# Giant River Prawn (*Macrobrachium rosenbergii*)

## Ecological Risk Screening Summary

**U.S. Fish and Wildlife Service, May 2013**
**Revised, May 2018**
**Web Version, 7/2/2018**

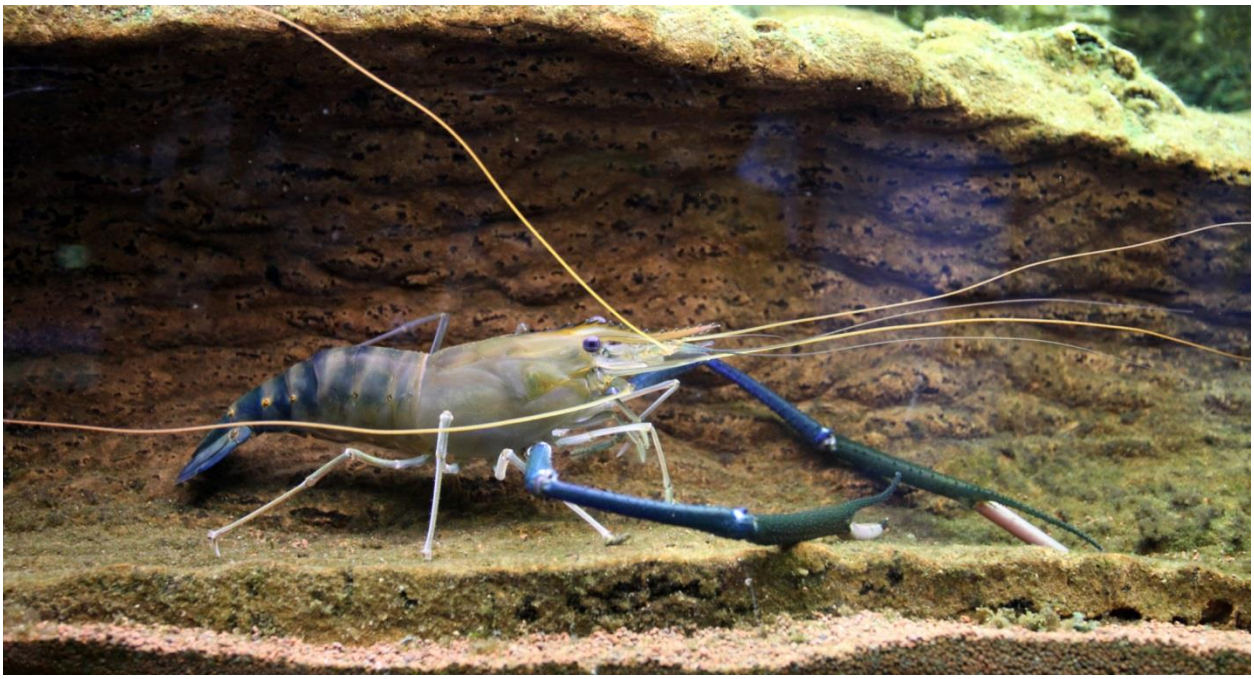

Photo: Citron. Licensed under CC BY-SA 3.0. Available: https://commons.wikimedia.org/wiki/File:Macrobrachium_rosenbergii.jpg. (May 2018).

# 1 Native Range and Status in the United States

## Native Range

From Wowor and Ng (2007):

"Asian mainland to the western border of Huxley's Line excluding Palawan, i.e. from eastern part of Pakistan, India, Sri Lanka, and southern China up to Borneo and Java."

From De Grave et al. (2013):

"The natural range of this species is eastwards from eastern Pakistan up to Borneo and Java (Wowor and Ng 2007, as *M.dacqueti* [*sic*])."

## Status in the United States

From Fofonoff et al. (2018):

"In May-November 2001, 40 shrimp of this species were caught in Simmons Bayou, Jackson County, Mississippi in waters of 1-12 PSU, near an aquaculture facility (Woodley et al. 2002). We know of no further records of this shrimp in the continental US."

"Culture experiments with *Macrobrachium rosenbergii* started [in Hawaii] in 1965, with records of escapes and releases on 'all the islands' (Eldredge 1994), but there are no reports of successful reproduction or establishment (Carlton and Eldredge 2009)."

This species is in trade in the United States. For example:

From Live Aquaponics (2018):

"25 LIVE PRAWNS UP TO 1 INCH […] Our Price: $49.75 […] Description: *Macrobrachium rosenbergii,* also known as Giant river prawn, Giant freshwater prawn, Malaysian Prawn, Freshwater Scampi, & Cherabin."

## Means of Introductions in the United States

From Benson et al. (2018):

"Probable escape from aquaculture. Staples and Cowie (2001) state that *Macrobrachium rosenbergii* in Hawaii "is extensively cultured in ponds but probably has not become established in streams"."

## Remarks

From Fofonoff et al. (2018):

"*Macrobrachium rosenbergii* was originally described from Andai, New Guinea by De Man in 1879. Wowor and Ng (2007), using morphological discriminant analysis have separated the shrimps previously identified as *M. rosenbergii* into two species, the *M. rosenbergii* of De Man, ranging from the Philippines and the lesser Sunda Islands to New Guinea and Australia, and *M. dacqueti*, ranging from Sri Lanka to Java and southern China. Unfortunately, the widely cultured form, in Indonesia, and through the world's tropics was *M. dacqueti*. Because of the wide use of the name *rosenbergii*, Wowor and Ng (2007) petitioned the International Commission on Zoological Nomenclature to apply this name to the Asian-West Indonesian form which they have identified as *M. dacqueti,* and created a new name (*M. wallacei*) for the East Indonesian-Philippine-Australian species typified by De Man as '*rosenbergii*' (Wowor and Ng 2007). The commission granted this petition in 2010 and the name '*rosenbergii*' now applies to the widely reared form, formerly *M. daqueti* (ICZN Opinion 2253 - Case 3428)."

We have endeavored to limit the information in this ERSS to the commonly cultured species currently known as *M. rosenbergii* and described by Wowor and Ng (2007) as *M. daqueti*.

# 2 Biology and Ecology

## Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2018):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Protostomia
Superphylum Ecdysozoa
Phylum Arthropoda
Subphylum Crustacea
Class Malacostraca
Subclass Eumalacostraca
Superorder Eucarida
Suborder Pleocyemata
Infraorder Caridea
Superfamily Palaemonoidea
Family Palaemonidae
Subfamily Palaemoninae
Genus *Macrobrachium*
Species *Macrobrachium rosenbergii* (De Man, 1879)"

"Taxonomic Status:
Current Standing: valid"

## Size, Weight, and Age Range

From CABI (2018):

"The largest males can attain a total length from tip of rostrum to the end of the telson of 320 mm compared to 250 mm for the largest females (Holthuis, 1980)."

## Environment

From Cheng and Chen (1998):

"*Macrobrachium rosenbergii* can tolerate a wide range of salinities (0 to 25 ppt) and a wide range of temperatures (14 to 35°C). For growth, the optimal temperature is 29 to 31°C and the optimal pH is 7.0 to 8.5 (New 1995). *M. rosenbergii* inhabits freshwater but the larval and post larval phases are spent in brackish water."

## Climate/Range

From Fofonoff et al. (2018):

"Subtropical-Tropical"

## Distribution Outside the United States

### Native

From Wowor and Ng (2007):

"Asian mainland to the western border of Huxley's Line excluding Palawan, i.e. from eastern part of Pakistan, India, Sri Lanka, and southern China up to Borneo and Java."

From De Grave et al. (2013):

"The natural range of this species is eastwards from eastern Pakistan up to Borneo and Java (Wowor and Ng 2007, as *M.dacqueti* [*sic*])."

### Introduced

From De Grave et al. (2013):

"The species is widely cultured both within its natural range and far beyond (Africa, South America). Established populations of aquaculture escapees have been recorded in Para, Brazil (Silva-Oliviera et al. 2011) and Martinique (Lim et al. 2002). Further specimens have been in Sao Paulo state [Brazil], but these may represent a non-breeding population."

From Fofonoff et al. (2018):

"On the Caribbean island of Dominica, *M. rosenbergii* was only established in areas where native freshwater shrimps had been eliminated (Alston, 1991, cited by Williams et al. 2001). Breeding populations are also established in Venezuela and equatorial Brazil. In Venezuela, populations are known from abandoned aquaculture ponds, stocked beginning in 1980, on Isla Margarita and in the Gulf of Paria in the Orinoco River Delta in 1996 (Perez et al. 2007). In equatorial Brazil, juveniles and egg-bearing adults were collected in the states of Para, Piaui, and Maranhão, from 2003 to 2009 (Cintra et al. 2003; Loebmann et al. 2010). A possibly established population was reported in southern Brazil in Parana State, in the Rio Guaraguaçu (Gazola-Silva et al. 2007). Silva-Oliveira et al. (2011) found that *M. rosenbergii* was extensively distributed and breeding in the state of Para, in the Amazon Delta and the coast to the west."

"Many accidental releases of *M. rosenbergii* have occurred in Puerto Rico, but there are no reports of established populations (Williams et al. 2001)."

"In Guam, *M. rosenbergii* was imported for culture from Hawaii in 1974 (Fitzgerald & Nelson 1979). A mass release of this shrimp occurred after a dam burst in a culture facility in 1992 (Eldredge 1994), but the establishment of a breeding population is unknown."

## Means of Introduction Outside the United States

From CABI (2018):

"It has been introduced into many countries for aquaculture."

From Fofonoff et al. (2018):

"In spite of the widespread culture of *Macrobrachium rosenbergii*, and the frequency of escapes and releases, the number of established populations appears small. This has been attributed to the low aggressiveness of this shrimp (Williams et al. 2001)."

## Short Description

From CABI (2018):

"*M. rosenbergii* is a striking looking prawn in which the second pair of walking legs can really justify the genus name meaning 'large arms'. In the males these walking legs can have a vibrant shade of blue and can also be twice the body length. The largest males can attain a total length from tip of rostrum to the end of the telson of 320 mm compared to 250 mm for the largest females (Holthuis, 1980)."

"In general, the body form is typical of a decapod crustacean with the head and thorax fused into a cephalothorax. The rostrum at the front end of the cephalothorax is very prominent with 11-14 dorsal teeth and 8-10 ventral teeth. Another distinctive feature of the adult male is that the moveable finger of the second walking leg or cheliped is covered in tightly packed long setae that give a velvety appearance to the appendage. The first 'walking leg' is not readily visible being very long and delicate in form but tightly folded up under the cephalothorax and functions as a feeding appendage with fine forcep-like chelae at their tips."

"Males can attain larger size than females and in dominant males the second walking legs are much longer and thicker. The abdomen of the male is narrower and the female, as well as having a wider abdomen, has longer pleura (the overlapping plates of cuticle extending from the exoskeleton) and these combined form a chamber for incubating the eggs carried on the pleopods. The male genital openings are on the fifth walking legs and the females genital pores are on the third walking leg."

"The colours of *M. rosenbergii* can vary according to where the prawns are found but the body can be greenish-grey. In small individuals, delicate striping on the cephalothorax can be seen but these markings are not apparent in tank-reared specimens. The chelipeds of dominant males are bright blue but more yellowish in non-dominant males and females. The ventral side is pale and translucent."

## Biology

From FAO (2018):

"This species lives in tropical freshwater environments influenced by adjacent brackishwater areas. It is often found in extremely turbid conditions. Gravid females migrate downstream into estuaries, where eggs hatch as free-swimming larvae in brackishwater.Before [*sic*] metamorphosis into postlarvae (PL), the planktonic larvae pass through several zoeal stages. After metamorphosis, PL assume a more benthic life style and begin to migrate upstream towards freshwater. Larvae swim actively tail first, ventral side uppermost. From PL onwards prawns swim forwards, dorsal side uppermost. From metamorphosis onwards prawns can also

walk, not only on the sub-stratum but also over damp areas including stones by river edges, up vertical surfaces (small waterfalls, weirs, etc.) and across land. Larvae mostly consume zooplankton (mainly minute crustaceans), very small worms, and larval stages of other crustaceans. Postlarvae and adults are omnivorous, eating algae, aquatic plants, molluscs, aquatic insects, worms, and other crustaceans. Males and females have different growth rates and males exhibit heterogenous individual growth (HIG); these are vitally important factors in grow-out management. Three distinct male morphotypes (and a number of intermediary types) exist: small male (SM), orange claw males (OC), and blue claw males (BC). The normal male developmental pathway is SM → OC → BC. BC males have extremely long second pereiopods; those of OC males are golden coloured; SM have small, slim, almost translucent claws. The type and behaviour of the males affects the growth rates of other prawns. The transition from rapidly growing OC to the slowly growing BC morphotype follows a "leapfrog" growth pattern. An OC metamorphoses into a BC only after it has become larger than the largest BC in its vicinity. The presence of this new BC male then delays the transition of the next OC to the BC morphotype, causing it to attain a larger size following its metamorphosis. BC males dominate OC males, regardless of their size, and suppress the growth of SM."

From Fofonoff et al. (2018):

"In caridean shrimp, the copulating pair is usually oriented at right angles to one another, with the genital regions opposing each other. The modified first and second pairs of pleopods are used to transfer a spermatophore to a receptacle between the thoracic legs of the female (Barnes 1983). After mating, female *M. rosenbergii* carry broods of fertilized eggs on their abdomen and migrate into brackish water. Females in Brazil had a mean fecundity of 55,000 eggs (Iketani et al. 2016). The eggs hatch into planktonic larvae with feathery appendages, called zoeae. Zoeae of caridean shrimps, such as *M. rosenbergii*, lack the prominent spines seen in brachyuran crabs, and look quite shrimplike (Food and Agricultural Organization 2011). They go through 11 molts and metamorphose into postlarvae, which have well-developed walking legs, and spend a lot of their time on bottom and vertical surfaces. Postlarvae tend to migrate upstream into fresh water. After a subsequent molt, the body takes on the adult shape. Under aquaculture conditions, larval development to postlarva takes 16 to 35 days (Food and Agricultural Organization 2011)."

## Human Uses

From De Grave et al. (2013):

"Throughout its native range, this is the most important commercial species of freshwater shrimp (Holthuis 1980)."

From Fofonoff et al. (2018):

"Extensive aquaculture of *M. rosenbergii* began in the 1960s in Hawaii, and became a major economic resource by the 1980s. Major producing countries include the US, Mexico, Peru, Brazil, Iran, India, Thailand, China, Taiwan, Indonesia and Malaysia."

From Wowor and Ng (2007):

"In 1993, the overall production was 17,164 tonnes, worth US$ 116,799,000 and in 2005 it reached 205,033 tonnes with a net value of US$ 896,263,000 (FAO, 2007). Giant freshwater prawn farming is thus a major contributor to global aquaculture, both in terms of quantity and value."

This species is in trade in the United States. For example:

From Live Aquaponics (2018):

"25 LIVE PRAWNS UP TO 1 INCH […] Our Price: $49.75 […] Description: *Macrobrachium rosenbergii*, also known as Giant river prawn, Giant freshwater prawn, Malaysian Prawn, Freshwater Scampi, & Cherabin."

## Diseases

From Cheng and Chen (1998):

"Taiwan, culture of *M. rosenbergii* has been intensified, and the farmed production increased from 1315 tons in 1984 to 16 196 tons in 1991 (New 1995). However, production of the prawns has declined gradually since that year due to disease outbreaks caused by a yeast in the cool season (Shu 1993) and by an *Enterococcus*-like bacterium in the hot season (Cheng & Chen 1998)."

From Bonami et al. (2005):

"White tail disease of the farmed freshwater prawn, *Macrobrachium rosenbergii*, is the cause of mortalities in the French West Indies, China and India. Two different sized [viral] particles, both developing in the cytoplasm of target cells, are found associated with diseased animals."

"White tail disease (WTD) is responsible for mortalities in hatchery-reared freshwater prawn, *Macrobrachium rosenbergii*, and subsequent economic losses in culture."

From Benson et al. (2018):

"*Macrobrachium rosenbergii* is known to be a carrier of (and resistant to) white spot virus (Hameed et al. 2000), and therefore could be a threat of spreading the disease to native shrimp species."

OIE (2018) lists "Infection with white spot syndrome virus" as one of its "OIE-Listed diseases, infections and infestations in force in 2018."

## Threat to Humans

No information available.

# 3 Impacts of Introductions

From Fofonoff et al. (2018):

"In spite of frequent escapes, '*Macrobrachium rosenbergii* is generally considered an ecologically harmless nonindigenous species because of its well documented non-aggressive behavior' (Williams [et al.] 2001). However, several established populations are known, and their impacts have not yet been studied."

From CABI (2018):

"Adverse impacts have not been reported so if there are effects they have so far not been noticeable. However, impacts of escapes in tropical river systems might not be noticed that readily. There is the potential for viruses to be introduced via aquaculture stock (Peng et al., 1998; Flegel, 2003) and a possible risk of interbreeding with local species. This seems to be a very small risk since it has been demonstrated that in the case of *M. carcinus* and *M. rosenbergii* (Graziani et al., 2003) no successful pairings occurred. When using artificial insemination interspecifically, although zygotes were produced they did not progress past the gastrula stage. Similarly no interspecific pairings took place between *M. rosenbergii* and *M. vollenhovenii* in a study by Papadopoulos (2001)."

From Silva-Oliveira et al. (2011):

"Females have been recorded to release up to approximately 500,000 eggs (depends on individual size and weight), and in tropical regions they can reproduce throughout the year (Pinheiro and Hebling 1998), there is a significant potential for a feral population to expand rapidly from even a small starting population."

"Using the framework suggested for Colautti and MacIsaac (2004) we could classify *M. rosenbergii* in Brazil as a stage IVa category exotic, an invasive species found in small numbers, but, widespread over a great part of North and Northeastern Brazil from the Amazon coast to the Delta of the Parnaíba Environmental Protection Area […] (Loebmann et al. 2010; this work). The occurrence of *M. rosenbergii* in the region demands attention. Despite the fact that no confirmed impacts resulting from its introduction have yet been observed, the biology of this species (see Brown et al. 2010 for review) suggests that some negative effect to the native biota is likely to occur, and this has been hinted at by local fishermen who claim that some species of fishes have not been seen since the introductions. The greater body size of the prawns sampled (51.4mm to 285.5mm) and the territorial behaviour could result in competition with native prawns for space. Also, the higher fecundity and fertility of *M. rosenbergii* also gives it a competitive advantage over native prawns in terms of its population dynamics. In addition, the species' larval diet of zooplankton and the omnivory of the adult mean that competition for food with many species may occur."

# 4 Global Distribution

**Figure 1**. Known global distribution of *Macrobrachium rosenbergii*. Map from GBIF Secretariat (2018). Occurrences in Australia, New Guinea, and North Maluku province of Indonesia are now considered to be occurrences of *M. wallacei* and were not included in the climate matching analysis. Occurrences in Puerto Rico do not represent established populations (Fofonoff et al. 2018) and were not included in the climate matching analysis.

# 5 Distribution Within the United States

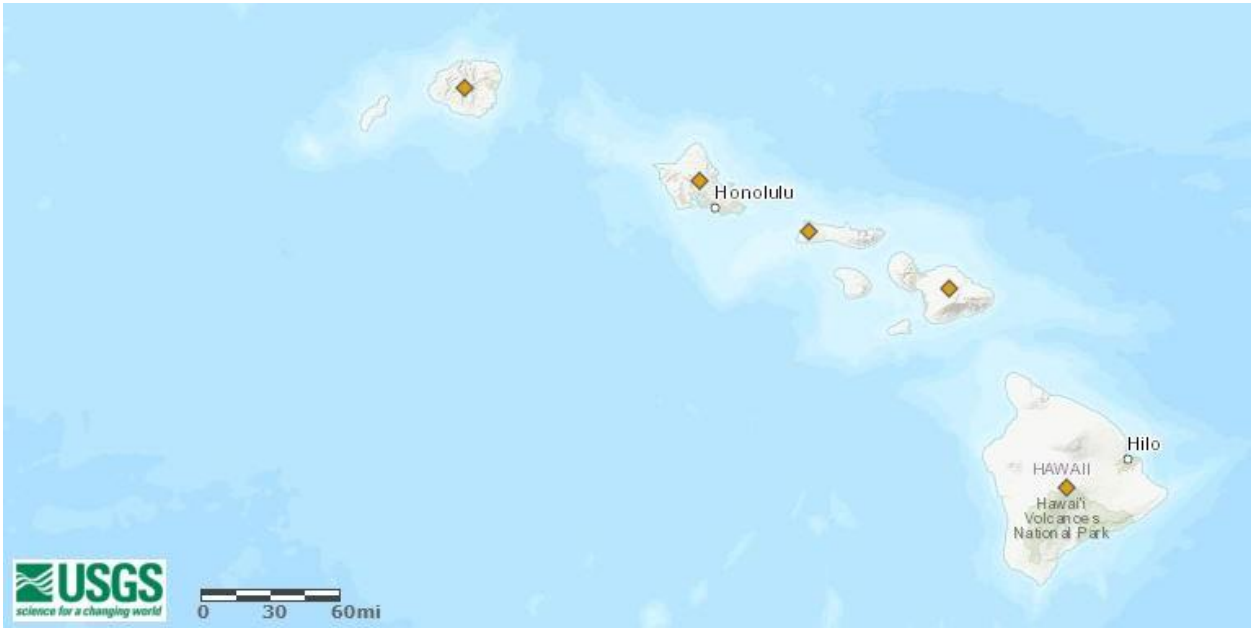


**Figure 2**. Known distribution of *Macrobrachium rosenbergii* in Hawaii. Map from Benson et al. (2018). Points represent failed populations and were excluded from climate match analysis.


**Figure 3**. Known distribution of *Macrobrachium rosenbergii* in the contiguous U.S. Map from Benson et al. (2018). Point represents a population of unknown status and was excluded from climate match analysis.

# 6 Climate Matching

## Summary of Climate Matching Analysis

The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.000, which is a low climate match. The range for a low climate match is from 0.0 to 0.005, inclusive. The climate match was highest in the far southern United States: parts of coastal California, Arizona, New Mexico, Texas, and peninsular Florida had a medium climate match. All other areas of the contiguous United States had a low match.

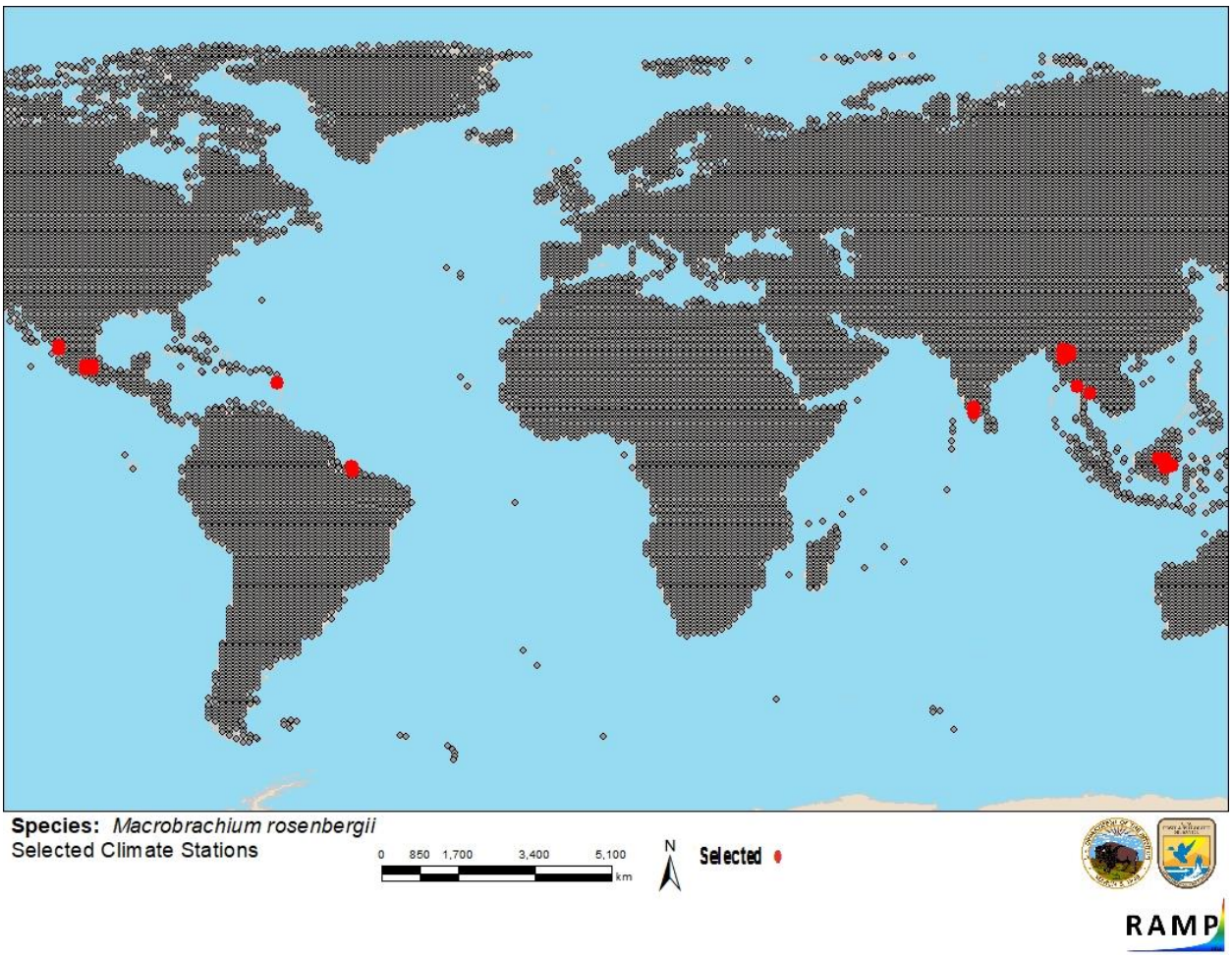


**Figure 4**. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; Mexico, Puerto Rico, Brazil, India, Myanmar, Thailand, Indonesia) and non-source locations (gray) for *Macrobrachium rosenbergii* climate matching. Source locations from GBIF Secretariat (2018) and Fofonoff et al. (2018; Caribbean).

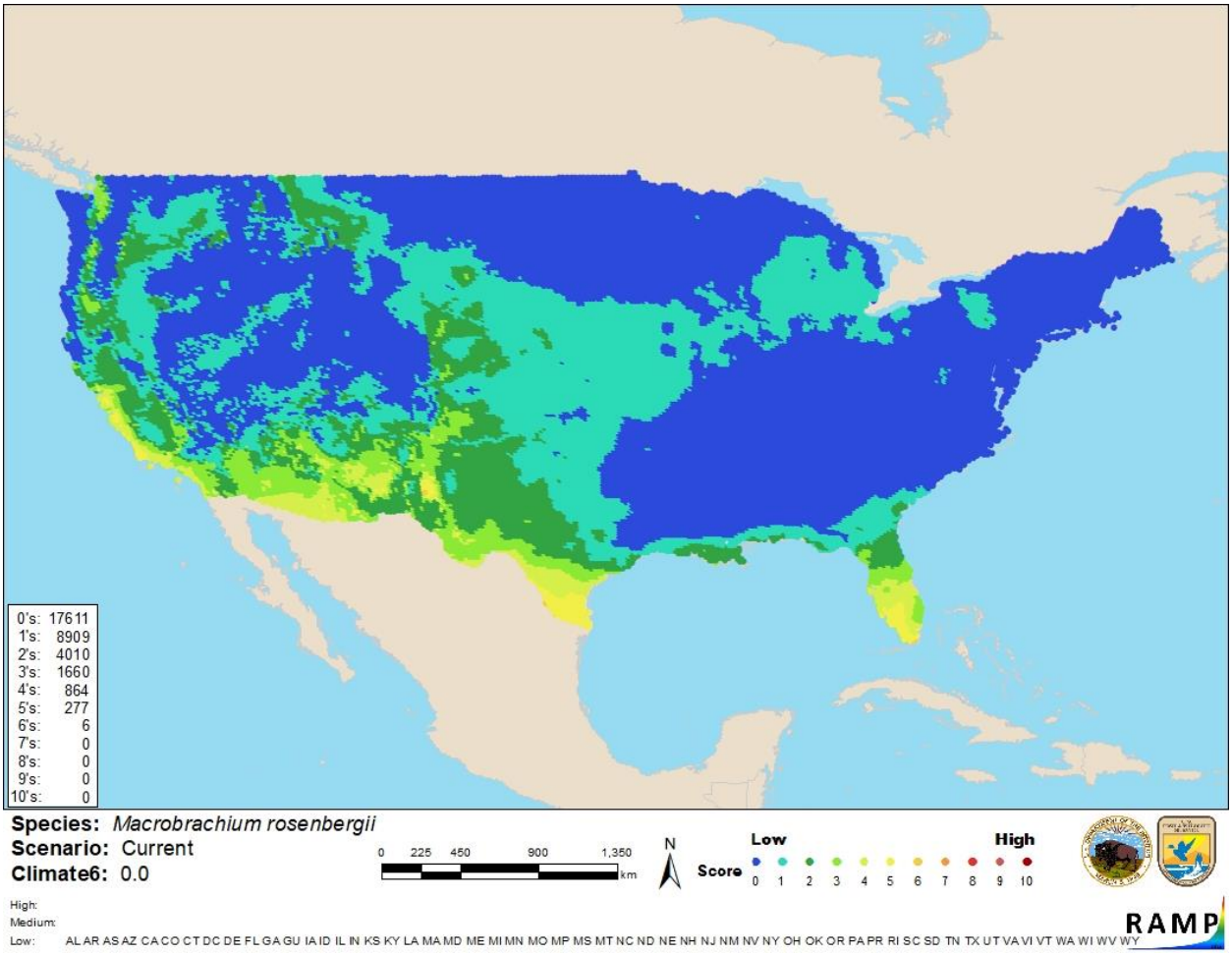


**Figure 5**. Map of RAMP (Sanders et al. 2018) climate matches for *Macrobrachium rosenbergii* in the contiguous United States based on source locations reported by GBIF Secretariat (2018) and Fofonoff et al. (2018). 0= Lowest match, 10=Highest match.

The "High", "Medium", and "Low" climate match categories are based on the following table:

| Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores) | Climate Match Category |
|---|---|
| 0.000≤X≤0.005 | Low |
| 0.005<X<0.103 | Medium |
| ≥0.103 | High |

# 7 Certainty of Assessment

There is adequate information available on the biology and distribution of *Macrobrachium rosenbergii*, especially in relation to its use in aquaculture. It has been documented as introduced outside of its native range in multiple countries; however, no information is available on any impacts of these introductions. Further research into the impacts, if any, of this species' introduction is needed to adequately assess the risk this species poses to the contiguous U.S. Certainty of this assessment is low.

# 8 Risk Assessment

## Summary of Risk to the Contiguous United States

*Macrobrachium rosenbergii*, the Giant River Prawn, is a freshwater prawn species native to Asia. This species is widely utilized in aquaculture, and it is an economically important species in multiple countries. *M. rosenbergii* has a low climate match with the contiguous United States It has been introduced in multiple locations outside of its native range due to escapes from aquaculture, but no information is available on the impacts of these introductions. Fishermen in Brazil suggest it may be responsible for the absence of some fish species, but we found no studies investigating this possibility. Certainty of this assessment is low due to lack of studies to assess possible impacts, and the overall risk assessment category is uncertain.

## Assessment Elements

- **History of Invasiveness (Sec. 3): None Documented**
- **Climate Match (Sec. 6): Low**
- **Certainty of Assessment (Sec. 7): Low**
- **Remarks/Important additional information: *M. rosenbergii* is known to be a carrier of (and resistant to) white spot virus; white spot syndrome virus is an OIE-Listed disease.**
- **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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