Little Brown Mussel (*Xenostrobus securis*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, January 2025
Revised, January 2025
Web Version, 1/23/2025

Organism Type: Mollusk
Overall Risk Assessment Category: High

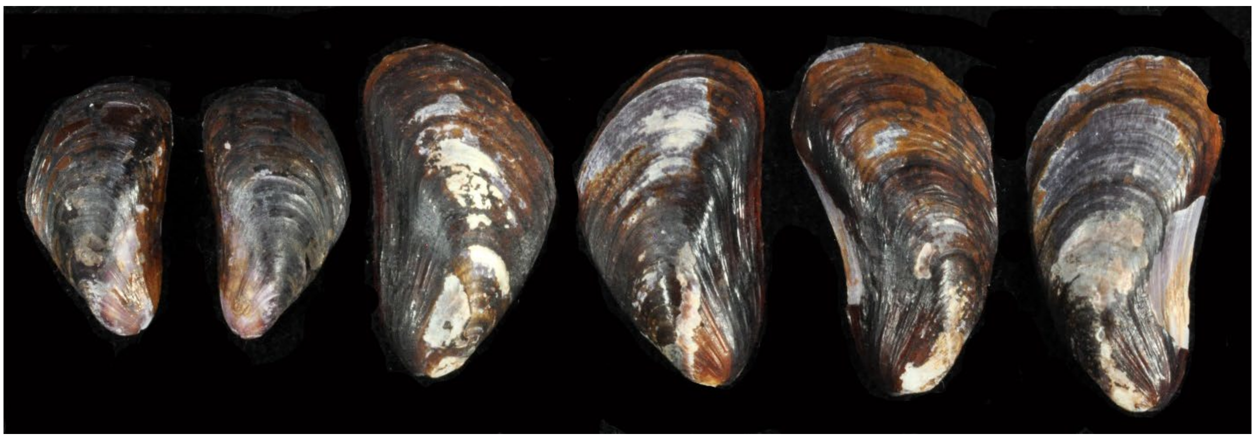

Photo: Museum national d'Histoire naturelle, Paris. Licensed under CC BY 4.0. Available: https://commons.wikimedia.org/wiki/File:Xenostrobus_securis_(MNHN-IM-2000-34894)_002.jpeg (January 2025).

1 Native Range and Status in the United States

Native Range

From Morton and Leung (2015):

"The natural range of *Xenostrobus securis* in Australia, in addition to New Zealand, includes the estuaries of rivers of eastern, southern and Western Australia (Wilson, 1967, Roberts and Wells, 1980)."

From Powell (1979):

"Western Australia to mid Queensland [Australia], and New Zealand, North, South and Chatham Islands."

Status in the United States

Morningstar (2025) reports two collections of *Xenostrobus securis* from the Dominguez Channel in Los Angeles County in December 2024.

From Morningstar (2025):

"Status: unknown"

No records of *Xenostrobus securis* in trade in the United States were found.

Regulations

No species-specific regulations on possession or trade were found within the United States.

Means of Introductions within the United States

From Morningstar (2025):

"Potential Pathway: shipping ballast water | hitch hiker"

Remarks

From Zenetos et al. (2003):

"Remarkably similar to *X. pulex* (Lamarck, 1819), a south Australian species, from which it differs in the following characteristics: exteriorly above the umbonal keel the shell is brown (black in *X. pulex*), often paler below the keel; the umbones are terminal in *X. pulex*, nearly terminal in *X. securis*. Mature specimens of *X. securis* are significantly narrower than *X. pulex*."

Other common names applied to this species include axe-head mussel (Morningstar 2025) and black pygmy mussel (Au et al. 2024).

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From MolluscaBase (2025):

"Biota > Animalia (Kingdom) > Mollusca (Phylum) > Bivalvia (Class) > Autobranchia (Subclass) > Pteriomorphia (Infraclass) > Mytilida (Order) > Mytiloidea (Superfamily) > Modiolidae (Family) > Xenostrobinae (Subfamily) > *Xenostrobus* (Genus) > *Xenostrobus securis* (Species)"

According to MolluscaBase (2025), *Xenostrobus securis* (Lamarck, 1819) is the current accepted name for the species.

The following synonyms of *X. securis* from MolluscaBase (2025) were used to search for information for this report: *Limnoperna fortunei kikuchii, Modiola fluviatilis, Modiola securis*.

Size, Weight, and Age Range

From Zenetos et al. (2003):

“20-30 mm length. Height/length ratio=0.59, width/length=0.35, max. observed length 47 mm (Russo, 2001).”

From Lau et al. (2018):

“It has a life span of ~21 months (Kimura and Sekiguchi, 2009) […]”

Environment

From Palomares and Pauly (2025):

“Benthic; brackish; depth range 1 - 20 m [Pascual et al. 2010].”

From Sanz-Latorre et al. (2023):

“Its wide euryhalinity [sic] is one of the main factors explaining its distribution and invasive success, as adults can survive in salinities between 1 and 31 PSU (Wilson 1968) and the larvae between 8 and 17.5 PSU (Wilson 1969). Similarly, it is highly tolerant to temperature changes in a range from 14 °C to 30 °C (Astudillo et al., 2017), and it is also able to withstand short periods of extreme temperatures of up to 42 °C (Olabarria et al., 2016).”

From Lau et al. (2018):

“Around the world, *X. securis* can be found on various intertidal and subtidal habitats including rocks, sandy and muddy bottoms and artificial structures (Sousa et al., 2009).”

Climate

From Palomares and Pauly (2025):

“Temperate”

Distribution Outside the United States

Native

From Morton and Leung (2015):

“The natural range of *Xenostrobus securis* in Australia, in addition to New Zealand, includes the estuaries of rivers of eastern, southern and Western Australia (Wilson, 1967, Roberts and Wells, 1980).”

From Powell (1979):

“Western Australia to mid Queensland [Australia], and New Zealand, North, South and Chatham Islands.”

Introduced

From Sanz-Latorre et al. (2023):

"In Asia, the presence of *X. securis* has been reported in China, Japan and Korea (Iwasaki 2006; Iwasaki et al., 2004; Kimura et al., 1999; Shirafuji and Sato 2003), whereas in Europe, the first records are from 1992, at the Italian Adriatic coast (Lazzari and Rinaldi 1994; Sabelli 1993). Today, *X. securis* can be found widespread at [sic] Italian, French and Spanish Mediterranean coasts (Barbieri et al., 2011; Giusti et al., 2008; Gofas and Zenetos 2003), and in [sic] the shores of the Spanish Atlantic Ocean and Cantabrian sea (Adarraga and Martínez, 2012; Bañón et al., 2008; Devloo-Delva et al., 2016; Garci et al., 2007; Gestoso et al., 2012; Pejovic et al., 2016). In the Basque Country, its presence was reported in 2012 only at the estuary of Nerbioi, Bizkaia [Bay of Biscay] (Adarraga and Martínez, 2012) […]."

From NIES (2025):

"Range in Japan: Coast of Kanto, Chubu districts, and western Japan."

"The first record was at Kojima Bay, Okayama Pref., in 1972."

From Morton and Leung (2015):

"*X. securis* has […] been introduced into bays in Sacheon and Mason on the southern coast of Korea (Shirafuji and Sato, 2003)."

"The species was later [after 1992] reported upon from the Slovenian coastline, also in the northern Adriatic Sea (De Min and Vio, 1997)."

From Lau et al. (2018):

"In Hong Kong, *X. securis* was first recorded in Shing Mun River in 2010 (Morton and Leung, 2015), and has subsequently been observed in other areas such as Kwun Tong and Deep Bay (Lai et al., 2016) […]"

Means of Introduction Outside the United States

From Morton and Leung (2015):

"The introduction [to China] occurred prior to 2010 probably *via* shipping arriving at Yantian in Mirs Bay, China, close to Hong Kong. Point sources of infection could be Australia or Korea or Japan where it has similarly been introduced."

"Occhipinti-Ambrogi (2000) suggested that the species has probably been introduced accidentally with similarly introduced aquaculture candidates. It has also been suggested that its presence in Adriatic lagoons along with *Anadara inaequivalvis* (Bruguière, 1789), for example, is related to intense shellfish farming in the area although ballast water transport is likely, at least initially, for most Mediterranean introductions involving free-swimming larvae (Gofas and Zenetos, 2003) […]"

"[…] *X. securis* has been introduced into the Mediterranean Sea presumably *via* the Suez Canal."

From NIES (2025):

"With ballast water or fouling on ships"

Short Description

From Zenetos et al. (2003):

"Shell equivalve, subcylindrical. Outline modioliform. Periostracum smooth and shining. Dorsal margin usually straight, ventral margin straight or slightly arcuate (distinctly arcuate in older specimens) with posterior end evenly rounded. Umbones nearly terminal. Smooth sculpture. Periostracum shining. Internal margin smooth."

"color : shell brown, dark brown in older specimens; pale yellow zigzag lines in younger specimens. Internally the shell is usually purple above and white below the umbonal keel."

Biology

From Sanz-Latorre et al. (2023):

"[…] it has the ability to attach to a wide range of natural substrata of different granulometric characteristics (Pascual et al., 2010), soft or hard, and it also colonizes artificial substrata (Garci et al., 2007). This is due to the properties of its byssus threads, which are remarkably numerous, thin and long, making them suitable for different kinds of attachment points (Babarro and Lassudrie 2011). Small animals with short lifespans and high reproductive capacity are also usually found on the lists of successful invaders, traits *X. securis* possesses (Babarro and Lassudrie, 2011), as well as a very long spawning period that can last up to 10 months (Montes et al., 2020)."

"[…] filter feeders, they have a sessile lifestyle attached to hard substrata (even though *X. securis* can also live in muddy sediments) and they tend to live forming dense aggregations (Garci et al., 2007; Gestoso et al., 2012; Pascual et al., 2010)."

Human Uses

Poppe and Poppe (2025) offer specimens of *Xenostrobus securis* for sale through Conchology, Inc., a company based in the Philippines.

Diseases

No information was found associating *Xenostrobus securis* with any diseases listed by the World Organisation for Animal Health (2025).

Poelen et al. (2014) report *Xenostrobus securis* as a host of *Marteilia refringens*, etiological agent of marteliosis.

From Pascual et al. (2010):

"[…] the mussel could be a key host favouring spreading and epizootic outbreaks of marteliosis which is known to be harmful for local bivalve populations."

Threat to Humans

From Au et al. (2024):

"The growth of *X. securis* in Hong Kong has resulted in this species […] increasing the mortality of the cultured oyster, *Magallana hongkongensis* (Lam & Morton 2003), resulting in an estimated loss of more than HKD$2.4 million (approximately USD$304 thousands) to the local oyster production industry (Lau et al. 2018)."

3 Impacts of Introductions

From Sanz-Latorre et al. (2023):

"It has already been reported that the macrofaunal communities inhabiting *X. securis* beds are different from those found at [native] *M. galloprovincialis* assemblages, as significantly less [sic] number of individuals tend to live associated to [sic] the invasive species (Gestoso et al., 2012)."

From Au et al. (2024):

"The growth of *X. securis* in Hong Kong has resulted in this species outcompeting the native mussel, *Arcuatula senhousia* (Benson 1842), and also increasing the mortality of the cultured oyster, *Magallana hongkongensis* (Lam & Morton 2003), resulting in an estimated loss of more than HKD$2.4 million (approximately USD$304 thousands) to the local oyster production industry (Lau et al. 2018)."

From Iwasaki (2024):

"[…] the present study suggests a severe negative impact on the indigenous barnacle, *F*[*istulobalanus*] *kondakovi*. Kawasaki et al. [2016] reported that barnacles were replaced by *X. securis* after the invasion of the latter in Lake Kitakata, central Japan."

From NIES (2025):

"Pollution by fouling on channels."

4 History of Invasiveness

The History of Invasiveness for *Xenostrobus securis* is classified as High. Introductions of this species in Europe and Asia have been well-documented, with established populations known from seven countries outside the native range. Research on several of these populations has documented convincingly the negative impacts of introduced *X. securis* on populations of native species and economic costs for local oyster producers.

5 Global Distribution

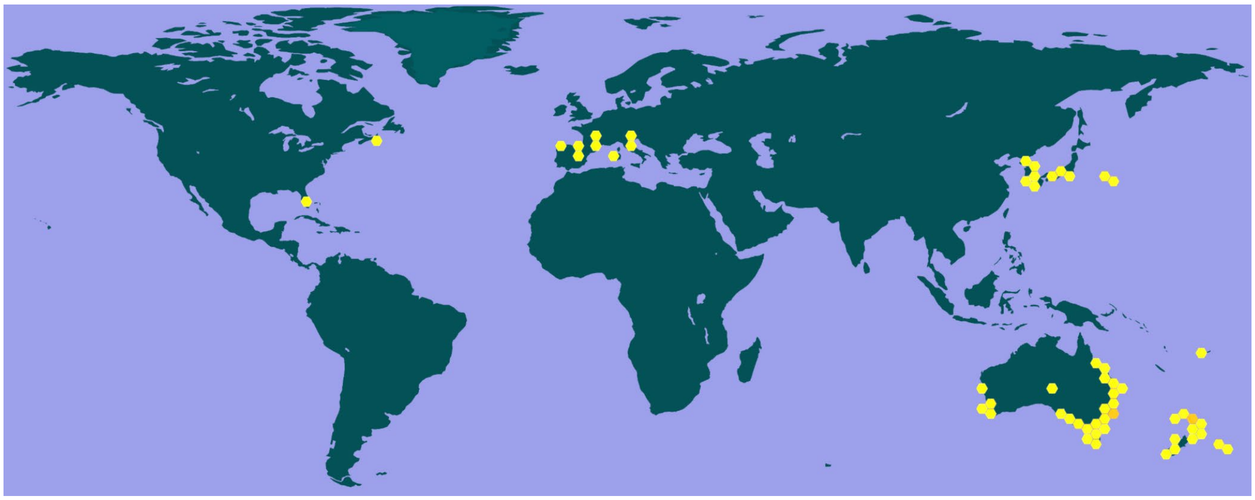

Figure 1. Reported global distribution of *Xenostrobus securis*. Map from GBIF Secretariat (2023). Observations are reported from North America, Europe, Asia, and Australia. Reported occurrences in Florida (United States), Canada, Sardinia (Italy), and Fiji could not be confirmed as established populations and were not included in the climate matching analysis. Points shown in marine waters east of Japan were not included in the climate matching analysis; this species is restricted to brackish waters and these points may represent coordinate errors. In addition, points placed at country centroids in France, Spain, Italy, and Australia were not included in the climate matching analysis because they do not represent precise locations of established populations.

6 Distribution Within the United States

Figure 2. Reported distribution of *Xenostrobus securis* in the United States. Map modified from Morningstar (2025). Observations are reported from southern California. These observations are not known to represent established populations and were not used as source locations for the climate matching analysis.

7 Climate Matching

Summary of Climate Matching Analysis

The climate matching analysis for *Xenostrobus securis* to the contiguous United States was highest in southern Texas, southwestern Florida, along the southern Atlantic coast, and in isolated coastal areas in New England, California, and Washington. Most of the remaining oceanic coastline of the contiguous United States was medium-high to high match as well, except for a stretch of the Pacific coast from northern California to the Olympic Peninsula of Washington, where climate match ranged from medium to very low. Inland areas of high match included much of the rest of California, the Southern Plains, Midwest, Great Lakes, and the inland Mid-Atlantic region. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.589, indicating that Yes, there is establishment concern for this species. 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). However, the climate match does not account for salinity tolerance. Species establishment will require both a suitable climate and the availability of aquatic habitat with appropriate salinity (see Environment, above).

Projected climate matches in the contiguous United States under future climate scenarios are available for *Xenostrobus securis* (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.

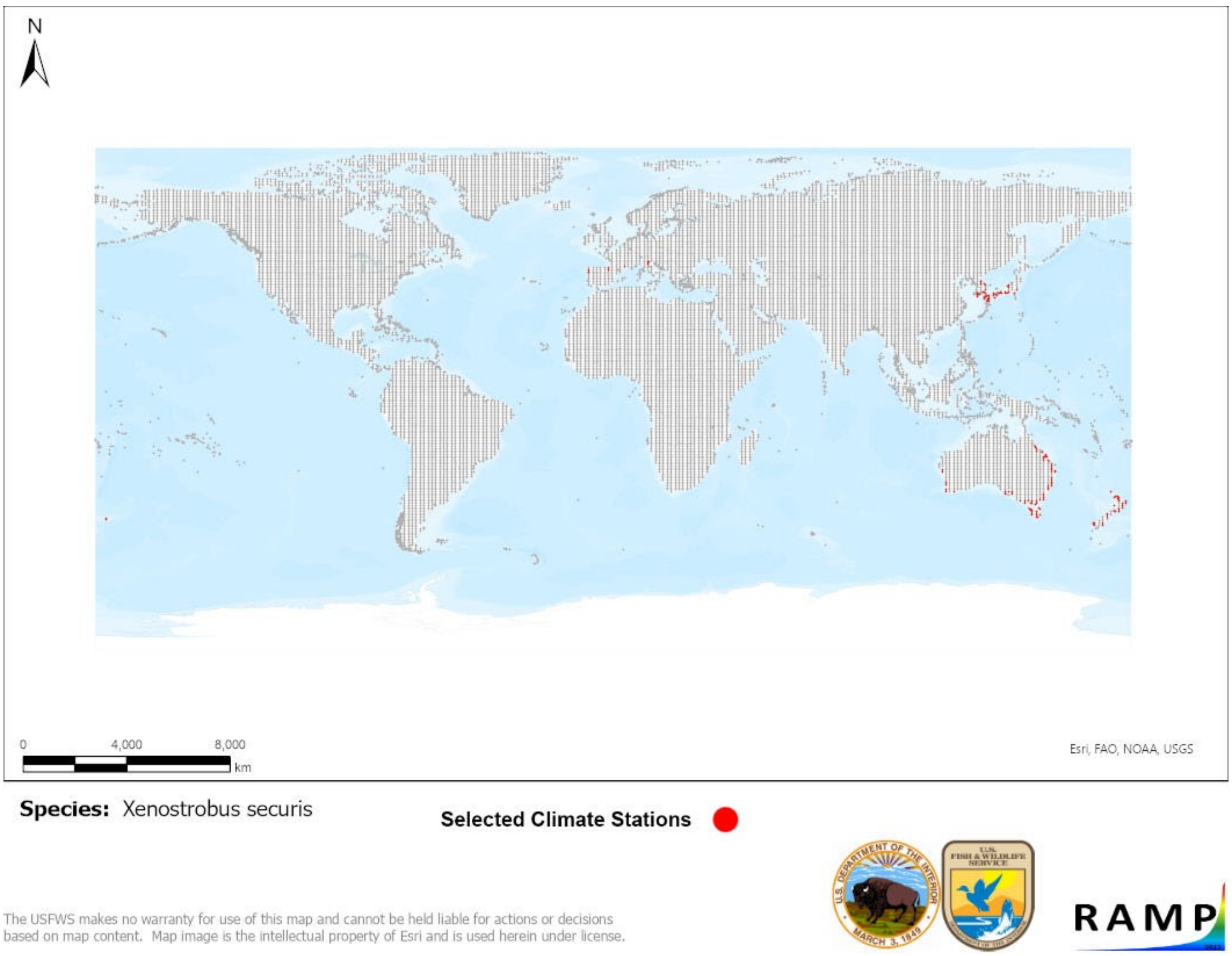

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations around the world selected as source locations (red; Australia, Democratic People’s Republic of Korea, France, Italy, Japan, New Zealand, Portugal, Republic of Korea, Spain) and non-source locations (gray) for *Xenostrobus securis* climate matching. Source locations from GBIF Secretariat (2023). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

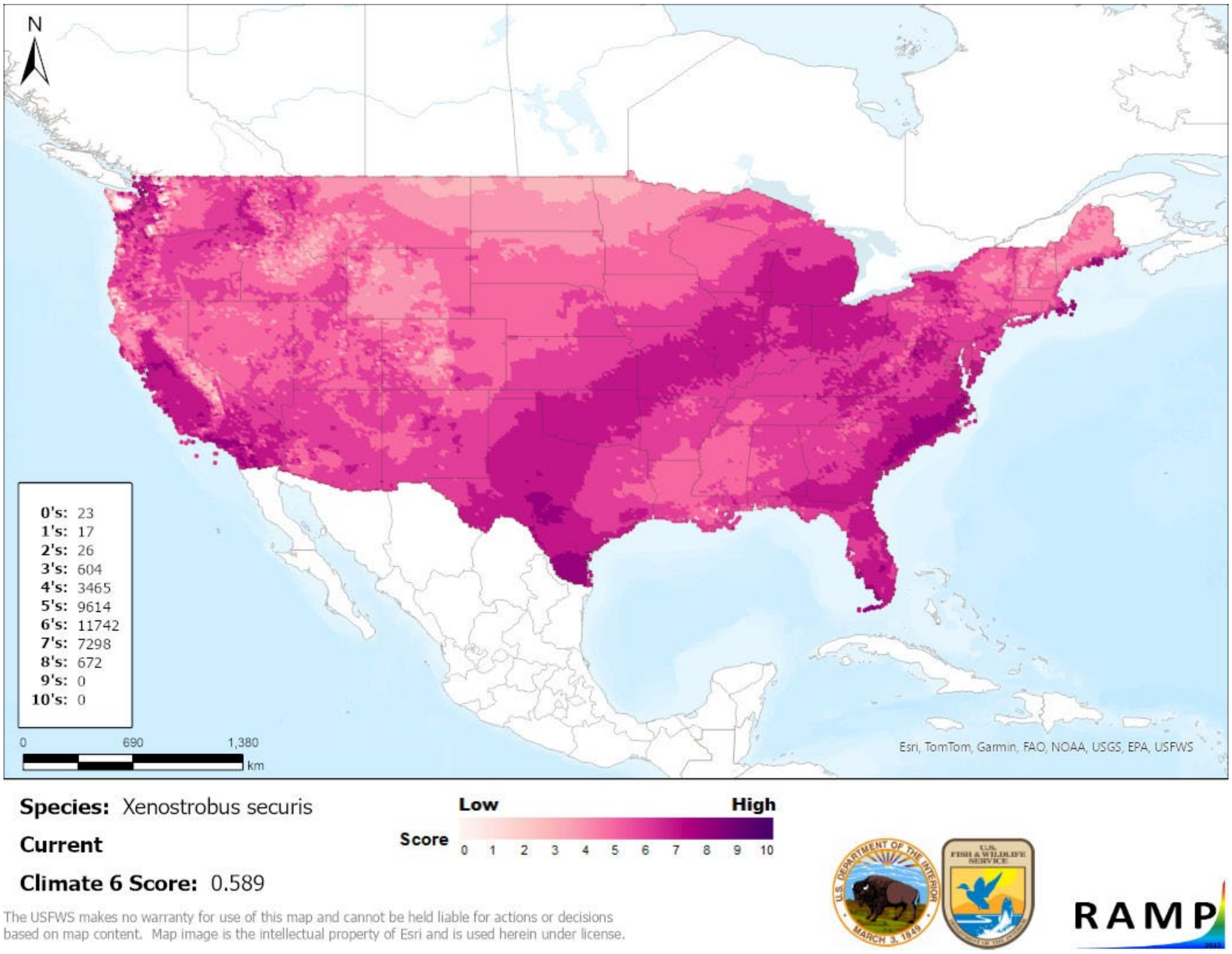

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Xenostrobus securis* in the contiguous United States based on source locations reported by GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

There is ample reliable and convincing documentation of the establishment of *Xenostrobus securis* outside its native range and the negative impacts of its introductions. However, the salinity tolerance of the species limits its potential to establish in substantial portions of the contiguous United States. The brackish water environments required for *X. securis* to survive and reproduce are common along the marine coastlines of the country but rare elsewhere. Therefore, the Certainty of Assessment for *Xenostrobus securis* is classified as Low.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Xenostrobus securis, little brown mussel, is a mollusk native to Australia and New Zealand. This species is typically found in estuarine environments, tolerating a broad range of substrates, temperatures, and salinities. However, it cannot survive in freshwater or seawater. *X. securis* is spread via ship ballast water and through accidental release in shellfish aquaculture. It can heavily alter pre-existing benthic communities and reducing populations of native mussels, barnacles, and cultured oysters. The History of Invasiveness for *Xenostrobus securis* is classified as High due to the ample information available about the introductions and negative impacts of this species. The climate matching analysis for the contiguous United States indicates establishment concern for this species, with high climate matches found along parts of each of the Gulf, Atlantic, and Pacific coasts. The climate match does not account for salinity tolerance, and therefore may not reflect actual establishment concern for inland areas. The Certainty of Assessment for this ERSS is classified as Low because of the salinity requirements of this species and the increased uncertainty around how widely it may be able to establish in the contiguous United States. The Overall Risk Assessment Category for *Xenostrobus securis* in the contiguous United States is High.

Assessment Elements

- **History of Invasiveness (see section 4): High**
- **Establishment Concern (see section 7): Yes**
- **Certainty of Assessment (see section 8): Low**
- **Remarks, Important additional information: Restricted to brackish water environments.**
- **Overall Risk Assessment Category: High**

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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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 (2023). Note that the future climate matching analysis does not account for salinity tolerance in brackish water species like *Xenostrobus securis* (see Environment, above). Species establishment will require both a suitable climate and the availability of aquatic habitat with appropriate salinity.

Under the future climate scenarios (figure A1), no regions of the contiguous United States were projected to have a consistently high climate match for *Xenostrobus securis*. However, small areas of high climate match did appear in various parts of the Great Lakes region and southern to central California under all future climate scenarios. The Southeast, Northern Plains, and parts of the Northwest Pacific Coast regions all had areas of low climate matches under all future climate scenarios. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.409 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.626 (model: MRI-ESM2-0, SSP3, 2085). 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 (0.589, figure 4) falls within 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 the most extreme scenario, areas within the Great Lakes saw a large increase in the climate match relative to current conditions. Additionally, under one or both of the climate scenarios at the 2085 time step, areas within the Colorado Plateau, Northeast, Northern Plains, and Western Mountains saw a moderate increase in the climate match relative to current conditions. Similarly, under one or both of the climate scenarios at the 2085 time step, areas within the Appalachian Range, California, Gulf Coast, Mid-Atlantic, Northern Pacific Coast, Southeast, Southern Atlantic Coast, Southern Florida, Southern Plains, Southwest, and Western Mountains saw a moderate decrease in the climate match relative to current conditions. No large decreases were observed regardless of time step and climate scenarios. The magnitude of change was much lower at the 2055 time step than at the 2085 time step, and similar across the two SSPs. Additional, very small areas of large or moderate change may be visible on the maps (figure A3).

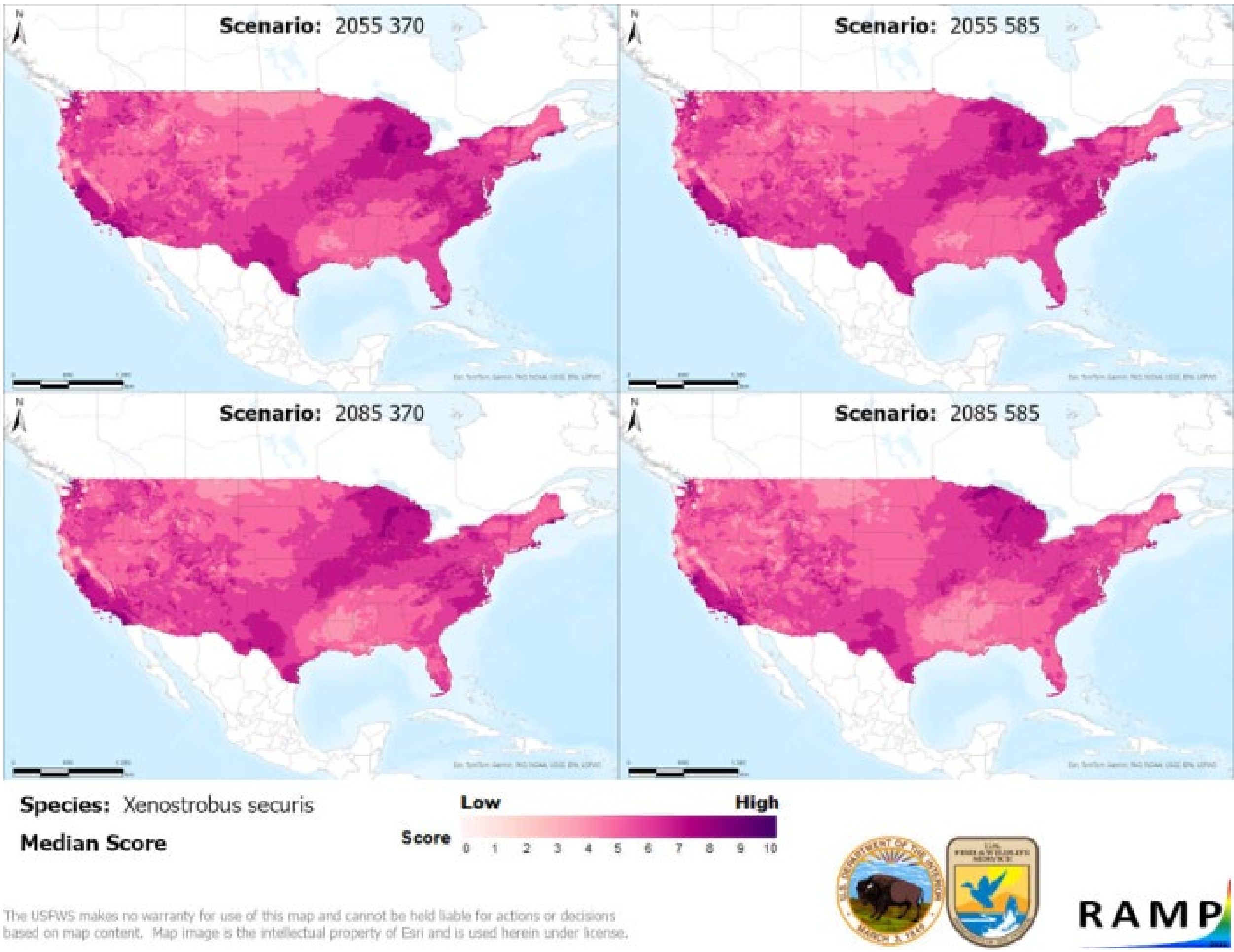

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Xenostrobus securis* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023). Shared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

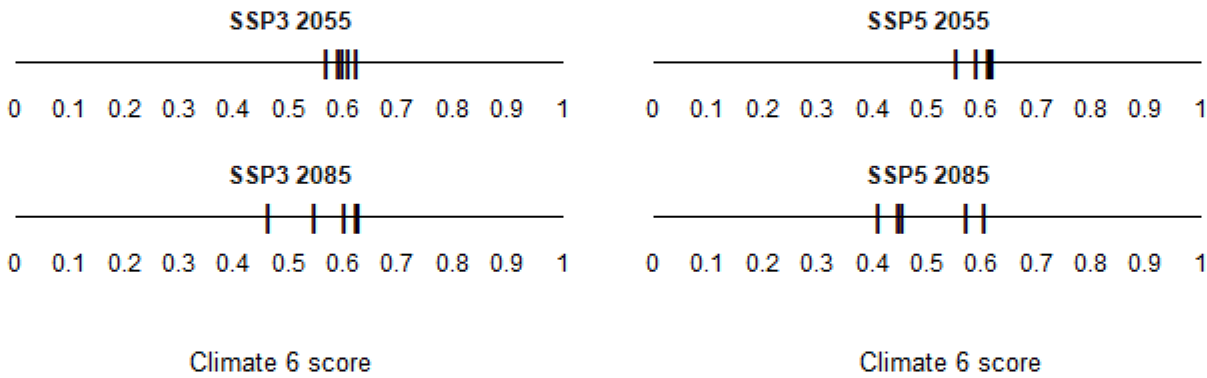

Figure A2. Comparison of projected future Climate 6 scores for *Xenostrobus securis* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018;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

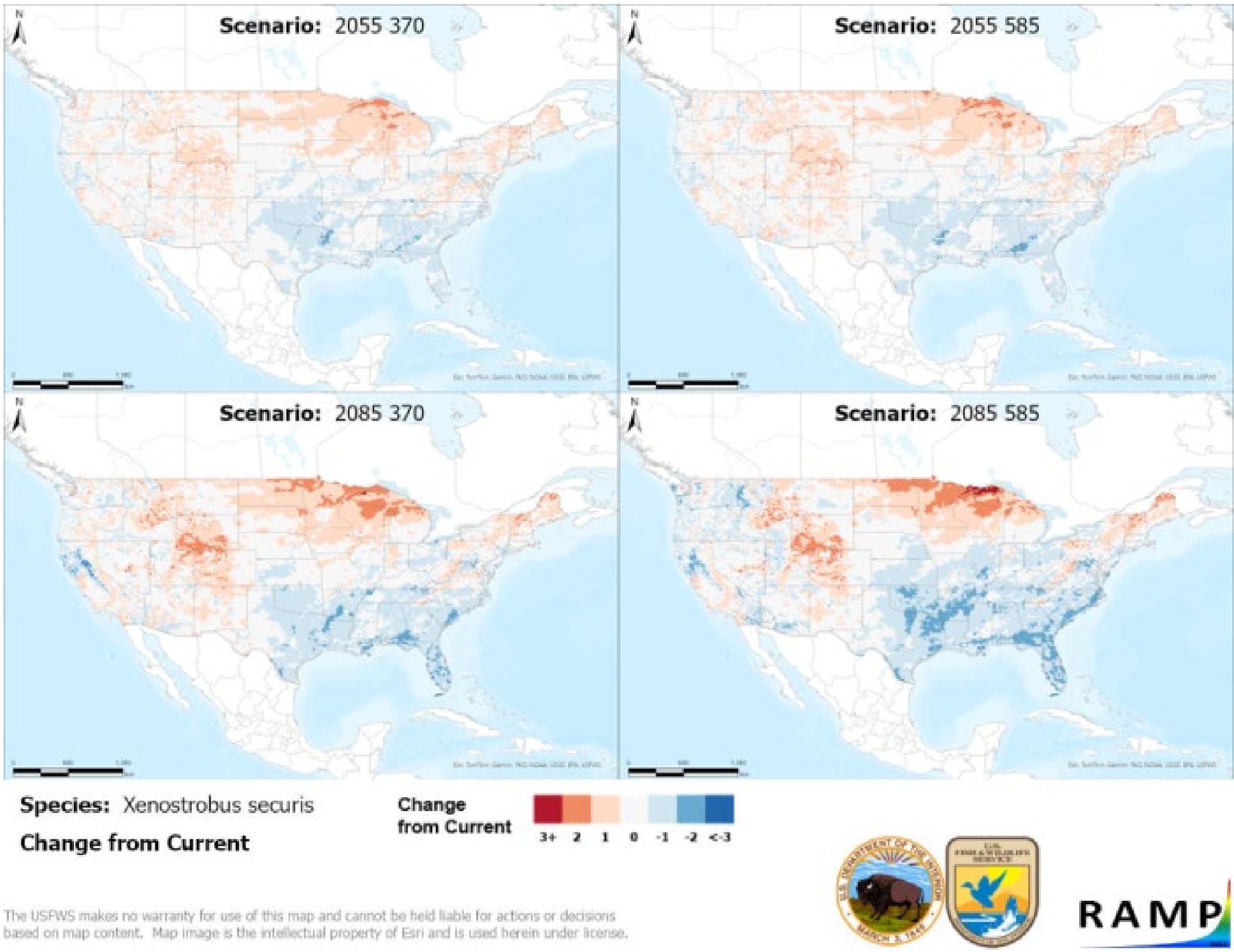

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Xenostrobus securis* based on source locations reported by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