Estuarine Mudcrab (*Rhithropanopeus harrisii*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, February 2011
Revised, May 2018
Web Version, 6/13/2018

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1 Native Range and Status in the United States

Native Range

From Perry (2018):

"Original range presumed to be in fresh to estuarine waters from the southwestern Gulf of St. Lawrence, Canada, through the Gulf of Mexico to Vera Cruz, Mexico (Williams 1984)."

Status in the United States

From Perry (2018):

"The Harris mud crab was introduced to California in 1937 and is now abundant in the brackish waters of San Francisco Bay and freshwaters of the Central Valley (Aquatic Invaders, Elkhorn Slough Foundation). Ricketts and Calvin (1952) noted its occurrence in Coos Bay, Oregon in 1950. *Rhithropanopeus harrisii*, a common resident of Texas estuaries, has recently expanded its range to freshwater reservoirs in that state (Howells 2001; […]). They have been found in the E.V. Spence, Colorado City, Tradinghouse Creek, Possum Kingdom, and Lake Balmorhea reservoirs. These occurrences are the first records of this species in freshwater inland lakes."

From Fofonoff et al. (2018):

"[…] *R. harrisii* has invaded many estuaries in different parts of the world, and has even colonized some freshwater reservoirs in Texas and Oklahoma, where high mineral content of the water may promote survival and permit reproduction (Keith 2006; Boyle 2010)."

This species is in trade in the United States.

From eBay (2018):

"3 Freshwater Dwarf Mud Crabs Free Shipping!!"

"Price: US $26.00"

"You are bidding on 3 unsexed Freshwater Dwarf Mud Crabs (*Rhithropanopeus harrisii*)."

Means of Introductions in the United States

From Fofonoff et al. (2018):

"Genetic studies of West Coast populations support the hypothesis of a single introduction of *Rhithropanopeus harrisii* to San Francisco Bay by shipping or oyster tranplants [*sic*], followed by human transport to Oregon estuaries by coastal shipping."

From Perry (2018):

"Christiansen (1969) noted that the spread of this crab was probably associated with shipping, possibly in ballast or clinging to the hulls of ships. Spread of the mud crab from California to Oregon occurred via currents during the larval stage (Petersen 2002). Howells (2001) noted that the source of introductions to Texas reservoirs may have resulted from "bait bucket or accidental angler/boater releases" or fish stocking activities from a coastal hatchery where *R. harrisii* occurs naturally."

From WoRMS (2018):

"Synonymised names *Panopeus wurdemannii* Gibbes, 1850

Pilumnus harrisii Gould, 1841
Rhithropanopeus harrisii tridentatus Maitland, 1874 (synonym)"

Information searches were conducted on the accepted scientific name, *Rhithropanopeus harrisii*, as well as the synonymized scientific names listed above.

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
Order Decapoda
Suborder Pleocyemata
Infraorder Brachyura
Superfamily Xanthoidea
Family Panopeidae
Genus *Rhithropanopeus*
Species *Rhithropanopeus harrisii* (Gould, 1841)"

"Taxonomic Status:
Current Standing: valid"

Size, Weight, and Age Range

From Perry (2018):

"Williams (1984) reported males with a carapace width of 21.3 mm,"

From Palomares and Pauly (2018):

"Maturity: L_m ?, range 0 - 0.55 cm Max length : 2.0 cm CW male/unsexed; [Williams 1984]; max. reported age: 2 years [Grosholz and Ruiz 1995]"

From Fofonoff et al. (2018):

"Mature adults range from 4.4-4.5 mm width to 14.6 mm for males and 21 mm for females (Gosner 1978; Williams 1984)."

Environment
From Fofonoff et al. (2018):

"Adults can tolerate freshwater for some time, but salinities of at least 2.5 ppt are needed for reproduction (Williams 1984). However, breeding populations have been found in inland reservoirs in Texas, with salt composition differing from seawater, and salinities of 0.5-3.0 g/l (Boyle et al. 2010)."

"In Chesapeake Bay, Maryland, it characteristically inhabits brackish water, ranging from 0 to 18.6 ppt (Ryan 1956; Williams 1984), but tolerates full marine salinities (Williams 1984; Norrmant and Gibowicz 2008). Larval development occurs successfully at salinities as low as 2.5 ppt and as high as 40 ppt (Costlow et al. 1966, cited by Goncalves et al. 1995)."

From OBIS (2018):

"Sample depth 0 - 43 m
Temperature 23.660 - 24.436 ℃
Nitrate 0.457 - 1.640 umol/l
Salinity 32.621 - 36.080 PPS
Oxygen 4.807 - 4.855 ml/l
Phosphate 0.100 - 0.360 umol/l
Silicate 0.805 - 3.819 umol/l"

Climate/Range
From Palomares and Pauly (2018):

"Temperate"

Distribution Outside the United States
Native
From Perry (2018):

"Original range presumed to be in fresh to estuarine waters from the southwestern Gulf of St. Lawrence, Canada, through the Gulf of Mexico to Vera Cruz, Mexico (Williams 1984)."

Introduced
From Perry (2018):

"This crab has been introduced to various European countries including Britain, Denmark, Belgium, the Netherlands, Poland, Germany, and France, and in Russia, Romania, and Bulgaria (Christiansen 1969). Williams (1984) noted that this crab was first observed in Europe in the Zuiderzee, The Netherlands and was confined in that area until 1936. Established populations were noted in rivers in southern Russia in 1939 (Williams 1984). Gadzhiev (1936) and

Turoboyski (1973) reviewed distribution of this species in the Caspian and Black seas. Mizzan and Zanella (1996) recorded this species in Italy."

From Fofonoff et al. (2018):

"*Rhithropanopeus harrisii* was collected in the Pedro Miquel Locks on the Pacific side of the Panama Canal in 1969 (Abele 1969, Carlton 1979). Some later attempts to collect it were unsuccessful (Cohen 2006), but in 2007 a reproducing population was found in Miraflores Third Lock Lake, an abandoned excavation filled with brackish water (Roche and Torchin 2007). On the other side of the Pacific, in 2005, *R. harrisii* was collected in the Nakagawa Canal, Japan, which connects the city of Nagoya to Ise Bay, on the southeast coast of Honshu. In total, 86 specimens were collected, suggesting an established population (Iseda et al. 2007)."

"In Europe, it was first reported in 1874 from the Zuiderzee estuary in the Netherlands where it was described as a new species, *Heteropanope tridentata*. This population was extirpated by 1943, when the Zuiderzee was converted to a freshwater lake (Wolff 2005). However, *R. harrisii* has successfully spread to other European estuaries. To the east, it has colonized Veerse Meer (in 1977) and Westerschelde (in 1988) estuaries in the Netherlands, and the Eider (in 1998), Elbe (in 1996), Ems (in 1977) and Weser (in 1997) estuaries on Germany's North Sea coast (Nehring 2000). Prior to these records, *R. harrisii* was found farther east in the Kiel Canal (in 1936), which connects the North Sea with the Baltic Sea (Nehring 2000). To the west, in 1985, this crab was collected in Doel, Belgium, on the River Scheldt (Wouters 2002), in the Caen Canal, Normandy, France (in 1955, Goulletquer et al. 2002), the port of Le Havre (Breton et al. 1995) and Cardiff Docks, Wales, on the Severn estuary (in 1996, Eno et al. 1997). To the south, *R. harrisii* has colonized estuaries flowing into the Bay of Biscay- the Loire River (in 1971, [Marchand] 1979, cited by Goncalves et al. 1995), the Gironde estuary (in 1971, Goulletquer et al. 2002), and on the Iberian Peninsula, the Mondego River estuary (in 1991, Goncalves et al. 1995) and the Guadalquivir River estuary, Spain (in 1992, Cuesta et al. 1992)."

"In the Baltic Sea, *R. harrisii* was first collected in the Kiel Canal in 1936. Between 1948 and 1950, it was collected in the Schlei, a Baltic inlet north of the Canal mouth (Nehring 2000). In 1953, it was collected near Copenhagen, but has not been recorded in Danish waters since then (Jensen and Knudsen 2005). In 1948, it was first recorded in Polish waters, in the Gulf of Gdansk, Poland (Jazdzewski et al. 2005). In the Baltic, it has appeared as far inland as the Curonian Lagoon, Lithuania, but it does not appear to be established there (Olenin 2005). However, in Polish waters, including the Szeczin Lagoon, and the Vistula Lagoon on the Gulf of Gdansk, the abundance of this crab is increasing (Grabowski [2004]). In 2009, *R. harrisii* was collected in Finland, near Turku, in the region known as the Archipelago Sea. Its abundance and range here is increasing rapidly (Fowler et al. 2010). In the Mediterranean Sea, *R. harrisii* is known only from a few estuaries, including the Etang de Berre, near Marseille, France, where it was first reported in 1999, (Noel 2002, cited by Galil et al.2002) and in the Adriatic, the Po River estuary, near Scardovari, Italy (in 1994, Mizzan and Zanella 1996, cited by Galil 2002), the Marano Lagoon, near Grado, Italy (in 1998, Galil et al. 2002), and the Venice Lagoon (in 2002, Mizzan 2005). In the Black Sea, *R. harrisii* was first reported from the Dnieper-Bug Lagoon, Ukraine, in 1936. It is also known from the Sea of Azov, where it was first recorded in 1948 (Gomiou et al. 2002). *Rhithropanopeus harrisii* was first reported from the Caspian Sea in the

Kulaly Islands, Kazakhstan, in 1958 (Aladin et al. 2002) and it is now abundant and widespread in the Caspian (Aladin et al. 2002). […] This crab has also been introduced to the increasingly salty Aral Sea, where it was first collected in 1971 ([Andreyev] 1988) and is still established and abundant (Aladin et al. 2008)."

"In South America, *R. harrisii* was collected from the Strait of Maracaibo, Venezuela in 1957, where it is now established and abundant."

Means of Introduction Outside the United States

From GISD (2018):

"It has invaded many locations in Europe and North America and is presumed to have dispersed mainly via oyster translocations and shipping."

From Fofonoff et al. (2018):

The initial invasion to the Netherlands may have occurred either with ship fouling or with plantings of the Eastern Oyster (*Crassotrea virginica*). The later spread of *R. harrisii* seems to have resulted from coastal shipping and oyster transfers, or through multiple introductions from the Western Atlantic - the frequent large jumps and spotty distribution are inconsistent with natural dispersal."

"*Rhithropanopeus harrisii* […] is now abundant and widespread in the Caspian (Aladin et al. 2002). It may have been transported by shipping through canals from the Black Sea, or with stocked fishes and shellfish."

"In South America, *R. harrisii* was collected from the Strait of Maracaibo, Venezuela in 1957, where it is now established and abundant. Transport by shipping, particularly oil tankers, is likely in this oil-rich estuary (Rodriguez and Suarez 2001)."

Short Description

From Fofonoff et al. (2018):

"The carapace of *Rhithropanopeus harrisii* has five marginal teeth, and the first two are partly fused (Gosner 1978). The carapace is roughly quadrilateral and approximately as long as wide, with more curvature front to back, than from side to side. In the widest region of the body, there are two transverse lines of granules, one running from the posterior lateral tooth to the opposite one across the mesogastric region, and another anterior to it. The front is almost straight, slightly notched, with its margin transversely grooved, appearing double when viewed from the front. The postorbital angle and first anterolateral tooth are completely fused. The first and second developed anterolateral tooth are about the same size and perhaps larger than the last tooth (Williams 1984)."

"The two chelipeds are unequal and dissimilar. The carpus (wrist) is scarcely grooved above and with a moderately developed internal tooth. The chelae (claws) have weakly developed dorsal ridges. The major chela has a short, fixed finger and a strongly curved dactyl (movable finger).

The minor chela has a proportionately longer fixed finger and long, straight dactyl. The walking legs are slender, compressed, and somewhat hairy. The body is brownish above and paler below. The fingers are white."

Biology

From Fofonoff et al. (2018):

"Male brachyuran crabs copulate with females, inserting the first pair of pleopods, carrying sperm, into the female's seminal receptacles. The eggs are fertilized internally, and then extruded as a 'sponge' or a mass of eggs, which is brooded between the abdomen and the body (Barnes 1983). Females carry broods of 1200-5000 eggs at a time and can produce up to four broods during a mating season (Turoboyski 1973). The eggs hatch into zoeae, larvae about 1 mm long, armed with long spines, which drift in the plankton. Each zoea goes through zoea stages, and eventually molts into a postlarval megalopa, about 2.0 mm long, with prominent eyes and partially developed appendages (Johnson and Allen 2005; Rice and Tsukimura 2007). The megalopa molts into a miniature 'first crab' which has all the features of an adult crab, and is capable of crawling on the benthos (Barnes 1983; Forward 2009). Settlement occurs at 15-32 days after hatching (Goncalves et al. 1995). Larvae show patterns of vertical migration which can reduce predation and result in retention in estuaries. Settlement is also promoted by chemical cues present in estuarine waters (Forward 2009)."

"*Rhithropanopeus harrisii* is an opportunistic [*sic*] and omnivorous feeder, consuming algae, detritus, polychaetes, mollusks, amphipods, and carrion, becoming increasingly carnivorous above a carpace [*sic*] width of 12 mm (Turoboyski 1973; Czerniejewski et al. 2008; Hegele-Drywa and Normant 2009; Aarnio et al. 2015). Fishes are the primary predator (Cohen and Carlton 1995; Aarnio et al. 2015). Predators include Eurasian perch (*Perca fluviatilis* Linnaeus, 1758), Pikeperch (*Sander lucioperca* (Linnaeus, 1758), and Fourhorned Sculpin (*Myoxocephalus quadricornis* (Linnaeus, 1758) (Aarnio et al. 2015)."

From Perry (2018):

"This crab is usually associated with some type of shelter or structure including, oyster reefs, living and decaying vegetation, and various kinds of marine debris in fresh to estuarine waters(Williams 1984)."

Human Uses

From GISD (2018):

"*Rhithropanopeus harrisii* has been used as a study organism in many developmental and physiological studies (e.g. Christiansen and Costlow, 1975; Kalber and Costlow, 1966). The crab has also been used to examine the effects of various pesticides on non-target crustacean species (Clare et al. 1992), including juvenile hormone analogues (JHA's), a pest control agent which mimics insect larval hormones (Cripe et al. 2003)."

Diseases

From GISD (2018):

"The rhizocephalan barnacle *Loxothylacus panopaei* parasitizes *R. harrisii* in its native range. Parasitic barnacles infect their crab hosts at the larval stage (cyprid or cypris larva), develop as an endoparasite, and then produce an external reproductive body called the externa. Rhizocephalans stunt growth in their hosts and cause castration in both males and females, preventing future reproduction. Alvarez et al. (1995) experimentally infected *R. harrisii* from the Chesapeake Bay with *L. panopaei* and found that parasitism had a significant effect on the survival of infected hosts. However, further studies are necessary to determine whether *L. panopei* is a viable candidate for biological control of *R. harrisii* in its introduced range."

From Roche and Torchin (2007):

"[…] this species can host white spot baculoviruses, making it a potential vector for crustacean diseases (Payen and Bonami 1979)."

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

From Roche and Torchin (2007):

"[…] in the Caspian Sea, where it has reached very high densities, the crab is responsible for pipe fouling and causes economic loss to fishermen by spoiling fishes in gill nets (Zaitsev and Öztürk 2001). In Texas, *R. harrisii* has also caused fouling problems in intake pipes and may have displaced a native species of freshwater crayfish (Keith 2007 pers. comm.)."

3 Impacts of Introductions

From CABI (2018):

"In Europe and on the West Coast of North America, *R. harrisii* is said tocompete [*sic*] with native crabs (Marchand and Saudray, 1971; Jazdzewski and Konopacka, 1993; Cohen and Carlton, 1995) as well as with species of fish feeding on benthos (Zaitsev and Öztürk 2001) and can alter food webs by acting as a predator and serving as prey of native species (Turoboyski, 1973; Cohen and Carlton, 1995; Zaitsev and Öztürk, 2001). In Texas, *R. harrisii*'s presence in inland impoundments may have displaced a native species of freshwater crayfish (Keith, 2008). According to Payen and Bonami (1979), *R. harrisii* can also be a potential host of white spot baculoviruses, which can be transmitted to co-occurring native crustaceans."

From Fofonoff et al. (2018):

"*Rhithropanopeus harrisii* is a successful invader in many parts of the world. However, its impacts have not been specifically studied throughout much of its introduced range."

"Competition- In Coos Bay, Oregon, *R. harrisii* has been suggested as a potential competitor with the native crab *Hemigrapsus oregonensis*, with the more aggressive *H. oregonensis* appearing to restrict *R. harrisii*'s penetration into more saline waters (Jordan 1989, cited by Petersen 2006)."

"Food/Prey- In the San Francisco Bay estuary, *Rhithropanopeus harrisii* is an important food item for the introduced White Catfish (*Ameirurus catus*) and Striped Bass (*Morone saxatilis*) and the native White Sturgeon (*Acipenser transmontanus*) (Cohen and Carlton 1995). It is likely to be an important prey item for fishes and other predators, wherever it is abundant. This impact may be especially important in ecosystems where native species of crabs are absent, such as the inner Baltic, Caspian and Aral Seas (Grabowski et al. 2004; Aladin [et al.] 2002; Aladin et al. 2008)."

"Predation- In systems where they are abundant, such as the inner Baltic, the Caspian and Aral Seas, *Rhithropanopeus harrisii* are potentially important predators on epibenthos and infauna (Aladin 2002; Aladin et al. 2008), but have not been specifically studied. Predation by *R. harrisii* has been found to affect the abundance of other small crabs, including *Elamenopsis kempi*, in the Panama Canal (Kam et al. 2011) and a snail, *Theodoxus fluviatilis*, in the Baltic Sea (Forsstrom et al. 2015). On a section of rocky shore in Finland, an expanding population of *R. harrisii* was associated with drastic reductions of the abundance of snails, amphipods and isopods, and the elimination of chironomids (Jormalainen et al. 2016)."

From Jormalainen et al. (2016):

"The North American mud crab *Rhithropanopeus harrisii* is a recent invader in the Baltic Sea, with an expanding distribution range. Here, we document the effects of mud crab on the native invertebrate community associated with the key foundation species *Fucus vesiculosus*. During the initial 3 years of invasion, mud crab abundance in *F. vesiculosus* increased from 2 % to about 25 % of the algae being inhabited by crabs. Simultaneously, the invertebrate community underwent a major transition: Species richness and diversity dropped as a consequence of decreasing abundance and the loss of certain taxa. The abundance of gastropods decreased by 99 % and that of crustaceans by 75 %, while chironomids completely disappeared. Consequently, the community dominated earlier by herbivorous and periphyton-grazing gastropods and crustaceans shifted to a mussel dominated community with overall low abundances of herbivores. At the same time filamentous epiphytic algae prospered and the growth rate of *F. vesiculosus* decreased. We suggest that this shift in the invertebrate community may have far reaching consequences on ecosystem functioning. These arise through changes in the strength of producer–herbivore interaction, caused by mud crab predation on the dominating grazer taxa. This interaction is a major determinant of ecological function of ecosystems, i.e. productivity and energy flow to higher trophic levels. Therefore, the decrease in herbivory can be expected to have a major structuring role in producer communities of the rocky littoral macroalgal assemblages."

From Forsström et al. (2015):

“We examined the predatory behavior of introduced *R. harrisii* both in the laboratory and field focusing in shallow, hard bottom habitats dominated by the alga *Fucus vesiculosus*. In the laboratory environment, *R. harrisii* was an effective predator of littoral grazers, readily consuming both sessile fauna (*Mytilus trossulus*) and also mobile species such as isopods (*Idotea balthica*) and gammarid amphipods (*Gammarus* sp.). When studying the predation of different sized prey items, *R. harrisii* preyed upon small and medium sized prey of both mobile and sessile species. However, in the field experiment with the native faunal community associated with *F. vesiculosus*, *R. harrisii* negatively impacted only the abundance of the snail *Theodoxus fluviatilis*, possibly through indirect effects. Nevertheless, *R. harrisii* significantly decreased both the prey species richness and diversity but not the total number of potential prey individuals associated with *F. vesiculosus*. In conclusion, predatory behavior of this novel crab has the potential to impact the native macroinvertebrate littoral community, but the realized predation pressure in the field is lower than could be expected from laboratory experiments.”

From Kotta et al. (2018):

“Here we show how the arrival of the invasive crab *Rhithropanopeus harrisii* into the Baltic Sea – a bottom-up controlled ecosystem where no equivalent predators ever existed – appeared to trigger not only strong top-down control resulting in a decline in richness and biomass of benthic invertebrates, but also an increase in pelagic nutrients and phytoplankton biomass.”

“Although the studied predator and prey are about the same size, our observations showed the invasive crab is able to effectively break the shells of the bivalves and gastropods within seconds only. Very high predator densities and per-capita predation rates [Forsström et al. 2015] likely triggered strong control over benthic communities, mostly of bivalves. Benthic deposit feeding clams together with suspension feeding mussels dominate in many temperate intertidal ecosystems including the Baltic Sea basin [Kotta and Witman 2009]. These bivalves feed extensively on deposited or suspended microalgae, and are responsible for the majority of energy fluxes within many benthic habitats, as well as fluxes between benthic and pelagic habitats [Tomczak et al. 2009, Griffiths et al. 2017]. Thus, it is plausible that a reduction of the bivalve populations by crabs, led to diminished nutrient capture and storage by benthic invertebrates, and increased pelagic nutrient availability ultimately boosting phytoplankton blooms.”

“Another indirect effect of the crab was a doubling of the biomass of *Dreissena polymorpha*, an invasive dreissenid bivalve, and the appearance of *Laonome* sp. nov [Kotta et al. 2015], an invasive polychaete. *Dreissena polymorpha* has much stronger shells than any of the native bivalves in the study area and predation on this invasive bivalve would be energetically costy [*sic*] for the crabs. Consequently, mud crabs presumably exert only a weak predation pressure on *D. polymorpha*. Moreover, the mud crabs indirectly increase phytoplankton biomass, providing food for the suspension feeding *D. polymorpha* and *Laonome* sp. and thereby create a good basis for the population growth of these invasive species. The range expansion of mud crabs and subsequent establishment of invasive suspension-feeding species provides an example of invasional “meltdown”, where the establishment of one invasive species in a new environment can facilitate the invasion of other non-native species [Simberloff and Von Holle 1999, Jeschke et al. 2012].”

4 Global Distribution

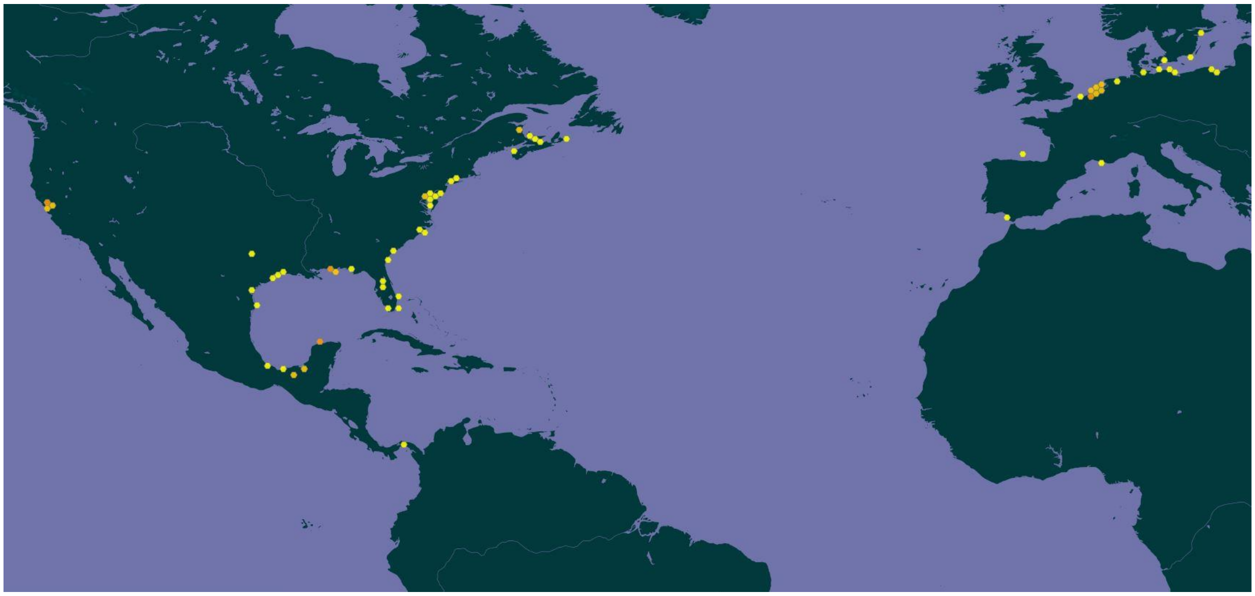

Figure 1. Known global distribution of *Rhithropanopeus harrisii*. Map from GBIF Secretariat (2017). A point in Brazil was excluded from the extent of this map and from subsequent climate match analysis because it does not represent an established population. No georeferenced occurrences were available for parts of the species established range including Venezuela, Central Asia, and Finland (Fofonoff et al. 2018).

5 Distribution Within the United States

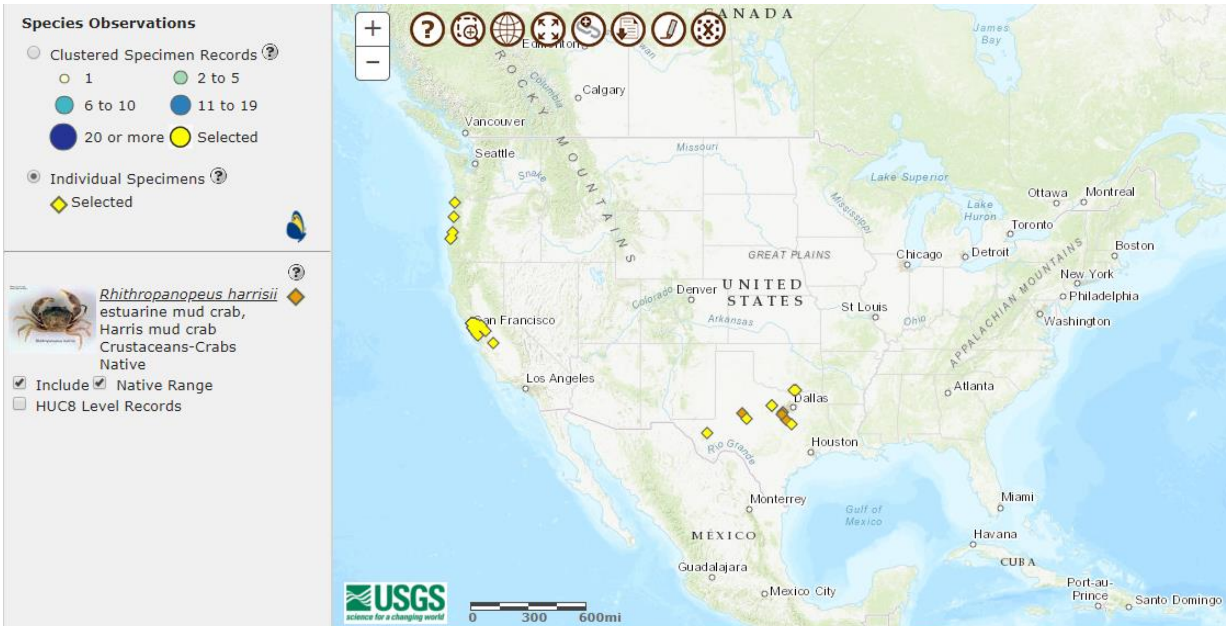

Figure 2. Known introduced distribution of *Rhithropanopeus harrisii* in the United States. Map from Perry (2018). Yellow points represent established populations; orange points represent collections. The native range is not shown.

6 Climate Matching

Summary of Climate Matching Analysis

The Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous U.S. was 0.459, which is a high climate match. Climate 6 scores of 0.103 or greater are a high match. The climate match was very high in the eastern Midwest, Atlantic coast states, along the Gulf Coast, and in Texas. It was also high in much of California. It was high to medium around the Great Lakes, along the Oregon coast and the Puget Sound. Most of the rest of the contiguous United States had a medium climate match. There were areas of low climate match in the North-Central United States and scattered across in the western United States.

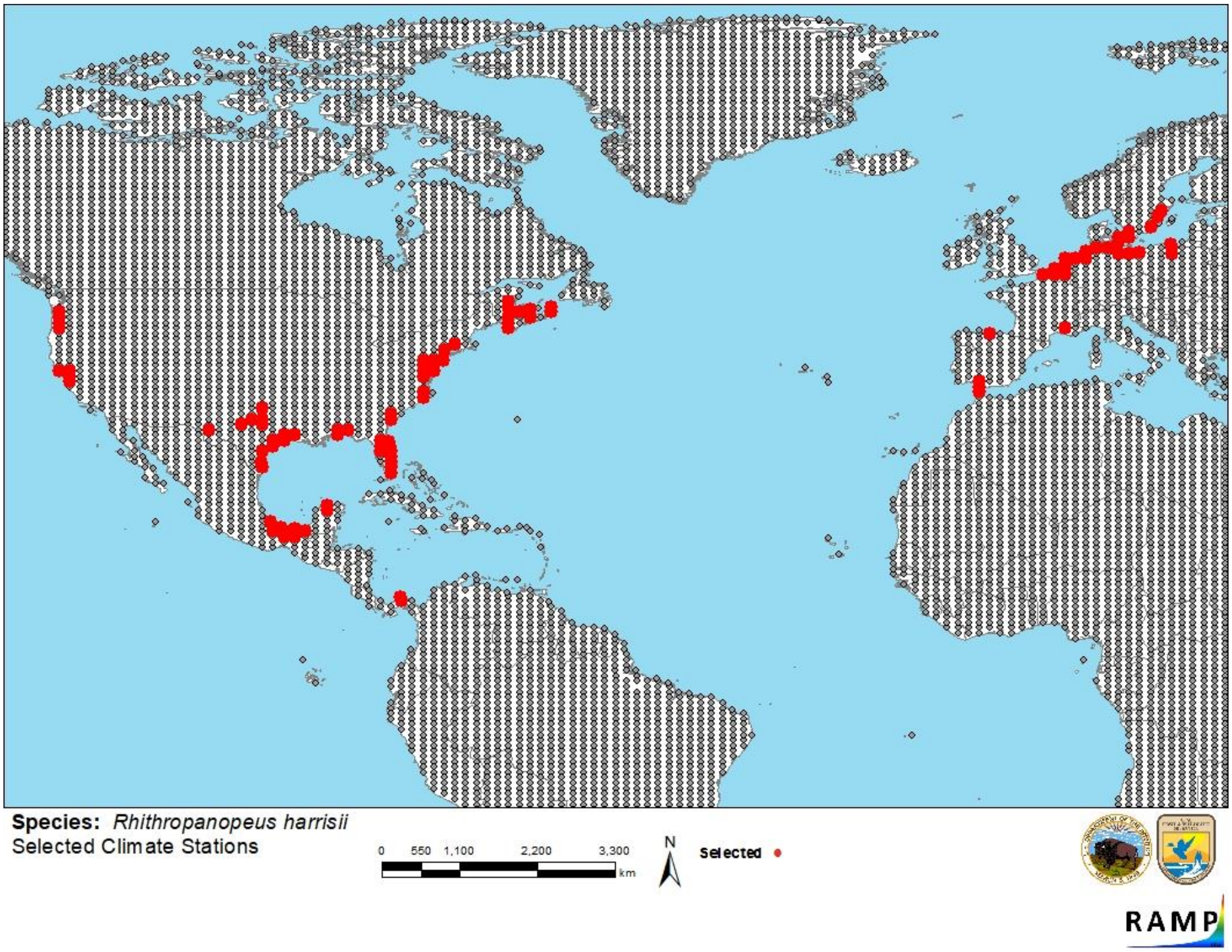

Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations in North America and Europe selected as source locations (red) and non-source locations (gray) for *Rhithropanopeus harrisii* climate matching. Source locations from GBIF Secretariat (2017) and Perry (2018).

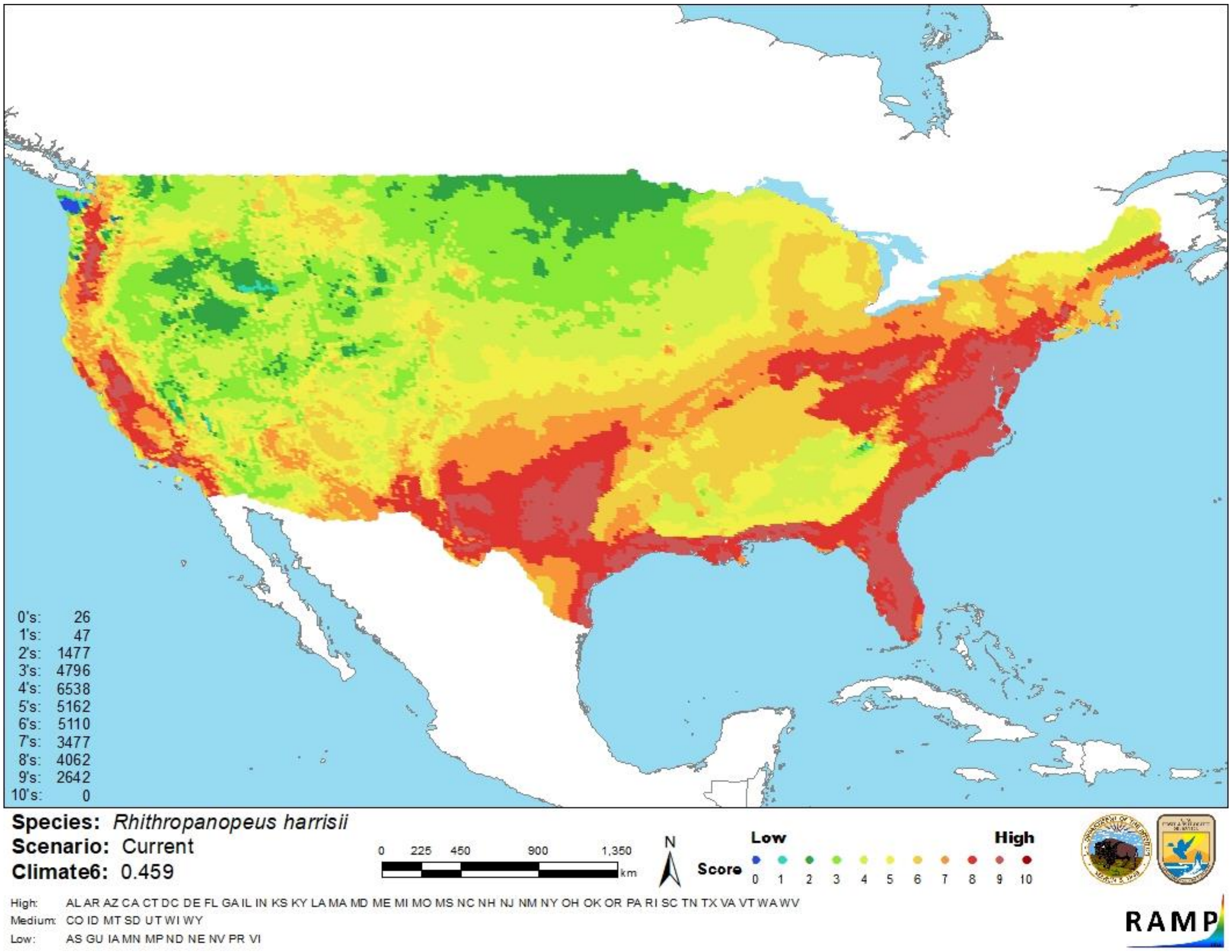

Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Rhithropanopeus harrisii* in the contiguous United States based on source locations reported by GBIF Secretariat (2017) and Perry (2018). 0=Lowest match, 10=Highest match.

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 of *Rhithropanopeus harrisii*. Many introductions of this species outside of its native range have been documented, and negative impacts of introductions of this species have also been documented. No further information is needed to assess the risk this species poses to the contiguous United States. Certainty of this assessment is high.

8 Risk Assessment

Summary of Risk to the Contiguous United States

The Estuarine Mudcrab (*Rhithropanopeus harrisii*) is a small crab native to the East Coast of North America from southern Canada to Mexico. This species is able to adapt to a wide range of salinities, and introductions of this species have been documented in Europe, Japan, Venezuela, the West Coast of the United States, and even freshwater reservoirs in Texas and Oklahoma with high mineral content. The spread of *R. harrisii* is believed related to shipping, oyster transport, fish stocking, and bait bucket or accidental angler/boater releases. Negative impacts of introduced populations of *R. harrisii* on native biodiversity have been documented in the scientific literature. Impacts include reduced abundance of gastropods, small crustaceans, amphipods and isopods; elimination of chironomids; decreases in species richness and diversity; increases in nutrients and phytoplankton; and changes in community composition. *R. harrisii* can host white spot baculoviruses and is parasitized by the rhizocephalan barnacle *Loxothylacus panopaei*. It is used as a research organism in developmental, physiological and pesticide studies. In high densities, *R. harrisii* causes pipe fouling and economic loss to fishermen by spoiling fishes in gill nets. *R. harrisii* has a high climate match with the contiguous United States, especially on the Atlantic, Gulf and Pacific coasts. Certainty of this assessment is high, and the overall risk assessment category is also high.

Assessment Elements

- **History of Invasiveness (Sec. 3): High**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): High**
- **Remarks/Important additional information:** As a host for white spot baculoviruses, *R. harrisii* is a potential vector for crustacean diseases. White spot syndrome virus is an OIE-reportable disease**.**
- **Overall Risk Assessment Category: High**

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.

BISON. 2018. Biodiversity Information Serving Our Nation (BISON). U.S. Geological Survey. Available: https://bison.usgs.gov. (May 2018).

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