Arc clam (*Anadara inaequivalvis*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, Web Version – 11/27/2017

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1 Native Range and Status in the United States

Native Range

From Sahin et al. (2009):

"[…] blood-cockle [*A. inaequivalvis*] are Indo-Pacific origin."

From Lutaenko (1993):

"Distribution: India, Burma, Thailand, Malaya, Indonesia, North Australia, Philippines, Japan, China […]"

Status in the United States

No records of *Anadara inaequivalvis* in the United States were found.

Means of Introductions in the United States

No records of *Anadara inaequivalvis* in the United States were found.

Remarks

Some records refer to *Anadara inaequivalvis* using the synonym *Scapharca inaequivalvis*. Information searches were performed using both names.

From Gofas (2004):

"*Anadara kagoshimensis* (Tokunaga, 1906) is the valid name for an invasive species in the Mediterranean and Black Sea. It has earlier been misidentified and reported under the names *Scapharca cornea* and *Anadara inaequivalvis*. *Anadara cornea* (Reeve, 1844) and *Anadara inaequivalvis* (Bruguière, 1789) are two valid species that do not occur in the Mediterranean and Black Sea, neither as a native nor as an introduced species."

From Zenetos et al. (2010):

"The Adriatic holds only 27 alien species (15 established, nine casual and three cryptogenic) but the striking characteristic is the high proportion of them which have become invasive. Together with the Levantine basin, the Adriatic may be the part of the Mediterranean which has been most transformed by the onset of alien species. The most invasive species include *Anadara kagoshimensis* (formerly known [identified] as *A. inaequivalvis*), *Musculista senhousia*, *Rapana venosa* and *Ruditapes philippinarum*, all originating from the temperate North Pacific and therefore comfortable despite seasonal lows in sea water temperature."

From Krapal et al. (2014):

"Morphological similarities between *Anadara kagoshimensis* (Tokunaga, 1906) and *Anadara inaequivalvis* (Bruguière, 1789) require the use of genetic markers in identifying the ark shell species that has recently invaded the Black Sea. The high genetic similarity (99.8-100%) hereby found between COI sequences obtained from the Black Sea samples and Japanese *A. kagoshimensis* confirms at a molecular level that the ark clam species invading the Romanian Black Sea belong to this taxon."

"As a matter of fact, diagnostic characters differentiating *Anadara* nominal species are weak, and indeed *A. kagoshimensis* exhibits high similarities with *A. inaequivalvis*. Moreover, the native distributions of the two species partially overlap, with the former widespread in the South China Sea, Yellow Sea and Sea of Japan, whilst the latter living in the Indo-Pacific Ocean (India and Philippines), with the exception of the Red Sea (Huber, 2010). Due to these similarities, a molecular confirmation of the correct identity of the anadarid species found in Europe should be mandatory."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Gofas (2014):

"Kingdom Animalia
Phylum Mollusca
Class Bivalvia
Subclass Pteriomorphia
Order Arcoida
Superfamily Arcoidea
Family Arcidae
Genus *Anadara*
Species *Anadara inaequivalvis*"

"Status: accepted"

"Synonymised names: *Arca binakayanensis* Faustino, 1932; *Arca inaequivalvis* Bruguière, 1789; *Scapharca inaequivalvis* (Bruguière, 1789)"

Size, Weight, and Age Range

No information on the size, weight, and age range of *Anadara inaequivalvis* was found.

Environment

From Zaitsev and Öztürk (2001):

"Sandy-muddy bottoms between 3 to 15m depth."

"Inhabits coastal waters to 40 m depth […] (MARINOV, 1990)."

Climate/Range

From Palomares and Pauly (2015):

"Tropical. Subtropical."

Distribution Outside the United States

Native

From Sahin et al. (2009):

"Both Rapa whelk and blood-cockle [*A. inaequivalvis*] are Indo-Pacific origin."

From Lutaenko (1993):

"Distribution: India, Burma, Thailand, Malaya, Indonesia, North Australia, Philippines, Japan, China […]"

Introduced

No records of introduced populations of *Anadara inaequivalis* were found. See Gofas (2004), Zenetos et al. (2010), and Krapal et al. (2014) for a discussion of the misidentification of the introductions in the Mediterranean and Black seas as *A. inaequivalvis* with those works and others correctly identifying the populations as *A. kagoshimensis*.

Means of Introduction Outside the United States

No records of introduced populations of *Anadara inaequivalis* were found. See Gofas (2004), Zenetos et al. (2010) and Krapal et al. (2014) for a discussion of the misidentification of the introductions in the Mediterranean and Black seas as *A. inaequivalvis* with those works and others correctly identifying the populations as *A. kagoshimensis*.

Short Description

From Zaitsev and Öztürk (2001):

"It is rather similar to *Cerastoderma lamarcki* from the Black Sea, but having a thick and heavy white shell, somewhat rectangular, with broad ligament."

From IBP (2015):

"Shell thick, solid, inequilateral in shape; valves slightly unequal in shape, with left valve overlapping the right valve; outer shell surface white; periostracum well-developed and blackish-brown in colour; inner shell suraface white in colour; many (30-36) wide radial ribs; byssal gape absent; umbonal area smooth; internal ventral margin strongly crenulate."

Biology

From Zaitsev and Öztürk (2001):

"The presence of haemoglobin in the haemolymph of this bivalve can be one of the reasons for its grater [sic] tolerance to seasonal hypoxic conditions on the north-western Black Sea shelf (GOMOIU, 1984)."

From Shain et al. (2006):

"Minimum size for spawning was found as 20 mm in May. Spawning season covers the period from June to September. During this period, the gonadal stages consisting of five phases including primordial, immature, mature, spawn, full spent, resting were observed."

Human Uses
From Sahin et al. (2009):

"It's known that from Arcidae family has been fished intensively in the Southeast Asian countries (FAO, 2000; Broom, 1985)."

Diseases
Information on diseases of *Anadara inaequivalvis* was not found.

Threat to Humans
Information on threats to humans from *Anadara inaequivalvis* was not found.

3 Impacts of Introductions

No records of introduced populations of *Anadara inaequivalis* were found. See Gofas (2004), Zenetos et al. (2010) and Krapal et al. (2014) for a discussion of the misidentification of the introductions in the Mediterranean and Black seas as *A. inaequivalvis* with those works and others correctly identifying the populations as *A. kagoshimensis*.

4 Global Distribution

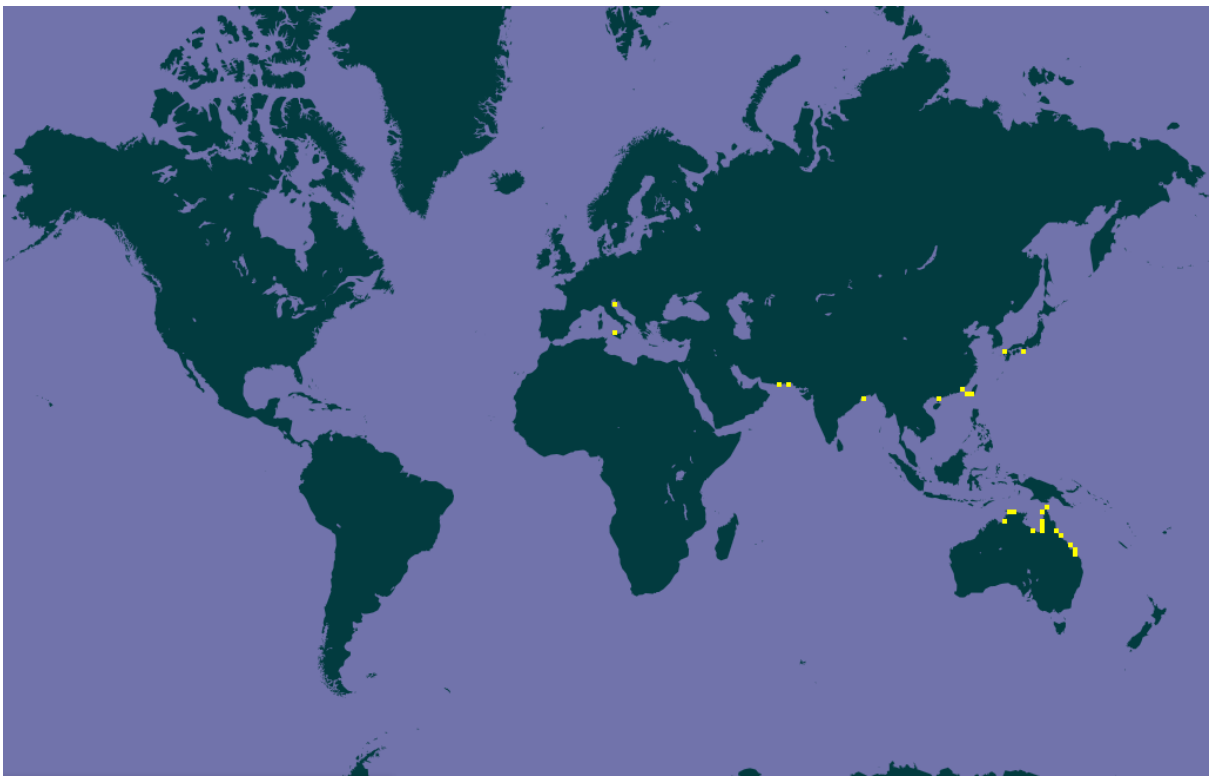

Figure 1. Known global distribution of *Anadara inaequivalis*. Map from GBIF Secretariat (2015).

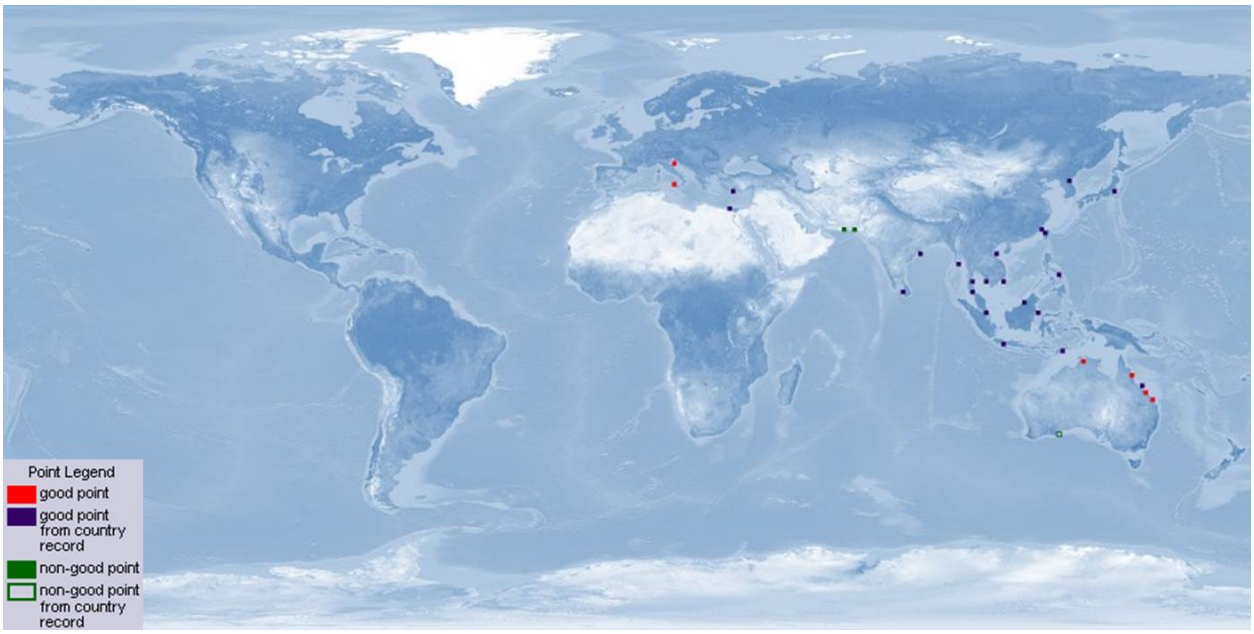

Figure 2. Known global distribution of *Anadara inaequivalvis*. Map from Kaschner et al (2016).

Locations in the Medditerranaen Sea are a due to a misidentification of *Anadara kagoshimensis* as *A. inaequivalvis* (Gofas 2004) and were not used as source locations for the climate match.

5 Distribution Within the United States

No records of *Anadara inaequivalvis* in the United States were found.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Anadara inaequivalvis* was high in southern Florida, portion of the Carolinas' coast, southern Texas, and the Arizona border with Mexico. There were low matches in New England, the Great Lakes, Midwest, and northwestern quarter of the country. All other areas had a medium climate match. The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean distance) for the Continental U.S. was 0.045, medium, and individually high in Florida, Missouri, North Carolina, Oklahoma, and South Carolina.

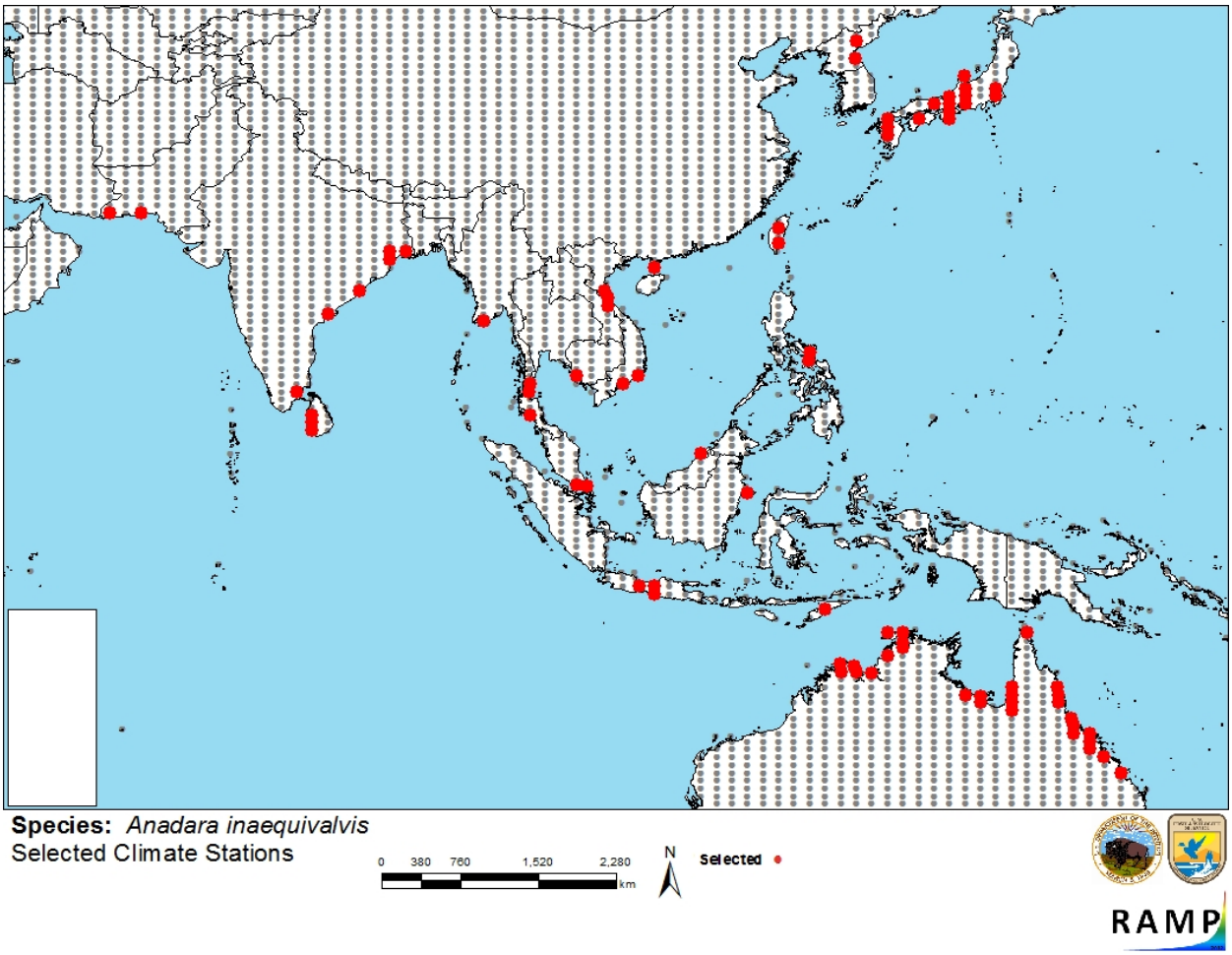

Figure 3. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (grey) for *Anadara inaequivalvis* climate matching. Source locations from GBIF Secretariat (2015) and Kaschner, et al (2016).

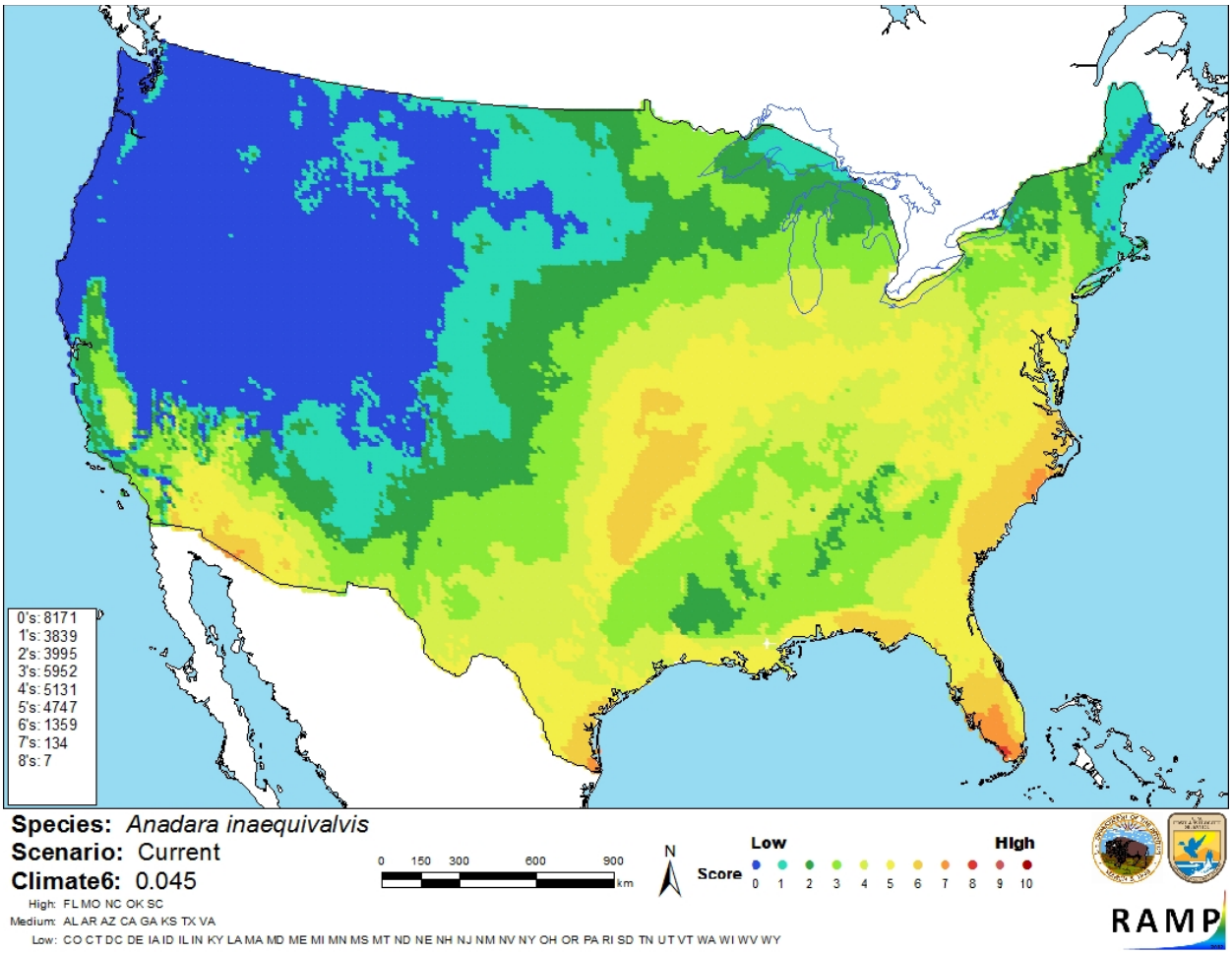

Figure 4. Map from RAMP (Sanders et al. 2014) of a current climate match for *Anadara inaequivalvis* in the continental United States based on source locations reported by GBIF Secretariat (2015) and Kaschner, et al (2016). 0 = Lowest match, 10 = Highest match.

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

Certainty of assessment is medium. The amount and quality of information that are available are both adequate. There are many reports for *Anadara inaequivalvis* introductions in the Mediterranean and Black Sea areas but those have been determined to be *A. kagoshimensis* instead of *A. inaequivalvis*. No other records of introductions of *A. inaequivalvis* were found.

8 Risk Assessment

Summary of Risk to the Contiguous United States

The history of invasiveness is uncertain. All records of introductions that were found referencing *A. inaequivalvis* have been recently determined to be *A. kagoshimensis*. The climate match is medium. The certainty of assessment is medium. The amount and quality of the information available is generally adequate. The overall risk assessment category is uncertain. Some introduction records are in question and have the potential to alter the overall risk assessment.

Assessment Elements

- **History of Invasiveness (Sec. 3): Uncertain**
- **Climate Match (Sec. 6): Medium**
- **Certainty of Assessment (Sec. 7): Medium**
- **Remarks/Important additional information** No additional remarks.
- **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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