White River Crayfish (*Procambarus acutus*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, July 2015

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1 Native Range, and Status in the United States

Native Range
From Benson (2015):

"Southern Atlantic coast drainage from Georgia to Maine and from the Florida panhandle to Mexico; central Mississippi Valley to the upper Great Lakes drainages."

Status in the United States
From Crandall (2010):

"This species is known from the coastal plain and piedmont from Maine to Georgia, and from the Florida panhandle to Texas, and Minnesota to Ohio (Ghedotti 1998, Loughman 2007). Furthermore, this species has been introduced to many areas of the US, including California, Maine and Kentucky (Loughman 2007)."

"California - Introduced, Connecticut - Introduced, … Maine - Introduced, Maryland - Introduced, … Rhode Island - Introduced"

Means of Introductions in the United States

From Benson (2015):

"Probable bait bucket or aquaculture introductions."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2015):

"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
Subfamily Cambarinae
Genus Procambarus
Subgenus Procambarus (Ortmannicus)
Species *Procambarus acutus* (Girard, 1852) – white river crawfish
Direct Children:
Subspecies *Procambarus acutus acutus* (Girard, 1852)
Subspecies *Procambarus acutus cuevachicae* (Hobbs, 1941)"

"Taxonomic Status: valid"

Size, Weight, and Age Range

From Benson (2015):

"can reach 5 in"

From Skelton (2012):

"The smallest breeding male known is about 72 mm (2.8 in) in length (Hobbs 1981)."

Environment

From Crandall (2010):

"This species is found in permanent sluggish, to moderately flowing streams and most permanent lentic (lakes, swamps, ponds) water bodies (Thoma and Jezerinac 2000). In West Virginia, this species has been found in ephemeral wetland habitats (Loughman 2007). It is considered to be a habitat generalist (US Forest Service 2008)."

Climate/Range

From CABI (2015):

"Based on their distribution in North America, the eastern white river crayfish is classified as a temperate species; however, aquaculturists generally regard it as having traits normally associated with a warm-water species, similarly to *P. clarkii*. Nothing is known about its environmental requirements in natural conditions. In cultivation ponds of South Carolina, it was shown that the mortality of *P. acutus acutus* at warmer water temperatures of spring and autumn is 10 times that experienced at colder temperatures in the winter but that its growth rate is faster in the warmer water temperatures than in the colder water temperatures."

Distribution Outside the United States

Native

This species is not native outside the United States.

Introduced

From CABI (2015):

"Outside the USA, it is known from the River Nile in Egypt, where it co-occurs with *P. clarkii* (Ibrahim et al., 1997), and from the Netherlands, where it has been present since 2005 (Soes and van Eekelen, 2006). However, whether these latter populations belong to *P. acutus* or *P. zonangulus* is unknown."

From Holdich et al. (2009):

"So far has only been recorded from The Netherlands, where it has been present since 2005 (Soes and van Eekelen, 2006), a fact not known when the atlas was compiled. *Procambarus acutus* is closely related to *P. zonangulus* Hobbs & Hobbs, 1990, and it was known for sure which of the two species was present; however, Soes (2009, pers. comm.) has recently confirmed that it is *P. acutus*."

Means of Introduction Outside the United States

From CABI (2015):

"This may occur as bulk shipments of *Procambarus* spp. are made to areas where attempts are being made to develop crayfish aquaculture. We only know about the attempt to introduce the

white river crayfish (possibly, *P. zonangulus*) into the rice fields of Lower Gauadalquivir in the province of Seville (Spain), together with *P. clarkii*. For unknown reasons, the white river crayfish did not prosper whereas *P. clarkii* did so (Gutiérrez-Yurrita et al., 1999). On the contrary, the introduction of *P. acutus* (or *P. zonangulus*) in Egypt and in the Netherlands was successful."

Short description

From Skelton (2012):

"The overall color of the White River Crawfish pinkish tan to brownish-olive with a broad dark stripe along the abdomen. The claws are slender and delicate in appearance and have small dark tubercles. The areola is fairly narrow but never obliterated. The rostrum typically tapers, but occasionally has marginal tubercles or spines and there is a single small cervical spine or tubercle."

Biology

From CABI (2015):

"The species constructs simple shallow burrows, to which crayfish of all sizes, whether mature or immature, male or female, retreat to reproduce and survive temporary dry periods, occupying them for 3-4 months or more (Huner and Barr, 1991). Crayfish may use atmospheric oxygen to breathe, provided gills remain moist. Burrows consist of simple vertical shafts 30–40 cm deep ending in an enlarged cul-de-sac. Five 15 cm-high chimneys may be present at the entrances of burrows."

"*P. acutus acutus* is relatively short-lived (2 years or less), have relatively high juvenile survival rates, and, at least the males, can alternate between sexually active (Form I) and inactive forms (Form II)."

"As all the arthropods, crayfish moult to increase in size, growth rate being affected by many factors, including water temperature, population density, dissolved oxygen levels, food quality and quantity, and genetic influences; however, environmental factors have the most influence on growth rate. After growing and attaining sexual maturity, both males and females stop growing."

"Contrary to *P. clarkii* that mates more than once during the year when environmental conditions are favourable, *P. acutus acutus* is a seasonal spawner. It has one reproductive period, restricted to the dry-phase, that produces a single annual cohort. Fastest year-on-year growth for *P. acutus acutus* occurs in autumn (November–December) and spring (April–May) and the slowest growth occurs in winter (December–January) and during the harvest season (May–June)."

"Mature animals mate in open water in autumn and early winter; the sperm, packaged into spermatophores, are stored in a seminal receptacle (annulus ventralis) on the underside of the female. The female may mate with more than one male and eventually retreats to the burrow to spawn with a peak in autumn. The burrow provides protection while the eggs and offspring are attached to the abdomen. Although crayfish can survive in a very humid environment within the burrow, they must have free-standing water for spawning. Spawning consists of expelling large,

dark eggs through the oviducts; eggs are fertilized externally with the sperm released from the spermatophores stored in the seminal receptacle, and then remain attached to the pleopods under the abdomen with an adhesive substance called glair. The incubation period is temperature dependent and it takes about 3 weeks for eggs to hatch at 23°C. Hatchling crayfish remain attached to the female's pleopods through two moults, after which they closely resemble adults in appearance. Hatchlings quickly become separated from the female and disperse as she moves about in open water."

"In a laboratory study by Mazlum and Eversole (2004), P. acutus acutus extruded and attached over 95% of the ovarian eggs. Pleopodal egg number per female increases linearly with the female total length but also with her nutritional status (Mazlum, 2005). The number of pleopodal eggs varies from 106 to 556 for 81 and 127 mm total length of the females in simulated burrows and from 32 to 330 eggs for 65 mm and 125 mm total length females in excavated pond burrows, respectively (Mazlum, 2005)."

"Little is known about *P. acutus acutus*' natural diet, except that it is an opportunistic and generalistic feeder, immature forms being more so. Whole body lipid content of females sampled from culture ponds found to be significantly greater than males with the proportion of lipids in adults varying through the culture cycle with the lowest lipid levels occurring in crayfish sampled after pond reflooding (Eversole et al., 1999)."

Human uses

From Crandall (2010):

"This species is used in both aquaculture and for fishing bait (Loughman 2007)."

Diseases

From Turner (1985):

"The adult fluke *Alloglossoides caridicola* was described from the antennal glands (excretory organs) of crayfish, *Procambarus acutus*, in southern Louisiana (Corkum and Turner, 1977, Proc. Helminthol. Soc. Wash. 44: 176-178). … These infections result in a loss of tissue in the nephnidial tubule. Each organ may harbor up to 10 worms, which have the effect of transforming it into a 'hollow shell.' "

From Tilmans et al. (2014):

"Contrasting patterns of crayfish plague prevalence were also observed in populations of the recently introduced crayfish species, *P.* cf. *acutus* and *O.* cf. *virilis*. Despite an extensive sampling (73 individuals analyzed from three sampling sites) no pathogen was detected in specimens of the former"

No OIE-notifiable diseases have been reported for this species.

Threat to humans

From CABI (2015):

"The possibility exists that this species might be a vector of parasites and diseases that might affect commercial species, as occurred in Europe with the transmission, by the North American crayfish species (e.g. *Pacifastacus leniusculus* and *P. clarkii*), of the crayfish plague to the native species, and in particular, to the commercial species *Astacus astacus* (Gherardi, 2007)."

3 Impacts of Introductions

From CABI (2015):

"No studies have focused on the environmental impact exerted by *P. acutus acutus*. We may infer that environmental impacts may be high both when it is the only crayfish species in the ecosystem of introduction and also when other crayfish species are present (see Gherardi, 2007 for a general discussion on the impacts of alien crayfish). These effects are due to the high fecundity, fast growth rate, competitive ability, and feeding habits of the species. Biodiversity may decrease due to the potential of hybridization with congeneric species (to be proven), to compete for food or space (e.g. with *P. clarkii*), to prey on macroinvertebrates including snails, as well as on fishes and amphibians (to be proven), to consume macrophytes (to be proven), and to be vector of parasites."

From Holdich et al. (2009):

"*Procambarus acutus* still has a local distribution [in The Netherlands], but at very high densities."

4 Global Distribution

Figure 1. Known global distribution of *P. acutus*. Map from GBIF (2015). Point in northwestern U.S. was not used in climate matching (Sec. 6) because it does not represent an established population.

5 Distribution within the United States

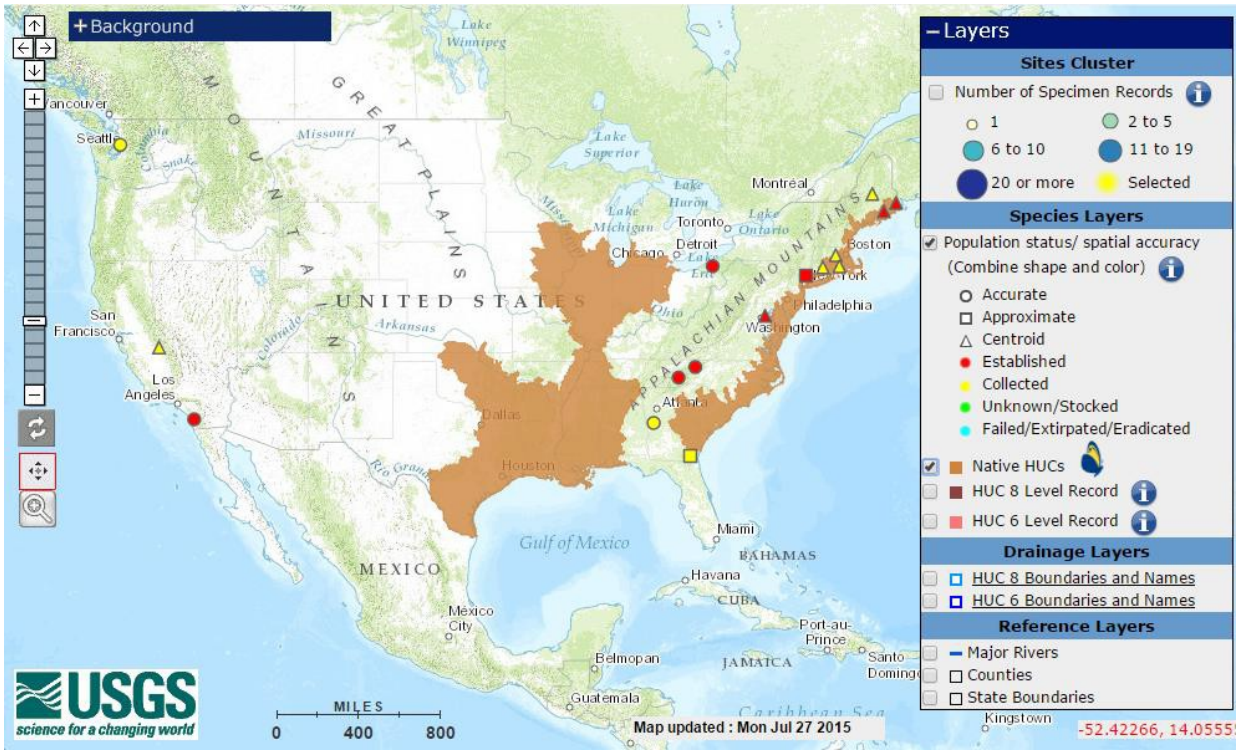

Figure 2. Distribution of *P. acutus* in the U.S. Map from Benson (2015).

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2014; 16 climate variables; Euclidean Distance) is medium to high throughout the eastern half of the contiguous U.S. California is also a high climate match south of San Francisco. The remainder of the West is a low match except for isolated patches of medium match in the Inner West and Southwest. Climate 6 proportion indicates that the contiguous U.S. has a high climate match. The range for a high climate match is 0.103 and greater; Climate 6 score of *P. acutus* is 0.637.

Crayfishes have been observed to establish populations in climates different from that found within their native range (M. Hoff, U.S. Fish and Wildlife Service, personal communication). The climate match shown here may be an underestimate of climate suitability for the establishment of *P. acutus*.

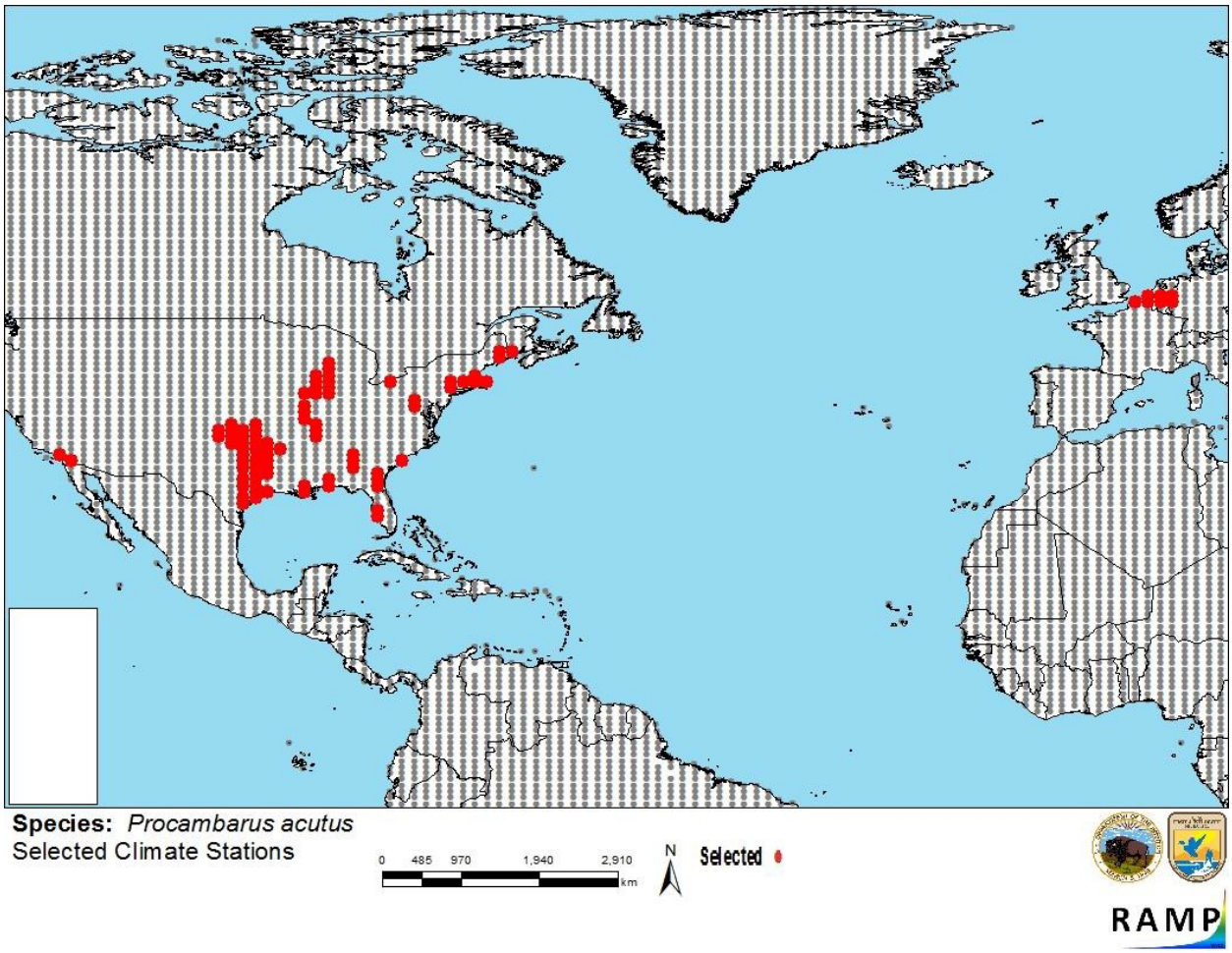

Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (gray) for *P. acutus* climate matching. Source locations from GBIF (2015) and Benson (2015).

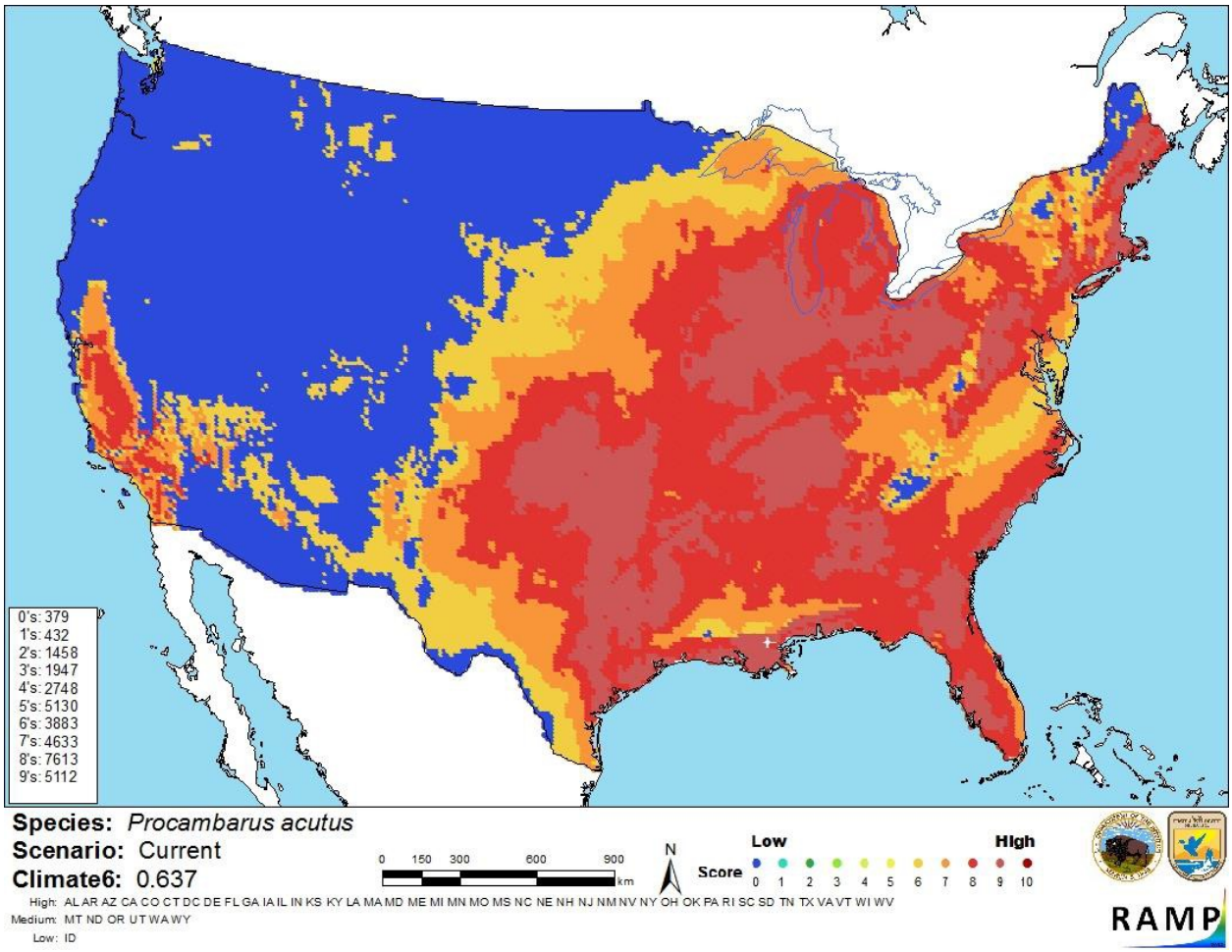

Figure 4. Map of RAMP (Sanders et al. 2014) climate matches for *P. acutus* in the continental United States based on source locations reported by GBIF (2015) and Benson (2015). 0= Lowest match, 10=Highest match. Counts of climate match scores are tabulated on the left.

7 Certainty of Assessment

The biology and ecology of *P. acutus* are reasonably well-known. However, little is known about its impacts on novel ecosystems. Certainty of this assessment is low.

8 Risk Assessment

Summary of Risk to the Continental United States

Procambarus acutus is a crayfish native to the eastern and central U.S. It has been introduced into at least 8 new locations in the U.S., as well as Egypt and The Netherlands. Little is known about its impact on the ecosystems where it has been introduced, although in The Netherlands its populations achieve high density. Impacts are hypothesized to be high given that its congener, *P. clarkii*, is highly invasive. Climate match to the contiguous U.S. is high. Overall risk posed by this species is uncertain.

Assessment Elements

- ☐ **History of Invasiveness (Sec. 3):** Uncertain
- ☐ **Climate Match (Sec.6):** High
- ☐ **Certainty of Assessment (Sec. 7):** Low
- ☐ **Overall Risk Assessment Category: Uncertain**

9 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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10 References Quoted But Not Accessed

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

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