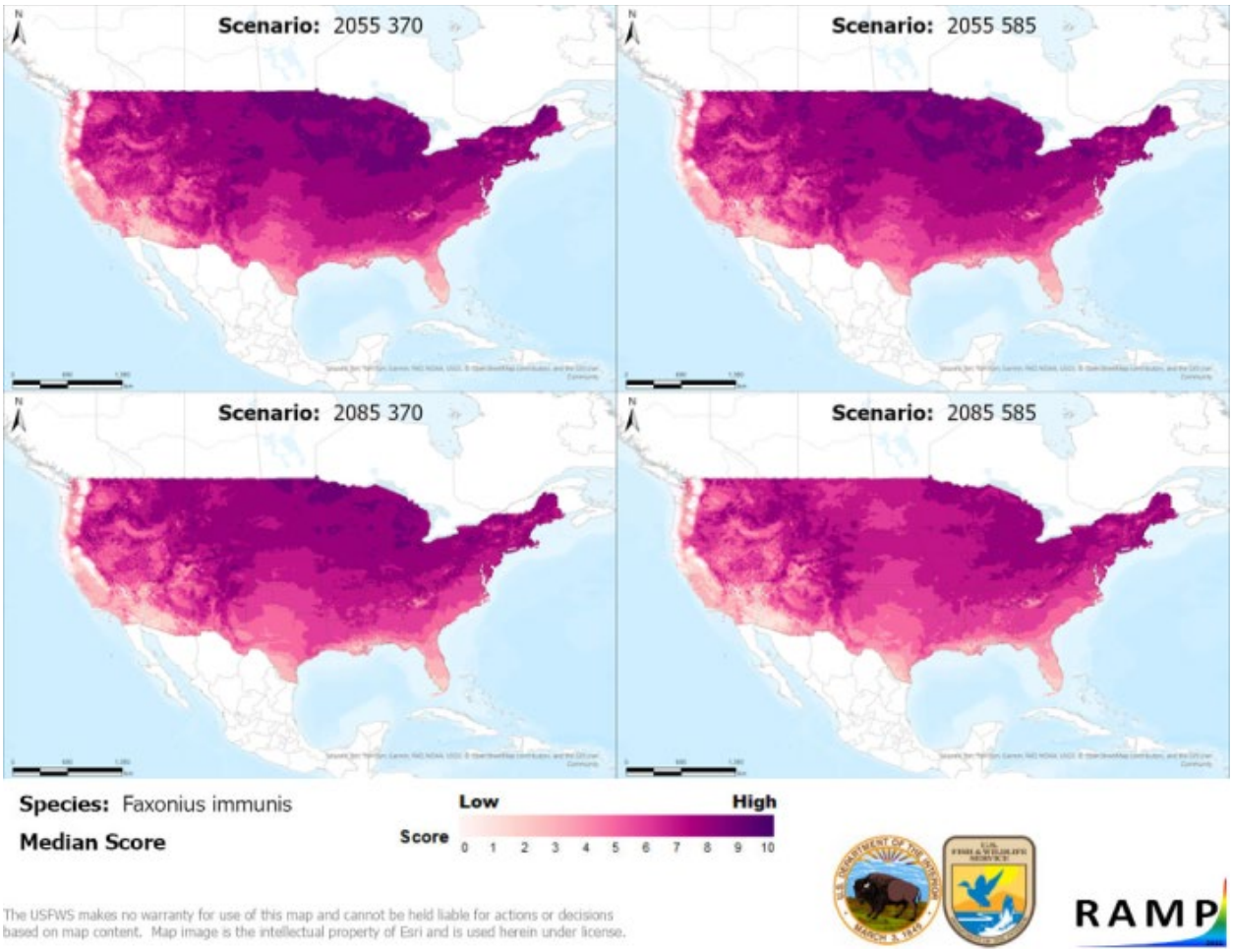


Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Faxonius immunis* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023) and Hosabettu and Daniel (2026). 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.

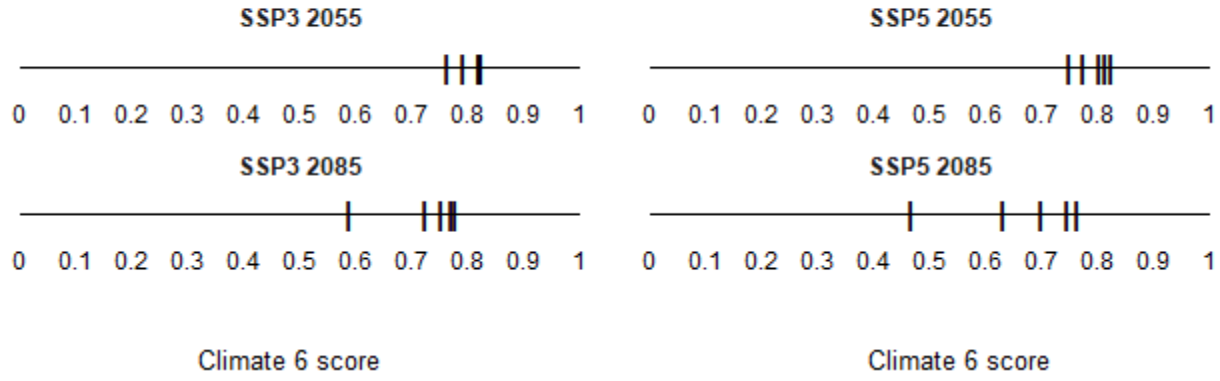


Figure A2. Comparison of projected future Climate 6 scores for *Faxonius immunis* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC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

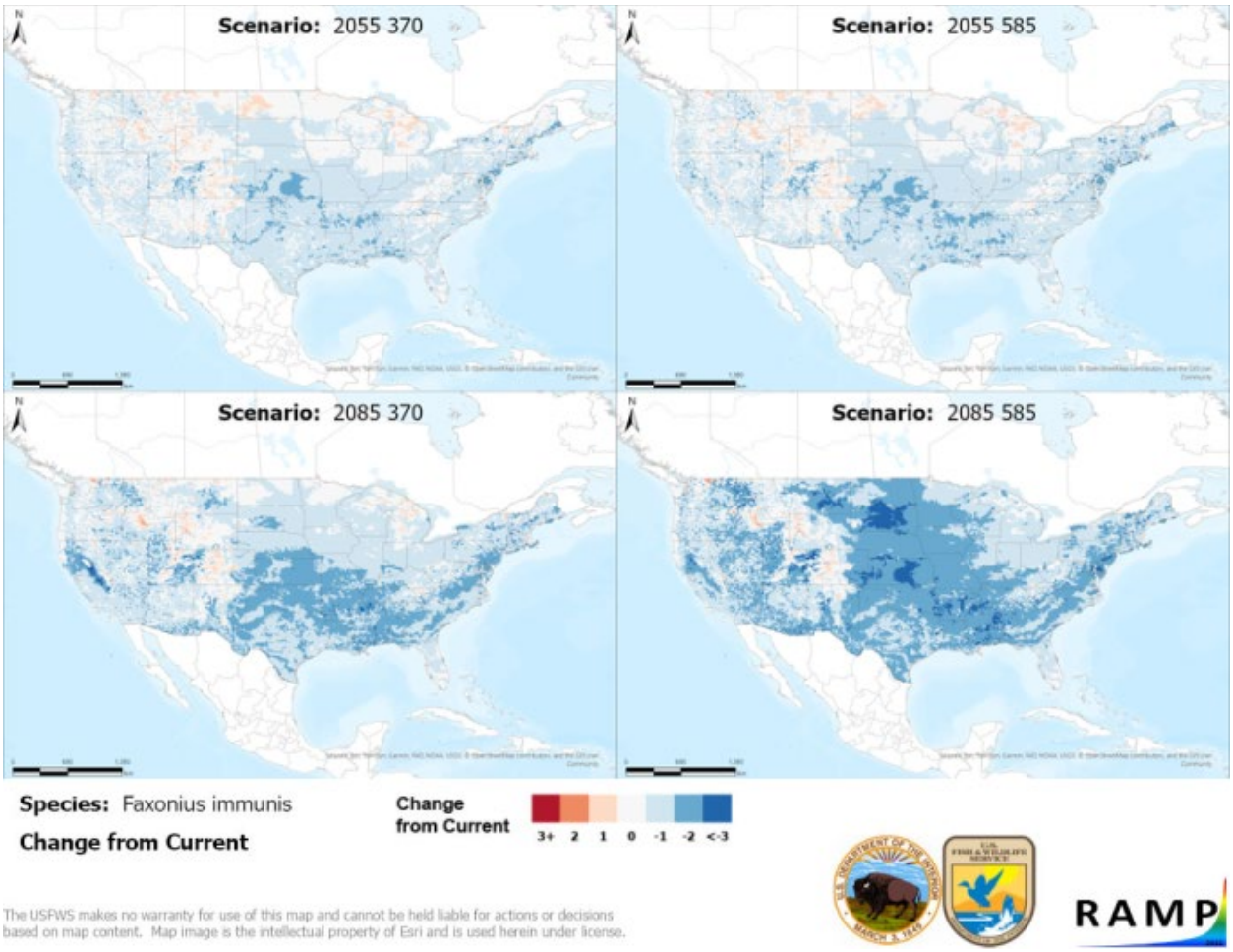


Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Faxonius immunis* based on source locations reported by GBIF Secretariat (2023) and Hosabettu and Daniel (2026). 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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