Ringed Crayfish (*Faxonius neglectus*)
Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, December 2022
Revised, January 2023
Web Version, 7/17/2024

Organism Type: Crustacean
Overall Risk Assessment Category: High

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1 Native Range and Status in the United States

Native Range

From NatureServe (2023):

"*Orconectes neglectus* [i.e., *Faxonius neglectus*, see Remarks] is native to the White River and Spring River (Neosho) drainages in the western Ozark region of Arkansas, Missouri, Oklahoma and Kansas (Pflieger, 1996)."

From Imhoff et al. (2012):

"The ringed crayfish, *Orconectes neglectus neglectus* (Faxon, 1885; […]), is native to streams in southwestern Missouri as well as portions of Arkansas, Colorado, Kansas, Nebraska, Oklahoma and Wyoming (Taylor et al. 2007)."

Status in the United States

From Imhoff et al. (2012):

"The ringed crayfish, *Orconectes neglectus neglectus* (Faxon, 1885; […]), is native to streams in southwestern Missouri as well as portions of Arkansas, Colorado, Kansas, Nebraska, Oklahoma and Wyoming (Taylor et al. 2007)."

From NatureServe (2023):

"*Orconectes neglectus* is native to the White River and Spring River (Neosho) drainages in the western Ozark region of Arkansas, Missouri, Oklahoma and Kansas (Pflieger, 1996). It was introduced into the Spring River (Black) drainage of Arkansas and Missouri sometime after 1984 and spread throughout the lower portion of the West Fork and into portions of the South Fork Spring River."

"This crayfish was recently reported as an exotic in western Colorado in most counties west of the Continental Divide in systems that eventually empty into the Colorado River (Sovell and Guralnick, 2005)."

"[…] has been introduced to Oregon (formerly considered distinct as *O. transfuga*- see Bouchard, 1977) into the Rogue River Basin where it is well established, and recently the John Day River (Rogers, 2005)."

From Daniels et al. (2001):

"*Orconectes neglectus*, a crayfish native to the Mississippi River drainage in Arkansas, Oklahoma, Missouri, and Kansas, is reported from streams in southeastern New York for the first time. This species is the newest component of a crayfish fauna that is increasingly dominated by introduced species. […] this species is established and reproducing in clear, rubble-bottom streams in southeastern New York [lower Hudson River drainage]."

From Wells and Sytsma (2014):

"The detection of *O. neglectus* (ringed crayfish) in Hyatt Reservoir expanded their distribution in southern Oregon. *O. neglectus* have been found in the lower, middle and upper Rogue River drainage as well as the Applegate River, Cow Creek, and Willow Lakes. In 2012, PSU [Portland State University] crews found *O. neglectus* in Little Hyatt Reservoir, which is connected to Hyatt Reservoir by Keene Creek."

From Pearl et al. (2013):

"We found invasive *Orconectes n. neglectus* (Faxon, 1885) at 68% of sites in the Rogue basin and provide first documentation of their broad distribution in the Umpqua basin [Oregon]."

"*Orconectes n. neglectus* was present in the Rogue basin [Oregon] from at least 1960 (NMNH #178213) and occupied ≥2 km of river by 1962 (Fitzpatrick 1966). It may have arrived significantly earlier: Rivers (1963) included reference to *O. n. neglectus* in his description of Rogue basin fisheries as of 1941. Historic data and our sampling suggest *O. n. neglectus* has continued to expand around the Rogue basin."

Faulkes (2015) reports that *F. neglectus* is present in the online pet trade in North America; however, recent Google searches could not find individuals for sale in the United States.

Regulations

While effort was made to find all applicable regulations, the following list may not be comprehensive.

Faxonius neglectus is prohibited in Colorado west of the continental divide (Colorado Parks and Wildlife 2022) and Wisconsin (as a nonnative crayfish, Wisconsin DNR 2022).

The family Cambaridae, which includes *Faxonius neglectus*, is prohibited in New Mexico (NMDGF 2023), Nevada (Nevada Board of Wildlife Commissioners 2022), Utah (Utah DWR 2023), and Washington (WDFW 2022). The family Cambaridae is restricted in Arizona (Arizona Game and Fish Commission 2022) and California (CDFW 2021). The family Cambaridae is controlled in Georgia (State of Georgia 2023) and Oregon (ODFW 2022),

Means of Introductions in the United States

From Daniels et al. (2001):

"The presence of *Orconectes neglectus* in the area [southeastern New York] may result from a bait-bucket or pet trade release or an accidental release during a fish-stocking operation. Given the life span of this species and the presence of several large individuals in the area, it is likely that the initial release occurred over five years ago."

From Imhoff et al. (2012):

"The source and timing of the invasion [of the Eleven Point River drainage, Missouri] is unknown. 'Baitbucket introductions' by recreational fishers are generally considered the primary vector for alien crayfish introductions in North America (Lodge et al. 2000), but *Orconectes n. neglectus* is not on the state of Missouri's Approved Aquatic Species List (AASL; State of Missouri 2011) for commercial trade, and thus not legally sold in fishing bait shops. However, 62% of Missouri's known crayfish invasions involve species not on the AASL (R.J. DiStefano, unpublished data). Missouri fishing license holders are permitted to catch wild crayfish for several uses (bait, human consumption, pets, etc.; State of Missouri 2011), and we suspect that

wild-caught crayfish are being transported across drainage basin boundaries and released to the wild."

From Pearl et al. (2013):

"Observed crayfish distribution, vectors reported elsewhere, and the lack of evidence of local aquaculture suggest *O. n. neglectus* and *P. clarkii* invasions in our area are related to bait releases or stocking with game fish. […] Bouchard (1977) concluded that *O. n. neglectus* in the Rogue basin arrived with stocked warm water fishes or anglers, with the latter the likely mode at the disjunct sites found in the 1970's."

Remarks

From Crandall and De Grave (2017):

"We have revised the classification of the North American taxa, especially at both generic and subgeneric levels, based on recent phylogenetic results. […] The surface-dwelling taxa now excluded from *Orconectes* sensu stricto are herein placed in the resurrected genus *Faxonius* Ortmann, [1905] […]"

From Daniels et al. (2001):

"Williams (1954) recognized two subspecies; the nominate subspecies [*O. n. neglectus*] is present in the Arkansas, Kansas, and Platte River drainages and *O. n. chaenodactylus* inhabits streams in the North Fork of the White River drainage (Williams 1952). Intergrades between the subspecies have been reported (Pflieger 1996). Key characteristics that differentiate the subspecies include the shape and size of the gape of the cheliped, the presence of a branchiostegal spine, the shape of the rostrum, and the extent of the broadening of the mesial process (Williams 1952, 1954)."

DecaNet (2024) lists *Faxonius neglectus chaenodactylus* (Williams, 1952) and *Faxonius neglectus neglectus* (Faxon, 1885) as accepted subspecies of *F. neglectus*. *Orconectes neglectus* (Faxon, 1885) and *Cambarus neglectus* Faxon, 1885 are listed as synonyms.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

According to DecaNet (2024), *Faxonius neglectus* (Faxon, 1885) is the accepted name for this species. Both the accepted name and the synonyms *Orconectes neglectus* and *Cambarus neglectus* were used in information searches for this report.

From ITIS (2022):

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 neglectus* (Faxon, 1885)

Size, Weight, and Age Range

From Price and Payne (1984):

"Young-of-the-year appeared in open water samples in May, grew rapidly, and, according to Price & Payne (1979), probably reached minimum adult size of 13.5 mm by November."

"The maximum age attained by *O. n. chaenodactylus* is at least 5 years for males and 4 years for females […]. Apparently few individuals reach these maxima, and the normal life span of this species is about 3 years for both sexes."

From Daniels et al. (2001):

"First and second form males and females ranged in size from 7.5 - 40.9 mm carapace length."

Environment

From NatureServe (2023):

"It occurs in clear, rocky permanent flowing streams ranging in size from small creeks to large rivers; often in rocky riffles and shallow pools having sufficient current to keep the bottom largely free of silt (Pflieger, 1996)."

From Daniels et al. (2001):

"The nine sites [in New York] supporting *Orconectes neglectus* were similar and matched the descriptions of streams in its native range (Williams 1954). All were first or second order streams with clear, cool, flowing water. Rubble and boulder dominated substrates, but gravel, sand, and silt were noted at a few sites. Collection sites were shallow, ranging from 3-100 cm, but *O. neglectus* was never taken in the deeper pools. Sites were basic, with pH ranging from 7.6 to 9.0."

Rabalais and Magoulick (2006) collected *F. neglectus* [reported as *Orconectes neglectus*] from a stream in the Spring River drainage of Arkansas and Missouri where water temperatures ranged from 11.9°C to 30°C over the course of several months.

Mouser et al. (2019) reported on a population of *F. neglectus* in a cave environment, specifically Tumbling Creek Cave in southwestern Missouri.

Climate/Range

No information regarding climatic requirements of *Faxonius neglectus* was found.

Distribution Outside the United States

Native

The native range of *Faxonius neglectus* is wholly within the United States. See section 1 for a description of the native range.

Introduced

This species has not been reported as introduced outside the United States.

Means of Introduction Outside the United States

This species has not been reported as introduced outside the United States.

Short Description

From Daniels et al. (2001):

"In life, the dorsal surface of the carapace of *Orconectes neglectus* is light brown or yellow behind the cephalic groove and dark anterior to it. There is a wedge of black or dark brown on each side of the carapace that extends forward laterally. Ventral to the dark band is a wedge of yellow and ventral to the yellow band is a dark one along the ventral edge of the thorax. The chelipeds are tipped in orange and proximal to the orange is a wide, dark ring. Width of this ring is typically 30-40% of the length of the dactyl. This color pattern is weakly retained in preserved specimens. *O. neglectus* does not have the postero-lateral red spot on the carapace typical of *O. rusticus*."

From Schainost (2016):

"Another color characteristic […] is the rusty-red tinge on the edges of the telson (tail). Again, this is most visible on freshly molted specimens."

"One of the key identification characters of many crayfishes is the shape of the first pleopod of a Form I male. The terminal elements of the first pleopod of the Ringed crayfish are straight with the mesial process having a slightly flattened end."

"The aureola in the Ringed crayfish is wide but not well defined. There is room for several rows of punctuations."

"The rostrum of the Ringed crayfish is generally similar to that of the Northern and Rusty crayfishes except that it has a bump (median carina) in the center."

"The claw of the Ringed crayfish is shorter and stouter than those of the Northern or Calico crayfishes. The movable finger (dactyl) is straight in young specimens but develops a distinctive curve as they get older. The surface of the claw is smooth and there are no setae between the fingers. The size of the gap between the fingers can vary with sex and age. As a rule, larger Ringed crayfish have larger finger gaps. Form I males also develop larger gaps than females or Form II males."

Biology

From NatureServe (2023):

"It is the most abundant crayfish in its range with the most general habitat requirements (Pflieger, 1996)."

From Price and Payne (1984):

"Detritus is a major component of the diet of *O. n. chaenodactylus* (cf. Price, unpubl.), and the upper 5 m of riffle offer the best combination of nutrients and protection."

From Schainost (2016):

"A detailed study of the habitat use of the Ringed crayfish in an Ozark stream was done in Oklahoma. Here males tended to prefer slighter deeper water than females. Areas with gravel/cobble substrate were dominated by juveniles whereas adults preferred beds of vegetation (*Myriophyllum*). Juveniles inhabited areas of moderate velocity whereas adults occupied low velocity as well as high velocity areas [Gore and Bryant 1990]."

"Ringed crayfish here [in Nebraska] most commonly use the cover provided by overhanging grasses (especially exposed grass root mats) and vegetation along the banks. They also use beds of aquatic vegetation or algae that may be found along shorelines or in mid-channel beds, particularly in the Niobrara River, though these are less common than shoreline grasses. While woody debris may be present in theses streams, I seldom find Ringed crayfish here."

"I have not found the Ringed crayfish to burrow in Nebraska. Even in drying streams, dewatered canals, or periods of no flow, they were not found to dig burrows. Instead they were found in small cavities excavated beneath rocks or logs. The cavity is exact size and shape of the crayfish with no room to turn or move around as if they had wiggled their way under the rock."

"For Ringed crayfish in southern Missouri, breeding occurs from October to April. Females were carrying eggs between late March and mid-May and the eggs were hatching by mid-May. Females in a coldwater streams [sic] were still carrying eggs and young as late as June 20 when those in other localities had no young anymore [Harris 1903; Pflieger 1996]. In Missouri, egg counts on 18 females (41 to 79 mm), found an average of 245 eggs, ranging from 54 to 505). The bright yellow eggs were 1.6 to 2.0 mm in diameter [Pflieger 1996]. Ringed crayfish juveniles (5-10 mm) in Kings Creek, Kansas, did not begin showing up until July and August. […] In an Oklahoma stream, adults occupied backwater areas most of the year but, in the spring, egg-

bearing females moved to the higher-velocity riffles. Perhaps, as a result, juveniles were more commonly found in high-velocity areas [Gore and Bryant 1990]."

"One study looked at the gut contents of Ringed and Water Nymph [*Faxonius nais*] crayfishes in Kings Creek, Kansas. There was little difference between the two and they consumed leaves (42%), animal matter (16%), filamentous algae (13%), detritus (23%), and diatoms (6%). Of these, leaves contributed 46% to annual production while animal matter contributed 29%. The animal matter was mostly other crayfish, dragonflies and mayflies [Evans-White et al. 2003]."

Human Uses

This species has been reported in the pet trade in Germany (Garnelio 2023).

Faulkes (2015) reports that *F. neglectus* is present in the online pet trade in North America; however, recent Google searches could not find individuals for sale in the United States.

From Imhoff et al. (2012):

"Missouri fishing license holders are permitted to catch wild crayfish [including *F. neglectus*] for several uses (bait, human consumption, pets, etc.; State of Missouri 2011) […]"

Diseases

***F. neglectus* has been documented as a carrier of the crayfish plague, a disease listed by the World Organisation for Animal Health (2022).**

Panteleit et al. (2017) identify *F. neglectus* [under the name *Orconectes neglectus*] as a carrier of the crayfish plague pathogen, *Aphanomyces astaci*.

Threat to Humans

No information available.

3 Impacts of Introductions

From Rabalais and Magoulick (2006):

"*Orconectes neglectus chaenodactylus* have invaded portions of the Spring River drainage and appear to have displaced *Orconectes eupunctus* from parts of their range. Results from our study suggest that adult male *Orconectes eupunctus* are capable of growing and surviving in their former range when protected from predation and competition. However, adult male *O. neglectus chaenodactylus* did not negatively effect [sic] the growth and survival of adult male *O. eupunctus* in a field competition experiment. Therefore, competition may not be the mechanism underlying this displacement. It is possible that competition could be taking place between other combinations of age class and sex or during other periods of the year. *Orconectes eupunctus* may be better adapted to larger streams than smaller tributaries and so may be more susceptible to displacement from upstream reaches. Further study is needed to examine other potential mechanisms in the displacement of *O. eupunctus* from the West Fork Spring River."

From Magoulick and DiStefano (2007):

"We recently found that an Ozark endemic crayfish, *Orconectes neglectus*, has been introduced into the Spring River drainage of southern Missouri and northern Arkansas and appears to have the potential to negatively impact the native communities. We used quantitative kick netting along the Spring River and selected tributaries to determine the distribution and abundance of *O. neglectus* and its potential to impact native crayfish species. The native crayfishes *Orconectes eupunctus*, a species of special concern, and *Cambarus hubbsi* appear to no longer occur throughout much of their former range in the Spring River drainage where *O. neglectus* is now abundant. *Orconectes eupunctus*, *C. hubbsi*, and *O. neglectus* mainly used fast-flowing riffle and run habitats with a mix of gravel, cobble, and boulder, whereas the other common species collected, *Orconectes punctimanus* and *Orconectes ozarkae*, were more generalists in habitat use and were found at all sampled sites. *Orconectes eupunctus* and *C. hubbsi* were positively associated with each other, but negatively associated with *O. neglectus*, despite their similar habitat use. These results provide evidence that *O. neglectus* is expanding its range, possibly to the detriment of *O. eupunctus* and *C. hubbsi*. An intensive field survey and manipulative experiments would be required to confirm the disappearance of the native species, and the mechanisms involved."

From Magoulick (2014):

"I examined the effects of drought (drought or control) and crayfish presence (none, native crayfish *Orconectes eupunctus* or invasive crayfish *Orconectes neglectus*) on stream mesocosm structure and function (leaf breakdown, community metabolism, periphyton, sediment and chironomid densities) in a fully factorial design."

"I found some subtle differences between crayfish species effects, including that sediment and AI [autotrophic index] were lower in *O. eupunctus* treatments than in *O. neglectus* treatments. This suggests that *O. eupunctus* may be more active in benthic foraging than are *O. neglectus* and that *O. eupunctus* foraging activity reduces algae relative to other components of the periphyton, either by targeting it or as an indirect effect. It is possible that these subtle differences could cascade throughout the food web, but further research is needed to address this question."

"Although I found some differences between effects of native and invasive crayfish, in large part, the native and invasive crayfish species appeared ecologically redundant in this mesocosm experiment."

From Pearl et al. (2013):

"[…] we found *O. n. neglectus* and [*Pacifastacus*] *leniusculus* distributions were roughly independent of one another. We had expected some effect of *O. n. neglectus* on *P. leniusculus* […] This occupancy analysis is focused on species presence, so we cannot make conclusions regarding effects on abundance."

"It is also possible that our study represents different stages of invasion in the Rogue and Umpqua basins, and effects of invaders take varying time to become evident (e.g., Westman et al. 2002). We tended not to find the two species together on the main stem Rogue River where *O. n. neglectus* has been established for at least 50 yr. If the streams listed above experienced more recent *O. n. neglectus* expansions, they have had less time to manifest negative effects on *P. leniusculus*. We know little about the timing of the Umpqua invasion and available data imply that *O. n. neglectus* can spread rapidly in these riverine systems. The oldest *O. n. neglectus* records we found in the Umpqua basin were from 1994 on the North Umpqua (a tributary of mainstem Umpqua River; INHS #4879) and 2001 in a reservoir on a tributary of the South Umpqua (the other major tributary; INHS #8400). If invasion is more recent in the Umpqua than Rogue, effects on *P. leniusculus* might not yet be evident, particularly at the level of complete displacement from a site."

The following information pertains to *potential impacts* from *Faxonius neglectus* introductions and was not used to evaluate History of Invasiveness (see below).

From Johnson et al. (2014):

"Mercury concentrations were measured in 2 nonnative and 1 native crayfish species from western Oregon (USA). Nonnative red swamp crayfish [*Procambarus clarkii*] had mercury concentrations similar to those in native signal crayfish [*Pacifastacus leniusculus*] (0.29 ± 0.05mg/g dry wt and 0.36 ± 0.06mg/g dry wt, respectively), whereas the nonnative ringed crayfish had lower mercury concentrations (0.10 ± 0.02mg/g dry wt) than either of the other species. The mean energy content of muscle was similar between the native signal crayfish and nonnative ringed crayfish but was significantly higher in the nonnative red swamp crayfish. Across species, mercury concentrations were negatively correlated with energy density. Such energetic differences could exacerbate changes in mercury transfer through trophic pathways of food webs, especially via alterations to the growth dynamics of consumers."

From Mouser et al. (2019):

"Regardless of why they entered the cave, gapped ringed crayfish [*Faxonius neglectus chaenodactylus*] are capable of establishing populations relatively high in abundance that warrant substantial financial efforts to reduce. This is especially important in areas where predation risk on federally threated and endangered species may be heightened, as is the case for the endangered Tumbling Creek cavesnail."

Faxonius neglectus is regulated in Arizona (Arizona Game and Fish Commission 2022), California (CDFW 2021), Colorado (Colorado Parks and Wildlife 2022), Georgia (State of Georgia 2023), Nevada (Nevada Board of Wildlife Commissioners 2022), New Mexico (NMDGF 2023), Oregon (ODFW 2022), Utah (Utah DWR 2023), Washington (WDFW 2022), and Wisconsin (Wisconsin DNR 2022). See section 1 for more information.

4 History of Invasiveness

The History of Invasiveness for *Faxonius neglectus* is classified as High due to introductions outside of its native range resulting in established populations and documented negative impacts.

Established nonnative populations have been reported in southern Missouri, Oregon, and New York. Subspecies of *Faxonius neglectus* has been negatively associated with the displacement of native crayfish, *Faxonius eupunctus* (reported under the name *Orconectes eupunctus*) and *Cambarus hubbsi*. In one location, *F. eupunctus* has completely disappeared. Information regarding the negative impacts come from reliable, peer-reviewed sources.

5 Global Distribution

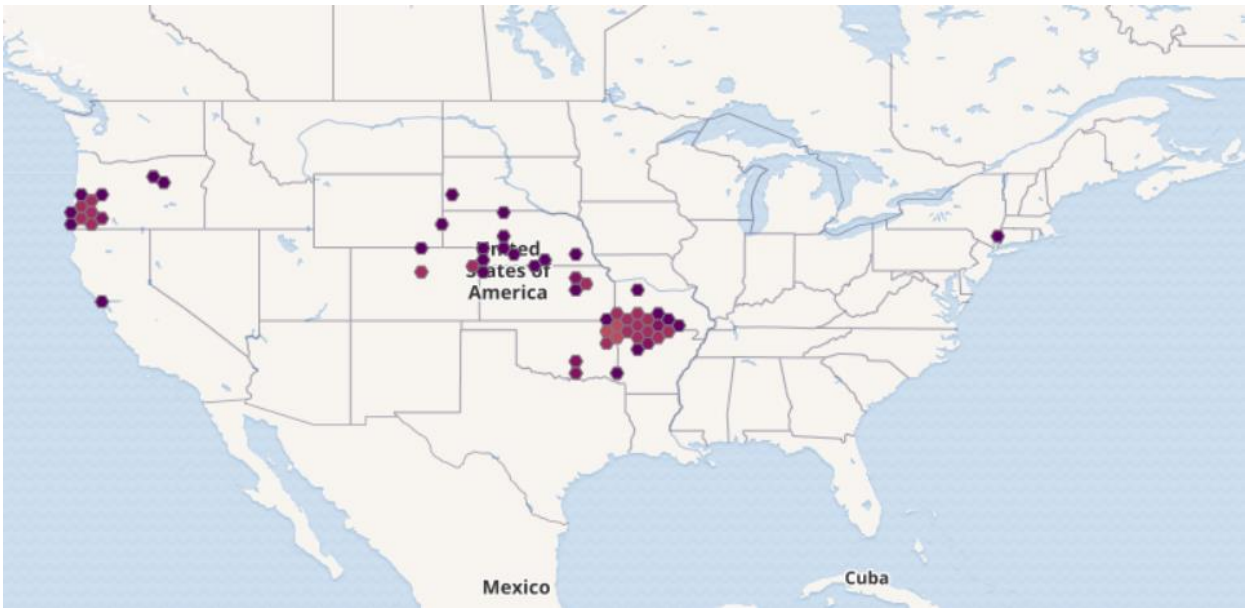

Figure 1. Known global distribution of *Faxonius neglectus*, reported from the central and western United States. Map from GBIF Secretariat (2022). Points located near the San Francisco Bay Area and in South Dakota were not verified as established populations and were excluded from the climate match analysis.

6 Distribution Within the United States

Figure 2. Known distribution of *Faxonius neglectus* in the United States. The orange shaded area represents a portion of the native range (but see section 1 for a complete description). Map from Procopio (2023).

7 Climate Matching

Summary of Climate Matching Analysis

The climate match was high in the Mid-Atlantic region, much of the Midwest and Plains regions including the native range, portions of the Pacific Northwest into northern California, much of the Columbia River basin, and the western edge of the Great Basin. The climate match was medium across the south, northern parts of the Midwest, Great Lakes, and in the Rockies. The only areas of low match were a small region of the southern Appalachian Mountains, peninsular Florida and the coastal Gulf Coast region, the Desert Southwest, the Cascade Mountains, and the Olympic Peninsula of Washington. There were also small patches of low match scattered through the Rocky Mountains. The Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.905, 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 neglectus* (see Appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category.

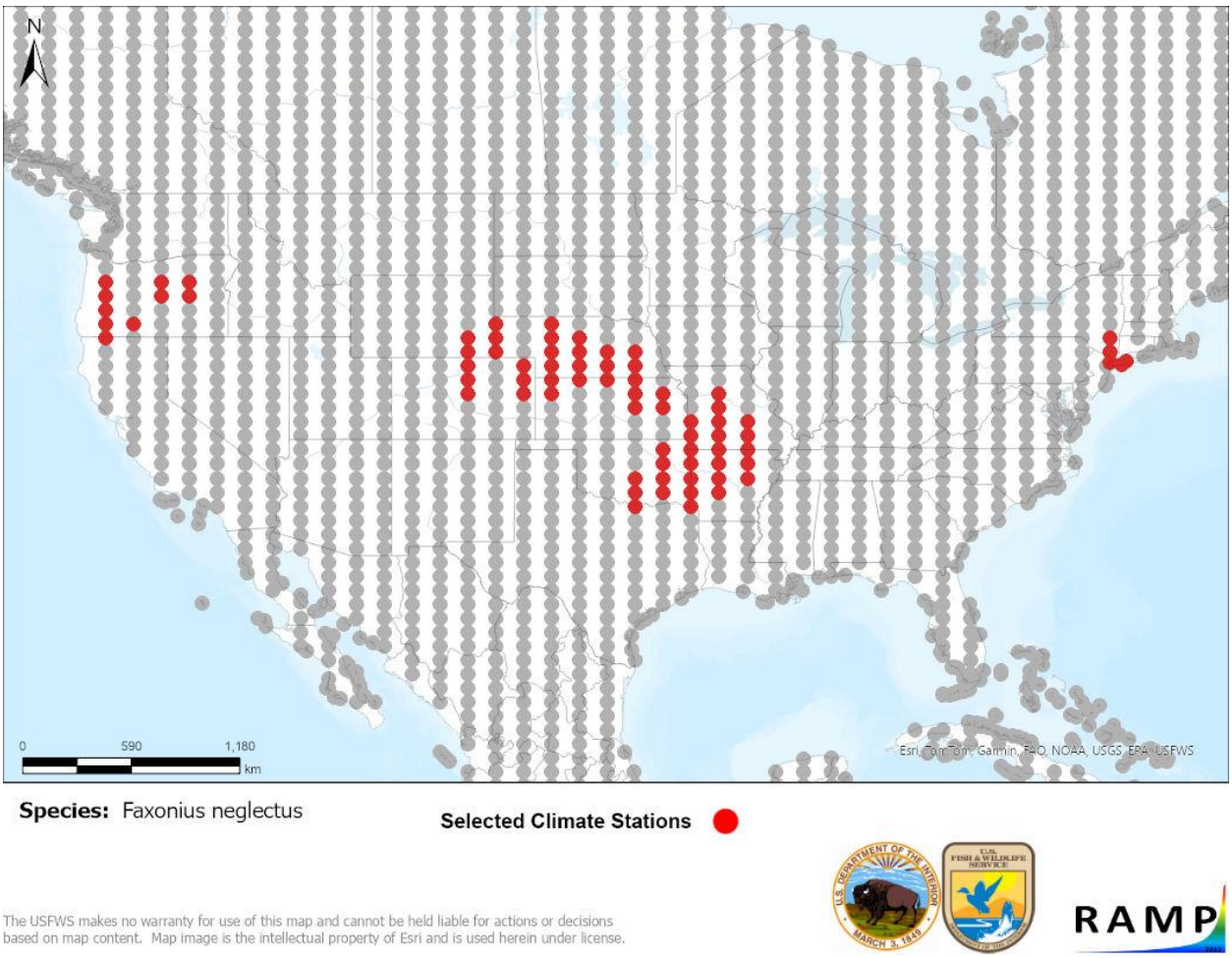

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations in North America selected as source locations (red; New York, Oregon, Colorado, Kansas, Nebraska, Oklahoma, Arkansas and Missouri) and non-source locations (gray) for *Faxonius neglectus* climate matching. Source locations from GBIF Secretariat (2022) and Procopio (2023).

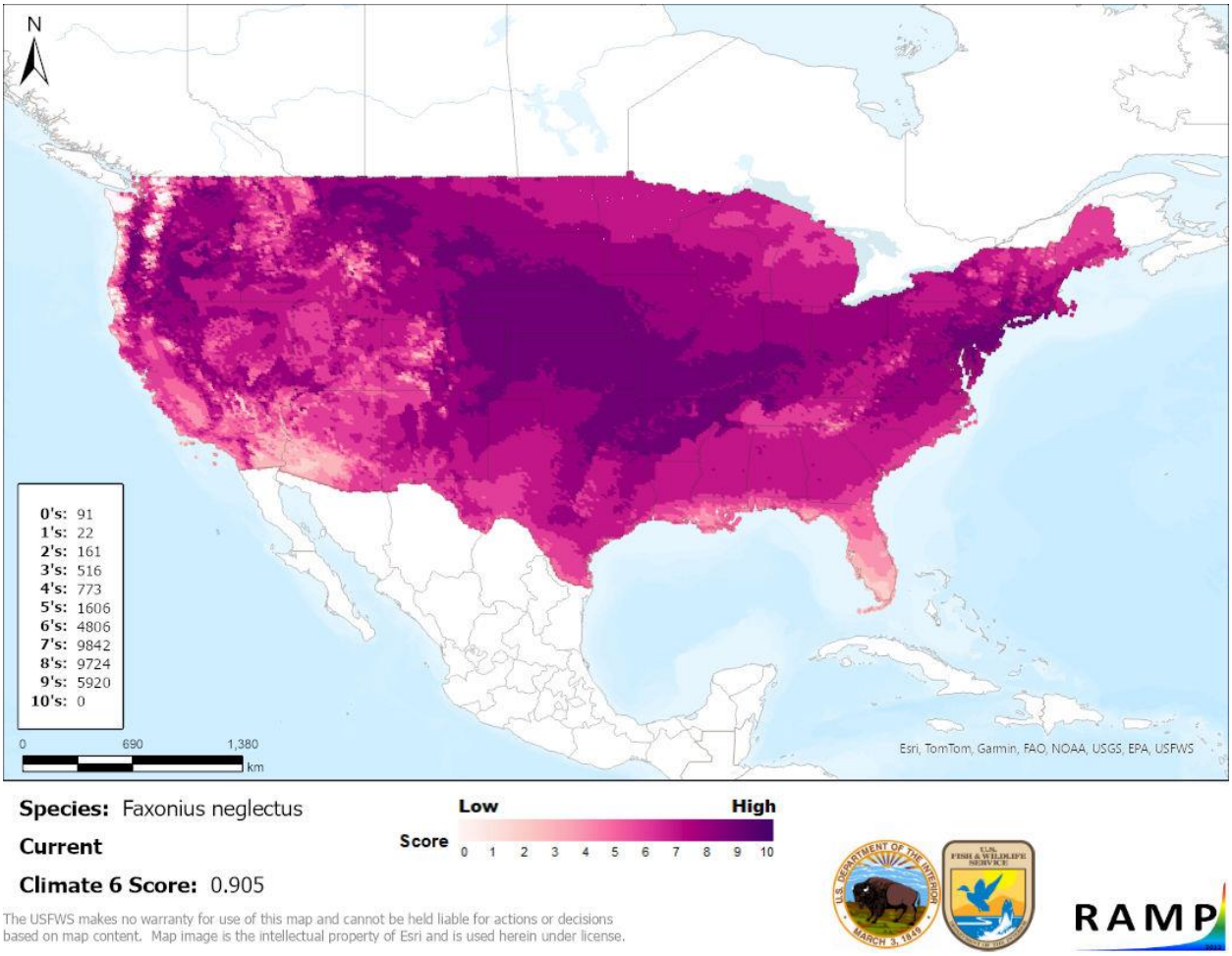

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Faxonius neglectus* in the contiguous United States based on source locations reported by GBIF Secretariat (2022) and Procopio (2023). 0= Lowest match, 10= Highest match.

8 Certainty of Assessment

Information was available on the biology, ecology, and distribution of *F. neglectus*. Information regarding impacts of introductions were available from peer-reviewed sources. The certainty of this assessment is classified as High.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Ringed Crayfish (*Faxonius neglectus*) is a crayfish native to the southern and western Plains region of the United States. It has been introduced into drainages adjacent to its native range as well as in the northeastern and northwestern United States. No information is available on specific introduction events, but introduction may have occurred through bait-bucket release, aquarium release, or release with stocked fish. *F. neglectus* has displaced two native crayfish species in the Spring River drainage of Missouri and Arkansas, although researchers have yet to identify the mechanisms by which this displacement has taken place. *F. neglectus* has also been

found in caves in southern Missouri and may threaten vulnerable species within those ecosystems. At least 10 U.S. States regulate *F. neglectus* at the species or family level. Due to the documentation of established populations outside of its native range and the documented negative impacts from reliable sources the History of Invasiveness is classified as High. The climate matching analysis for the contiguous United States indicates establishment concern for this species outside its native range. Most of the contiguous United States had high or medium matches. The Certainty of Assessment is classified as High. The Overall Risk Assessment Category for *Faxonius neglectus* 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: *F. neglectus* is known to carry the crayfish plague, a World Organisation for Animal Health notifiable disease.**
- **Overall Risk Assessment Category: High**

10 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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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 (2022) and Procopio (2023).

Under the future climate scenarios (figure A1), on average, high climate match for *Faxonius neglectus* was projected to occur in the Appalachian Range, Great Lakes, Northeast, Northern Plains, and Southern Plains regions of the contiguous United States. Under some scenarios, small areas of high match were also projected in the Western Mountains. Areas of low climate match was projected to occur in the Southern Florida region as well as southern California and the Desert Southwest. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.591 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.876 (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 (0.905, 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 Great Lakes and Northeast 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 in the 2085 time steps, areas within California, the Great Basin, Mid-Atlantic, Northern Plains, and Southern Plains saw a large decrease in the climate match relative to current conditions. Additionally, areas within the Appalachian Range, Colorado Plateau, Gulf Coast, Northeast, Northern Pacific Coast, Southeast, Southern Atlantic Coast, Southwest, and Western Mountains saw a moderate decrease in the climate match relative to current conditions. The degree of change increased from time step 2055 to time step 2085. Additional, very small areas of large or moderate change may be visible on the maps (figure A3).

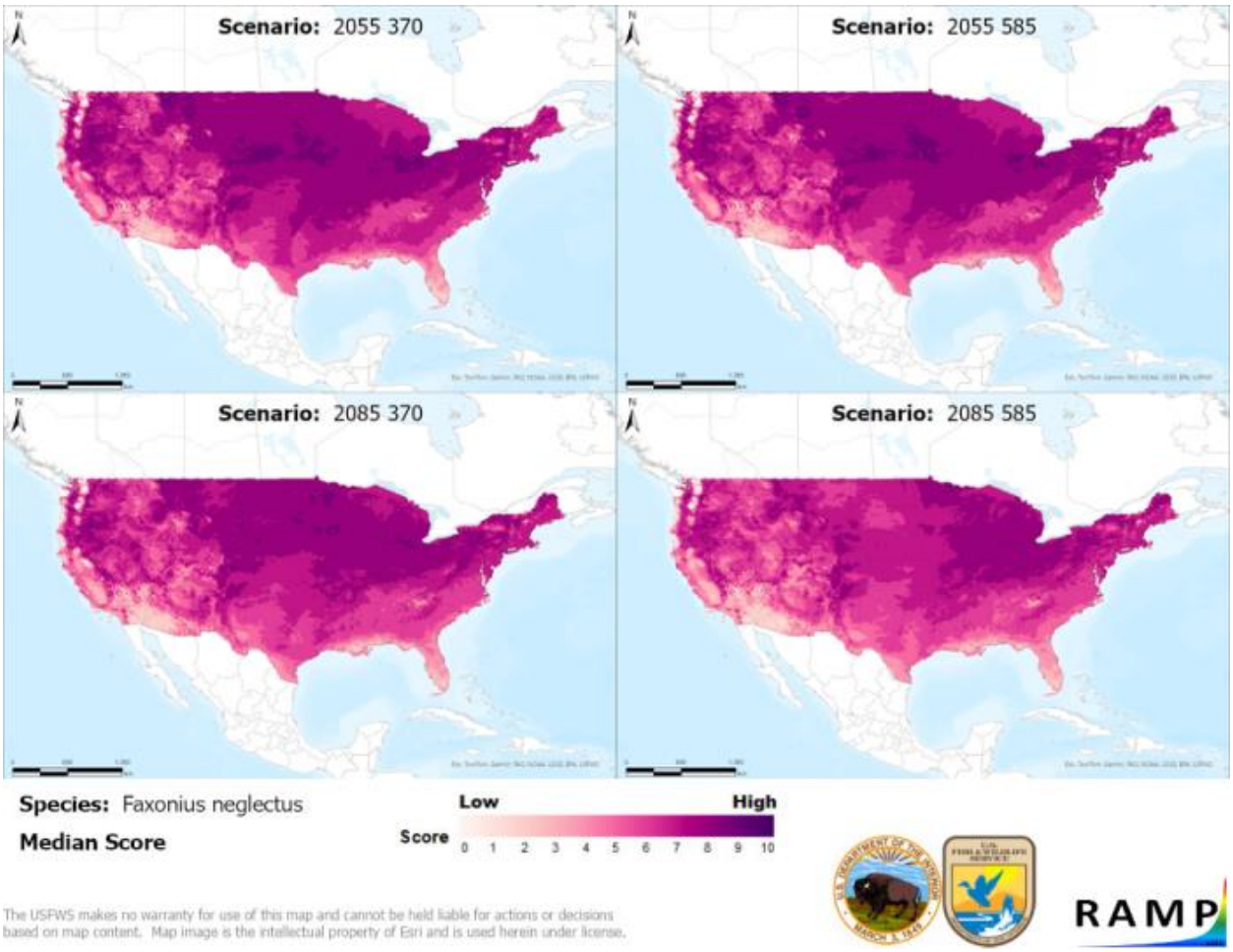

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Faxonius neglectus* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2022) and Procopio (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.

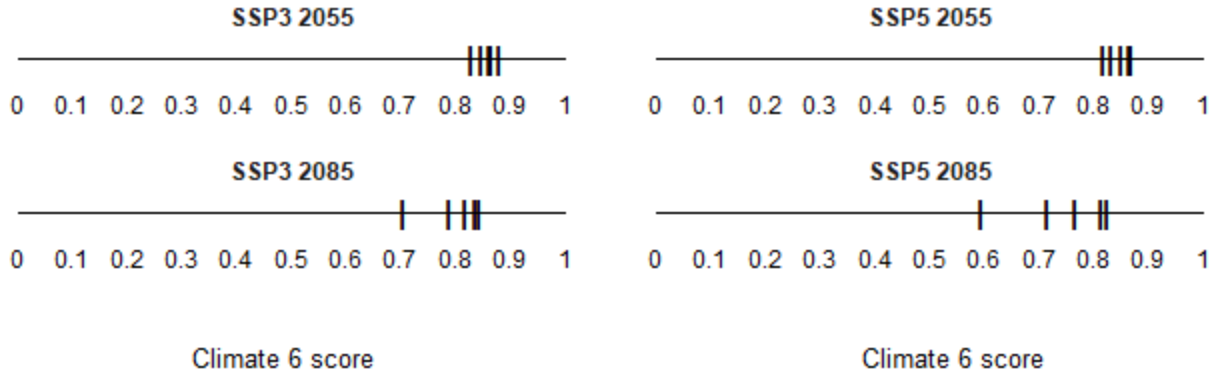

Figure A2. Comparison of projected future Climate 6 scores for *Faxonius neglectus* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018;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

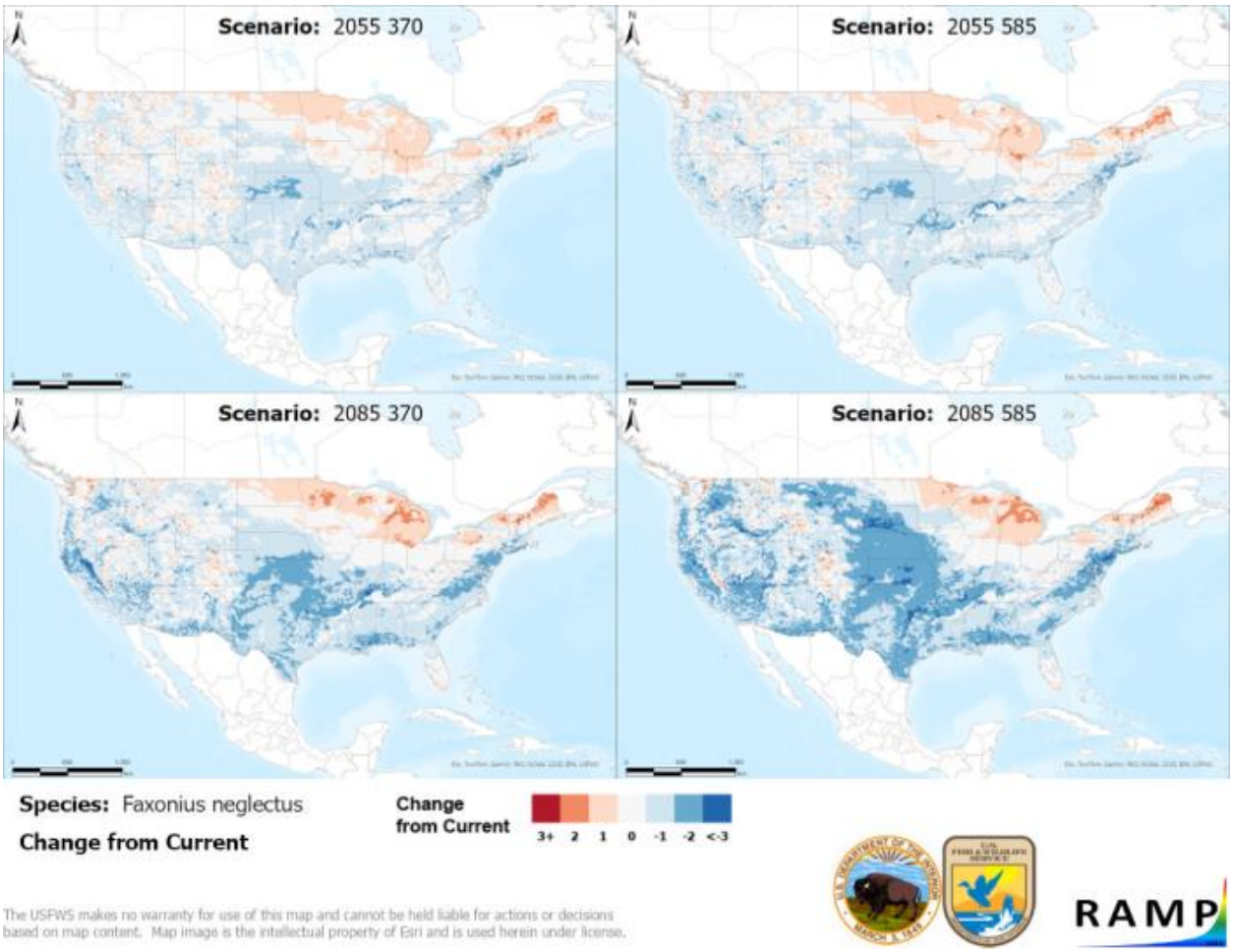

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Faxonius neglectus* based on source locations reported by GBIF Secretariat (2022) and Procopio (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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