Mytilopsis adamsi (a mollusk, no common name)
Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, March 2022
Revised, June 2022
Web Version, 8/17/2022

Organism Type: Mollusk
Overall Risk Assessment Category: Uncertain

Photo: *Mytilopsis adamsi* shells. Milo Milovanic, Stephanie Wise Boyle, Smithsonian National Museum of Natural History. Licensed under Creative Commons Zero. Available: https://collections.nmnh.si.edu/search/iz/?ark=ark:/65665/3c945acb46d9044d5ae837eb795182196 (June 8, 2022).

1 Native Range and Status in the United States

Native Range

From Ferguson (2000):

"That species [*Mytilopsis adamsi*] is native to tropical and subtropical Eastern Pacific waters extending from the Gulf of Mexico to Colombia."

From Olsson (1961):

"*Mytilopsis adamsi* Morrison [Morrison 1946] was described from a lagoon at the mouth of Musselshell Creek on San Jose Island, Pearl Islands, Panama. The same species may also occur on the mainland."

Status in the United States

No records of *Mytilopsis adamsi* in trade or in the wild in the United States were found.

From Arizona Office of the Secretary of State (2013):

"K. Mollusks listed below are considered restricted live wildlife:
[…]
2. All species in the family *Dreissenidae.*"

From Oregon Secretary of State (2022):

"(f) Prohibited Mollusks Common Name – Family –Genus/species:
[...]
(ii) Zebra mussel, Quagga mussel – Dreissenidae – All species (whether live or dead)"

Means of Introductions in the United States

Mytilopsis adamsi is not currently known to be introduced to the United States.

Remarks

The black-striped 'false' mussel, *Mytilopsis adamsi,* has the synonyms of *Mytilopsis allyneana*, *Mytilopsis zeteki*, and *Mytilus perviridis* (MolluscaBase 2022a). The valid name and all synonyms were used to search for information for this screening.

The taxonomic status of the *Mytilopsis* genus is still unsettled. According to MolluscaBase (2022a, b) *Mytilopsis adamsi* J. P. E. Morrison, 1946 and *Mytilopsis sallei* (Récluz, 1849) are two distinct species. This screening will follow that treatment, in line with the ERSS SOP (USFWS 2020). Other authors have synonymized the two names (e.g GISP 2004; Tan and Morton 2006; CABI 2019). Every effort has been made to only include information pertaining to *M. adamsi*. Some information included uses the name *M. sallei* but the literature leans toward agreement that the correct species identification for that population is *M. adamsi* (e.g. Tan and Morton 2006). This partial treatment of the two species as synonyms in the literature complicates determining which information is relevant. See the below quotes for more information.

From Salgado-Barragan et al. (2006):

"Following Morton (1980), the Indo-Pacific specimens were attributed to *M. allyneana* Hertlein and Hanna, 1949, and this species was considered as a junior synonym of the western Atlantic *M. sallei* (Récluz, 1849), which he theorized had crossed the Panama Canal in the 1960's, in

ballast water of ships, reached Fiji and then, dispersed to other localities in the Indo-Pacific. A more critical analysis of the Indo-Pacific specimens, made by Marelli & Gray (1985), indicated that *M. allyneana* is a synonym of *M. adamsi* and that species was probably transported to the Indo-Pacific Ocean during the 19th century on British ships that covered commercial routes from Central America to Fiji and India, prior to the opening of the Panama Canal. Unfortunately, the work of Marelli and Gray was poorly diffused and the declaration of Morton that *M. allyneana* was a synonym of *M. sallei* prevailed until recent years, and the research on the biological and ecological characteristics of these organisms have been attributed to the Atlantic species."

From CABI (2019):

"The native distribution of *M. sallei* centers on the Caribbean islands and the Bay of Mexico (Marelli and Gray, 1983; Nuttall, 1990a). It may have been carried on the hulls of ships to West Africa and beyond since the 16th century. It is generally believed that they were later also introduced to the Eastern Pacific via the Panama Canal (Morton, 1980; Nuttall, 1990a,b) to Fiji, Japan, Taiwan, Hong Kong, China, the Philippines, Thailand, Singapore, Malaysia and India. However, Marelli and Gray (1985) opined that *M. adamsi*, described from the Pearl Islands off Panama, is a native Eastern Pacific species distinct from *M. sallei*, and they maintained that *M. adamsi* (and not *M. sallei*) is the species now widespread in Asia. It remains possible that the native distribution of *Mytilopsis* species encompasses both sides of the American continent (Nuttall, 1990a,b), but without genetic evidence this is unlikely to be resolved."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From MolluscaBase (2022a):

"Animalia (Kingdom) > Mollusca (Phylum) > Bivalvia (Class) >Autobranchia (Subclass) > Heteroconchia (Infraclass)> Euheterodonta (Subterclass) > Imparidentia (Superorder) > Myida (Order) > Dreissenoidea (Superfamily) > Dreissenidae (Family) > Dreisseninae (Subfamily) > *Mytilopsis* (Genus) > *Mytilopsis adamsi* (Species)"

"Status accepted"

Size, Weight, and Age Range

No information on the size, weight, or age range of *Mytilopsis adamsi* was found.

Environment

From Salgado-Barragan et al. (2006):

"During recent samplings, carried out in May and June of 2005, we only found empty shells. At this time the salinity in the study area exceeded 50 psu, which is undoubtedly too high for a brackish species such as *M. adamsi*. These data suggest that this population might be considered a pseudopopulation that is only prevalent when rainfall causes reductions in salinity."

"In the 2000–2003 surveys, this species was only collected on the lower parts of the prop roots and on the bottom of the shrimp ponds suggesting that the species may be less tolerant to long periods of aerial exposure during low tide than other native sessile invertebrates […]"

From Wangkulangkul and Lheknim (2008):

"The salinities from the Haad-kaew Lagoon, Thale Sap Songkhla and Pak Phanang River (area around the water gate) taken at the times of sampling were 20, 6 and 31 psu, respectively."

Climate

From Rodrigues et al. (2021):

"The updated geographical occurrence of *M. adamsi* extends from Mexico (23°N) to Mauritius (20°S), also a high latitudinal variation […] but only inside the tropical zone, […]"

Distribution Outside the United States

Native

From Ferguson (2000):

"That species [*Mytilopsis adamsi*] is native to tropical and subtropical Eastern Pacific waters extending from the Gulf of Mexico to Colombia."

From Olsson (1961):

"*Mytilopsis adamsi* Morrison[Morrison 1946] was described from a lagoon at the mouth of Musselshell Creek on San Jose Island, Pearl Islands, Panama. The same species may also occur on the mainland."

Introduced

From Ferguson (2000):

"The Black Striped Mussel, now invasive in Darwin [Australia], is a *Mytilopsis* or *Congeria* species, most likely *Mytilopsis adamsi* […] It is probably the same species that invaded an Indian port in the 1960s and Singapore, Hong Kong, Japan and Taiwan since then. As there remains some uncertainty on its actual taxonomy we recommend that it be referred to as *Mytilopsis* (or *Congeria*) sp. until a definitive taxonomic decision is forthcoming."

From Salgado-Barragan et al. (2006):

"The false mussel *Mytilopsis adamsi*, […] is reported for the first time as an introduced species in the Urıas estuary and an adjacent shrimp farm, on the Pacific coasts of Mexico."

"The false mussel *Mytilopsis adamsi* Morrison, 1946, […] invaded the Indo-Pacific Ocean during the 19th century and has reached Fiji, India, Malaysia, Taiwan, Japan, and Australia (Marelli & Gray,1985; Morton, 1989; CRIMP, 2001; Hutchings et al., 2002)."

From Marelli (2021):

"The brackish water bivalve *Mytilopsis* probably invaded Fiji in the late 1800s and has subsequently been spread by invasive vectors to many places in the Indo-Pacific. Morphological evidence, historical documentation, scientific literature, museum records and genetic evidence suggest that this species is *M. adamsi* and not *M. sallei*."

"Using the character state of the apophysis as a diagnostic feature, specimens recently sampled from Singapore, Thailand and Mazatlán, Mexico were identified as *Mytilopsis adamsi*, as were specimens from Visakhapatnam, India."

From Wangkulangkul and Lheknim (2008):

"Although the presence of *M. adamsi* has been recorded in the south of Thailand since 2001 (Swennen et al. 2001), this is the first report of its widespread distribution and abundance in different habitats. It presently well established in the Haad-kaew Lagoon and continues into the lower part of the Songkhla Lagoon System and possibly also in the Pak Phanang Estuary."

From Prozorova et al. (2018):

"Invasive false mussel, *Mytilopsis adamsi* Morrison, 1946 (Bivalvia, Veneroida, Dreissenidae) was found to be abundant in tidal brackish water lake Ba Tai [Vietnam]. […] This is the first record of the false Adams's mussel in Vietnam. The finding indicates that the spread of *M. adamsi* is still in progress and that this invasive mussel continues to colonize brackish waters of Vietnam."

Means of Introduction Outside the United States

From Wangkulangkul and Lheknim (2008):

"The incidence of the mussel *M. adamsi* in south Thailand was probably the result of the accidental introduction of the species by international ships traveling to Hong Kong and Singapore between the 1980s and 1990s (Tan and Morton 2006), then subsequently to ports in the Gulf of Thailand. […] This indicates that *M. adamsi* was possibly transported to Haad-kaew Lagoon and Thale Sap Songkhla between the years 1990 and 2000 via international commercial cargo ships operating between the Songkhla Deepwater Sea Port […] and other regional ports of Hong Kong and Singapore."

From Salgado-Barragan et al. (2006):

"We suggest that *M. adamsi* may have been introduce together with *L. vannamei* adults or postlarvae, and this theory is supported by the fact that the mollusk was not observed in previous intensive surveys performed from 1993 to 1995 at the same shrimp farm (Hendrickx & Meda-Martínez, 2001) and also in the estuary (Salgado-Barragán, 2002). We cannot exclude the possibility that *M. adamsi* was transported into the estuary as larvae in ballast water or as juveniles or adults attached to hulls of ships from the Panama canal zone since the Mazatlán

harbor is one of the most important commercial ports in the Mexican Pacific. Once present in the estuary, *M. adamsi* would have been able to use local vectors to move to the oligohaline portions of the estuarine system."

Short Description

From Salgado-Barragan et al. (2006):

"The major morphological differences between *M. sallei* and *M. adamsi* are that *M. adamsi* possesses a straighter, less indented, ventral margin and is morphologically lower and wider (Marelli & Gray, 1985). In addition, the anterior septum, the structure that supports the anterior adductor muscle, is shorter and extends laterally to a greater extent in *M. adamsi*, whereas the septum of *M. sallei* is longer and lies closer to the plane of the valve margins (Marelli & Gray, 1985)."

From Olsson (1961):

"Its figure shows an elongated shell, twice as long as high, with a relatively large septum and eroded, deformed beak."

Biology

From Salgado-Barragan et al. (2006):

"The species is considered to be highly opportunistic and prolific and can survive under extreme environmental conditions, including wide variations in salinity, polluted waters with low oxygen or high heavy metal and hydrocarbon concentrations (Ramchandra et al., 1975; Morton, 1989; Puyana, 1995; Uma Devi, 1996; Mohan & Prakash, 1998)."

From Wangkulangkul and Lheknim (2008):

"It is interesting to note that *M. adamsi* has an ability to byssally colonize many surfaces, ranging from muddy sand substratum to other submerged materials, such as shells of other molluscs, plastic bags, buoy lines, fish cages and fishing gears."

From Ramchandra Raju et al. (1975):

"It is interesting to note that spawning is not influenced adversely by lower salinity concentrations. The animals not only spawn under lower salinity conditions but even further development appears to be favourably influenced in ranges below 25‰ including freshwater. Higher salinity ranges, on the other hand, appear to have an inhibitory action on spawning."

Human Uses

No information on human uses was found for *Mytilopsis adamsi*.

Diseases

No records of OIE-reportable diseases (OIE 2022) were found for *Mytilopsis adamsi*.
No information on diseases was found for *Mytilopsis adamsi*.

Threat to Humans

From Ramchandra Raju et al. (1975):

"Particularly seawater cooling system both on board ships as well as in industrial establishments on shore have been experiencing operational difficulties due to heavy fouling."

3 Impacts of Introductions

Some of the information presented in this section was published under the name *Mytilopsis sallei* but comes from populations where the literature supports the correct species identification as *M. adamsi*.

From Ramchandra Raju et al. (1975):

"Since its incidence [in Visakhapatnam, India], it has propagated in such large numbers that the intensity of their fouling exceeds the quantity of other fouling organisms by several times. In a short period of six months, the fouling by *Mytilopsis sallei* was found to have completely covered an experimental frame to such an extent that there was no scope for the settlement of any other organism […]."

"It has been observed that *M. sallei* is the most predominent fouling species in Visakhapatnam harbour. Particularly seawater cooling system both on board ships as well as in industrial establishments on shore have been experiencing operational difficulties due to heavy fouling."

From Wangkulangkul and Lheknim (2008):

"*M. adamsi* bivalves were observed on the substratum of the whole seasonally-closed portion of the Haad-kaew Lagoon as well as some attached on boat piers and other hard substrata, while densely populated colonies occurred on aquaculture cages in the permanently open lagoon […]."

From Salgado-Barragan et al. (2006):

"In some of these coastal areas the species [*Mytilopsis adamsi*] completely dominates the fouling communities and, in some countries, the economical costs of its elimination have been high (Ramchandra et al., 1975; Huang & Morton, 1983; Marelli & Gray, 1983; Sachidhanandam & Chou, 1996; Field, 1999; CRIMP, 2001; Anil et al., 2002)."

From Kennedy (2011):

"However, it [*Mytilopsis adamsi*] is now a significant fouling organism in Asia and perhaps Australia. It was introduced to Visakhapatnam Harbour in India on or before 1967 (Ganapati et al. 1971) and became an intensely fouling species on intertidal and subtidal structures and

vessels (Morton 1981). It had spread to Victoria Harbour, Hong Kong by the early 1980s (Huang and Morton 1983), again dominating the intertidal pier community (Morton 1989)."

Mytilopsis adamsi is a prohibited species in Arizona and Oregon as part of the Dreissenidae family.

4 History of Invasiveness

Records of nonnative introductions exist for *Mytilopsis adamsi* in Mexico, Thailand, Fiji, Indonesia, India, Japan, Taiwan, Hong Kong, Singapore, and Malaysia. These introductions resulted in established populations. There are reports of *M. adamsi* fouling infrastructure in multiple countries, possibly leading to large economic costs. In one settlement experiment, *M. adamsi* completely covered the placed substrate and excluded any other organisms. The history of invasiveness is classified as high.

5 Global Distribution

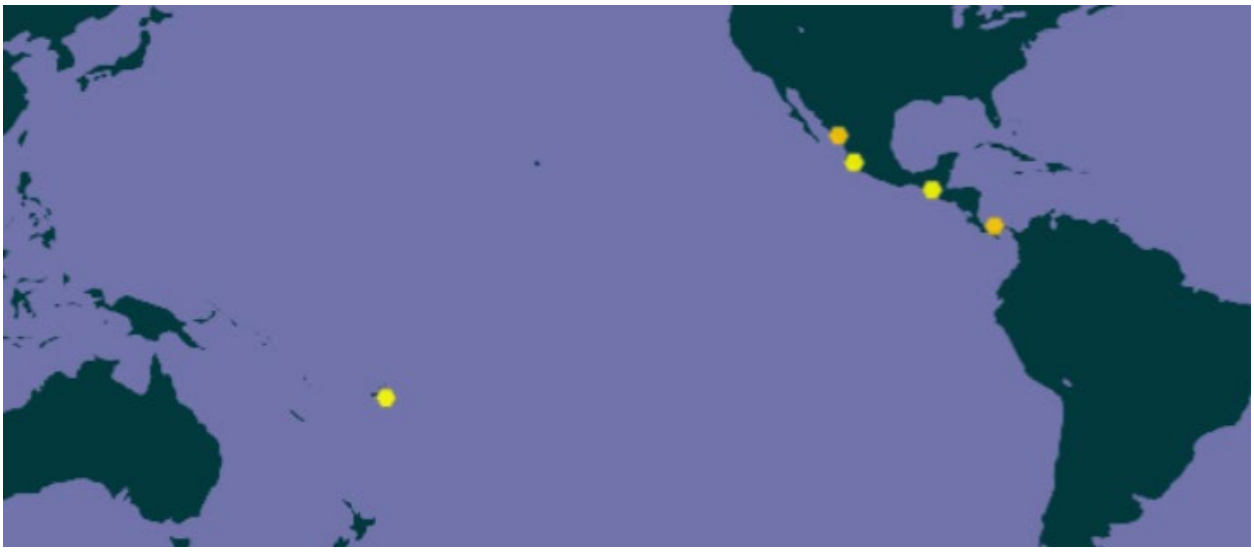

Figure 1. Known georeferenced observations of *Mytilopsis adamsi.* Observations are reported from Panama, Guatemala, Mexico, and Fiji. Map from GBIF Secretariat (2022). Because the climate matching analysis (section 7) is not valid for marine waters, no marine occurrences were used in the climate matching analysis.

Locations of observations in southern Thailand were given in Wangkulangkul and Lheknim (2008) and in Singapore by Tan and Morton (2006; under the name *M. sallei*).

Much of the range of *M. adamsi* may not be represented in the source points for the climate match due to a lack of georeferenced observations and the taxonomic issues with *M. sallei*.

6 Distribution Within the United States

Mytilopsis adamsi has not been reported in the wild within the United States.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Mytilopsis adamsi* to the contiguous United States was mainly low. Areas of medium match were found along the California coast, and along the eastern Gulf and southern Atlantic coasts. The overall Climate 6 score (Sanders et al. 2021; 16 climate variables; Euclidean distance) for the contiguous United States was 0.002, low (Scores between 0.000 and 0.005, inclusive, are classified as low). California, Florida, and Louisiana had medium individual Climate 6 scores. All other States had low individual scores. No States had high individual scores. Due to sections of the species' possible range not being well represented in the source points for the climate match, the climate match results may be an underestimation of where the species could potentially survive.

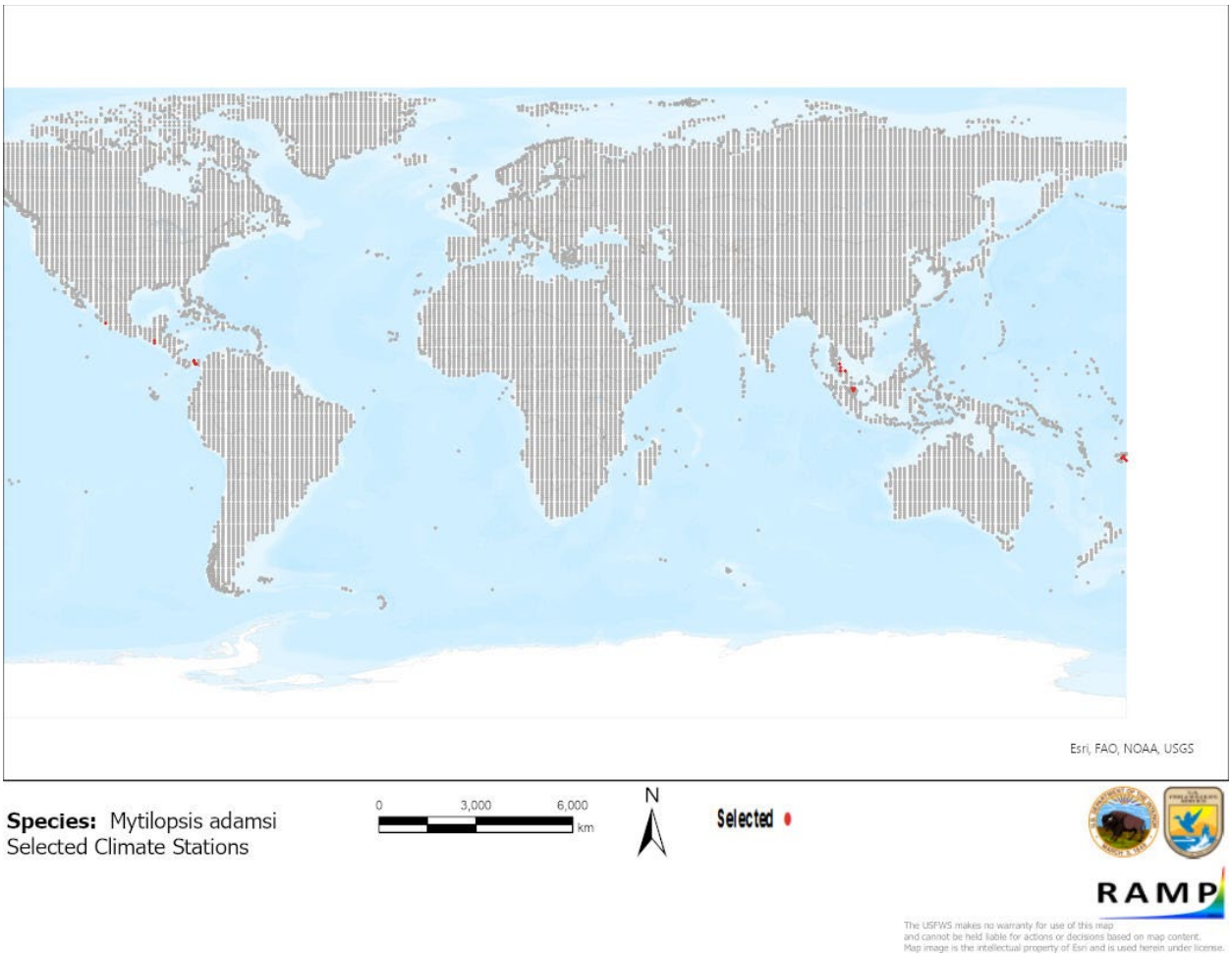

Figure 2. RAMP (Sanders et al. 2021) source map showing weather stations in Central America, Southeast Asia, and the south Pacific selected as source locations (red; Panama, Guatemala, Mexico, Thailand, Singapore, and Fiji) and non-source locations (gray) for *Mytilopsis adamsi* climate matching. Source locations from Tan and Morton (2006), Wangkulangkul and Lheknim (2008), and GBIF Secretariat (2022). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

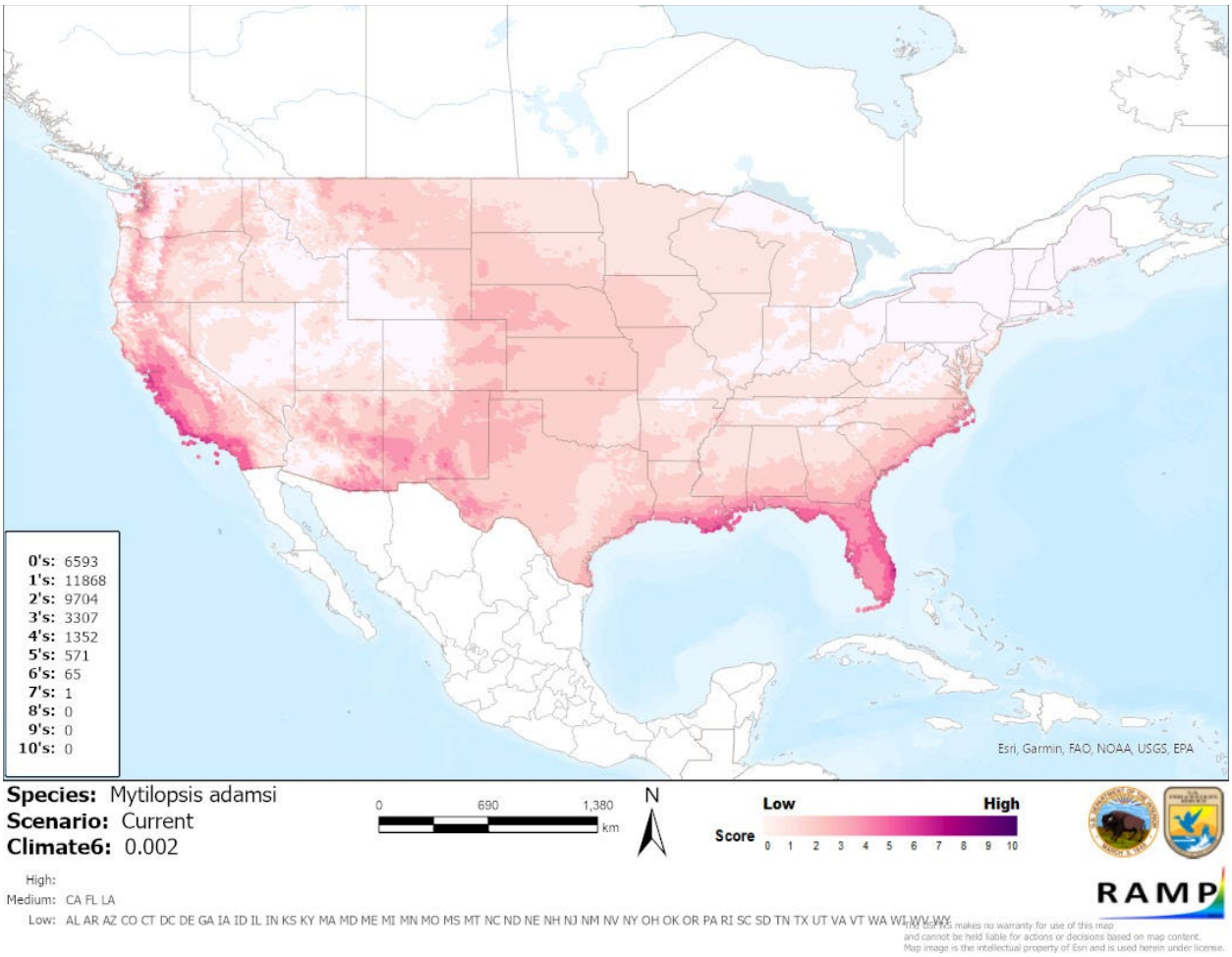

Figure 3. Map of RAMP (Sanders et al. 2021) climate matches for *Mytilopsis adamsi* in the contiguous United States based on source locations reported by Tan and Morton (2006), Wangkulangkul and Lheknim (2008), and GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: (Count of target points with climate scores 6-10)/ (Count of all target points)	Overall Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

8 Certainty of Assessment

The certainty of assessment is medium. Some information was available for the species' biology and ecology. Records of introduction were found along with information regarding impacts. The species' distribution was underrepresented by georeferenced observations. The taxonomy of the *Mytilopsis* genus is unsettled, resulting in some authors synonymize *M. adamsi* with *M. sallei*

which complicates understanding what information or populations should be assigned to *M. adamsi* and not *M. sallei*. Due to the taxonomic issues and lack of georeferenced observations the certainty of assessment is reduced.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Mytilopsis adamsi is a brackish water mollusk native to tropical West Pacific coast of Central America. This coastal species reproduces and grows better at lower salinities. *M. adamsi* is not currently present in trade. It is prohibited in Arizona and Oregon as part of the Dreissenidae family. Introductions outside of its native range have been reported in Mexico, southern and southeast Asia and the western Pacific. Established populations in those locations have caused significant fouling of infrastructure and can exclude other organisms from settling. The history of invasiveness is classified as high. Overall climate match with the contiguous United States is low. Most of the contiguous United States had a low match. Areas of medium match were found along the California, eastern Gulf, and southern Atlantic coasts. The certainty of this assessment is medium due to taxonomic uncertainty within the *Mytilopsis* genus and a lack of georeferenced observations of the species. The overall risk assessment category for *Mytilopsis adamsi* is Uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 4): High**
- **Overall Climate Match Category (Sec. 7): Low**
- **Certainty of Assessment (Sec. 8): Medium**
- **Remarks, Important additional information:** Some taxonomic confusion with *M. sallei*
- **Overall Risk Assessment Category: Uncertain**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 11.

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11 Literature Cited in Quoted Material

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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