U.S. Fish & Wildlife Service

Corbicula fluminalis (a clam, no common name)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, August 2011
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Available: https://commons.wikimedia.org/wiki/File:Toegeknepen_korfmossel.jpg. (April 2018).

1 Native Range and Status in the United States

Native Range

From Karatayev et al. (2007):

"[…] *C. fluminalis* is native to Central Asia."

From Korniushin (2004):

"[…] Central Asia, the Caucasus, Middle East and North Africa […]"

Status in the United States

From Korniushin (2004):

"Until now, *C. fluminalis* is not recorded in North America (Britton & Morton, 1979; Siripattrawan et al., 2000)."

C. fluminalis is not known to be in trade in the United States.

Means of Introductions in the United States

From Korniushin (2004):

"Until now, *C. fluminalis* is not recorded in North America (Britton & Morton, 1979; Siripattrawan et al., 2000)."

Remarks

From Ciutti and Cappelletti (2009):

"The taxonomic status of the genus *Corbicula* is still unresolved, as there is no agreement between investigators, neither [*sic*] about the general number of valid species, nor [*sic*] about species identity of the morphotypes recorded in America and Europe, i.e., some authors consider *C. fluminea* and *C. fluminalis* as morphotypes and the Global Invasive Species Database (GISD) consider them as synonymous (Korniushin 2004; Paunovi et al. 2008)."

From Korniushin (2004):

"[…] *C. fluminalis* is still a poorly known taxon."

"According to a phylogenetic analysis of all available sequence data carried out by Pfenninger et al. (2002), different morphotypes of *Corbicula* from Asia, Australia, North America and Europe (including those from Europe and Israel originally identified as *C. fluminalis*) form a cluster with poorly resolved relationships, with only *C. japonica* and a species from Madagascar forming outgroups."

"The results of this study show that the morphotypes assigned in the recent literature (Morton, 1986; Mandahl-Barth, 1988; Daget, 1998; Swinnen et al., 1998; Rajagopal et al., 2001) to *Corbicula fluminalis* are heterogeneic, differing not only in their shell characters, but also in anatomy and the mode of reproduction."

"The morphotypes from Central Asia, the Caucasus, Middle East and North Africa, including the lots conchologically and geographically nearest to the type lot, are collectively characterised by narrow siphons with scarce papillae and pronounced internal pigmentation, as well as by simultaneous presence of oocytes and sperm in their gonads, biflagellate type of spermatozoa and incubation (possibly facultative) of larvae in the gills. Application of the name *C. fluminalis* is restricted herein to these morphotypes. Differences in shell dimensions and sperm morphology suggest presence of several clonal lineages in the above region, this hypothesis being testable by

a detailed molecular investigation. *Corbicula fluminalis* in the present understanding (as a freshwater incubating taxon) is similar in its anatomy and reproductive biology to the East Asian *C. fluminea*, but can be well distinguished from the latter by the shell characters. Status of the both presumably distinct taxa can be finally settled, when a molecular investigation of the principal freshwater *Corbicula* lineages is completed."

This report attempts to limit its sources to those recognizing *C. fluminalis* as a valid species and distinct from *C. fluminea*. Similarly, the conclusions of this ERSS are applicable to *C. fluminalis* as distinct from *C. fluminea*. A separate ERSS exists for *C. fluminea.*

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2018):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Protostomia
Superphylum Lophozoa
Phylum Mollusca
Class Bivalvia
Subclass Heterodonta
Order Veneroida
Superfamily Corbiculoidea
Family Corbiculidae
Genus *Corbicula*
Species *Corbicula fluminalis* (O. F. Müller, 1774)"

"Current Standing: valid"

Size, Weight, and Age Range

From Łabęcka et al. (2005):

"Specimens of *C. fluminalis* found in the heated channel had the following mean shell measurements (n=18): L (length) = 2.0 cm, D (width) = 1.8 cm, H (height) = 2.0 cm, which precisely corresponds to the data published by GLÖER & MEIER-BROOK (1998) […]"

From Cianfanelli et al. (2007):

"[…] valves up to about 2.5 cm long […]"

Environment

From Karatayev et al. (2007):

"*C. fluminalis* […] can tolerate salinities ≤25‰ (reviewed in Morton 1986)."

"Although there are no data on the lower temperature limit for *C. fluminalis*, this species is found in Siberian rivers, including the Irtysh River, which freeze over in winter, indicating that it can survive temperatures down to 0°C (Volkova 1962)."

Climate/Range

From Korniushin (2004):

"Freshwater bivalve molluscs of the genus *Corbicula* are widely distributed in natural state across tropical and subtropical regions […]"

Distribution Outside the United States

Native

From Karatayev et al. (2007):

"[…] *C. fluminalis* is native to Central Asia."

From Korniushin (2004):

"[…] Central Asia, the Caucasus, Middle East and North Africa […]"

Introduced

From Karatayev et al. (2007):

"The current distribution of *C. fluminalis* includes France, Portugal, Spain (Araujo et al. 1993), the Netherlands (bij de Vaate and Greijdanus-Klaas 1990), Germany (Haesloop 1992), Belgium (Swinnen et al. 1998), Hungary (Csanyi 1998-1999), and Ukraine (Voloshkevich and Son 2002)."

From Ciutti and Cappelletti (2009):

"The first record of *Corbicula fluminalis* (Müller, 1774) (Mollusca: Bivalvia: Veneroidea: Corbiculidae) in Lake Garda (Italy) is presented. This clam was observed in July 2008 along the lake shore, with a high number of shells; sampling of lake sediment revealed the presence of live specimens."

"Recent reviews on alien invertebrates and molluscs in Italy report for *C. fluminalis* a single record from a small alpine lake in Trentino province (Northern Italy) (Lori *et al*. 2005) […]"

From Paunović et al. (2007):

"*C. fluminalis* was rare in terms of Serbian distribution. According to the present data, *C. fluminalis* is found only at two sites at the Danube River, as well as two in the Sava River."

From Łabęcka et al. (2005):

"Recently, the presence of an Asiatic clam, *Corbicula fluminalis* (O. F. Müller, 1774), was confirmed in the lower course of the Odra River [northwestern Poland]."

From Agudo-Padrón et al. (2017):

"On May 24, 2017, Leonardo Kleba Lisboa, a local professional limnologist, requested the identification of some bivalve mollusk specimens in several field photographs […] Those photographs were of a small lot of fresh shells found in the Upper Chapecó River – an important tributary in the great Upper Uruguay River Basin -- between the Municipalities of São Domingos and Ipuaçu […] The shells were found on the banks of the regional small hydroelectric power plant (Pequena Central Hidrelétrica/ PCH) Santa Luzia […] and showed signs of predation by birds […]"

"This record of *Corbicula fluminalis* (Müller, 1774) is the first confirmed sighting of the species in the [Santa Catarina] State territory [in Brazil]."

Means of Introduction Outside the United States

From Karatayev et al. (2007):

"In the late 1970s both *C. fluminea* and *C. fluminalis* were introduced to Europe […]"

"Increased international trade"

From Ciutti and Cappelletti (2009):

"[…] the mode of introduction for *C. fluminalis* is still unknown."

From Csányi (1998-1999):

"These new invading mussel species [*C. fluminalis* and *C. fluminea*] colonised the downstream section of the warm water outlet of the Paks Nuclear Power Plant [on Danube River, Hungary] together with giant specimens of *Sinanodonta woodiana* (Lea 1834). Their sudden occurrence at the 1526 rkm section and the plume-like distribution following the shore line of the right bank indicates that the origin of them should be the cooling water inlet (cold water) canal of the power plant. Regular transportation takes place by ships when the port is frequently used in the cold water canal. Most probably the mussels were carried to Hungary (and to Paks) by this way."

Short Description

From Korniushin (2004):

"[…] characterised by narrow siphons with scarce papillae and pronounced internal pigmentation, as well as by simultaneous presence of oocytes and sperm in their gonads, biflagellate type of spermatozoa and incubation (possibly facultative) of larvae in the gills."

From Łabęcka et al. (2005):

"The colour of the periostracum was olive green-yellow. The ornamentation in the form of narrow and tightly packed ridges was visible on the triangular, though asymmetrical shell of the bivalve. The posterior part was roundish and shorter than the anterior, sharper part of the shell. The nacre was intensively purple. Both the anterior and the posterior lateral teeth formed an arch […]"

Biology

From Karatayev et al. (2007):

"In the River Rhine […] *C. fluminalis* reproduced during October-December and March-April, when water temperatures range from 6 to 15°C (Rajagopal et al. 2000).

From Ciutti and Cappelletti (2009):

"Sampling in the littoral zone of Castelnuovo del Garda revealed the presence of living specimens of *C. fluminea* and *C. fluminalis*, with maximum densities of 19 ind m^{-2} and 5 ind m^{-2} respectively. The two clams were found together, on substrata characterized by the presence of pebbles and cobbles."

Human Uses

From CABI (2018):

"*Corbicula* sp. are considered a healthy food and have the highest glycogen content (50%) of any shellfish (Phelps, [1994]). They are also considered of high medicinal importance, e.g. *C. leana* in Japan (Ikematsu and Kamakura, 1975). The health and medicinal importance might rely on the caloric content estimated at 5.02 Kcal/g in dry weight (Sickel, 1976). They also contain appreciable amounts of vitamin B12 (Halarnkar et al., 1987)."

Diseases

No information available. No OIE-reportable diseases have been documented for this species.

Threat to Humans

No information available.

3 Impacts of Introductions

From Karatayev et al. (2007):

"Ecosystem impacts are better known for *C. fluminea* […] than for *C. fluminalis*; because these two species are ecologically similar in most respects, their effects on ecosystems are also expected to be similar."

From Ciutti and Cappelletti (2009):

"The two clams *C. fluminalis* and *C. fluminea* tend to show invasive behavior in Lake Garda, for rapidity in colonization and high numbers of individuals."

From Nguyen and De Pauw (2002):

"Invasive species of *Corbicula* originally attracted attention as an economically important fouling organism in irrigation and drainage canals, water distribution and industrial water use systems. However, its ecological influence on natural systems has recently become of major concern. In comparison with most freshwater bivalves, the clam is reported to have a high growth rate and a short life span. It also appears to have a relatively high annual production and high filtering rate. Such characteristics have led to speculation that the clam has the capacity to alter the trophic and nutrient dynamics of aquatic systems and to displace native bivalves (BRITTON & MORTON, 1982; MARSH, 1985; ISOM, 1986; RICCIARDI et al., 1995; STRAYER, 1999). On the other hand, some investigators have claimed, on the basis of field studies, that the potential influence of *Corbicula* species on aquatic ecosystems does not appear to be dramatic, and thus believed that the clam would not be a threat to native bivalves (STITES et al., 1995; MILLER & PAYNE, 1994, 1998; DILLON, 2000)."

"[…] the exotic clam species *C. fluminea* and *C. fluminalis*, which recently invaded several Belgian waters, are continuing to extend their colonisation. Most of the places (89%) where *Corbicula* species were found were (slightly to heavily) polluted by organic contaminants and heavy metals. However, no correlation between the clam density, clam proportion in relation to the abundance of the benthic community, and the quality of the sediment was found."

From Cianfanelli et al. (2007):

"The limited European spread [of *C. fluminalis*, reported once in Italy at the time of publication] suggests that it is less invasive than the congeneric *C. fluminea*. However, it has also been reported from eight other European countries (Belgium, France, Germany, Hungary, Luxembourg, Netherlands, Portugal, and Switzerland; Swinnen et al. 1998, Turner et al. 1998, Csa´nyi 1999, Falkner et al. 2001, Araujo 2005), though some of these reports are dubious because of the somewhat uncertain identity of the European populations."

4 Global Distribution

Figure 1. Known global established locations of *Corbicula fluminalis*. Map from GBIF Secretariat (2017). Map was cropped to the known distribution of *C. fluminalis*, including Central Asia, North Africa, and Europe. Numerous other occurrences reported in GBIF Secretariat (2017) were excluded from the map and the climate matching analysis in North America, South America, southern Africa, and eastern and southeastern Asia. *C. fluminalis* is not reported as introduced or established in these locations, and the reported occurrences are likely a result of misidentification given the potential for taxonomic confusion in this genus. Additionally, the occurrences shown here in central Italy, southern Egypt, and Pakistan were excluded from the climate matching analysis because they represent fossil specimens.

5 Distribution Within the United States

C. fluminalis has not been reported as introduced or established in the United States.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2018; 16 climate variables; Euclidean Distance) for *Corbicula fluminalis* in the contiguous United States was high, represented by a Climate6 score of 0.167. Scores of 0.103 and greater are classified as high match. Locally, highest matches occurred in the southern Midwest and Great Lakes region, Mid-Atlantic region, and California. Low climate match occurred along the Gulf Coast and in peninsular Florida, the coastal Pacific Northwest, the north-central U.S., and scattered areas of the Interior West. The remainder of the contiguous United States had a medium climate match.

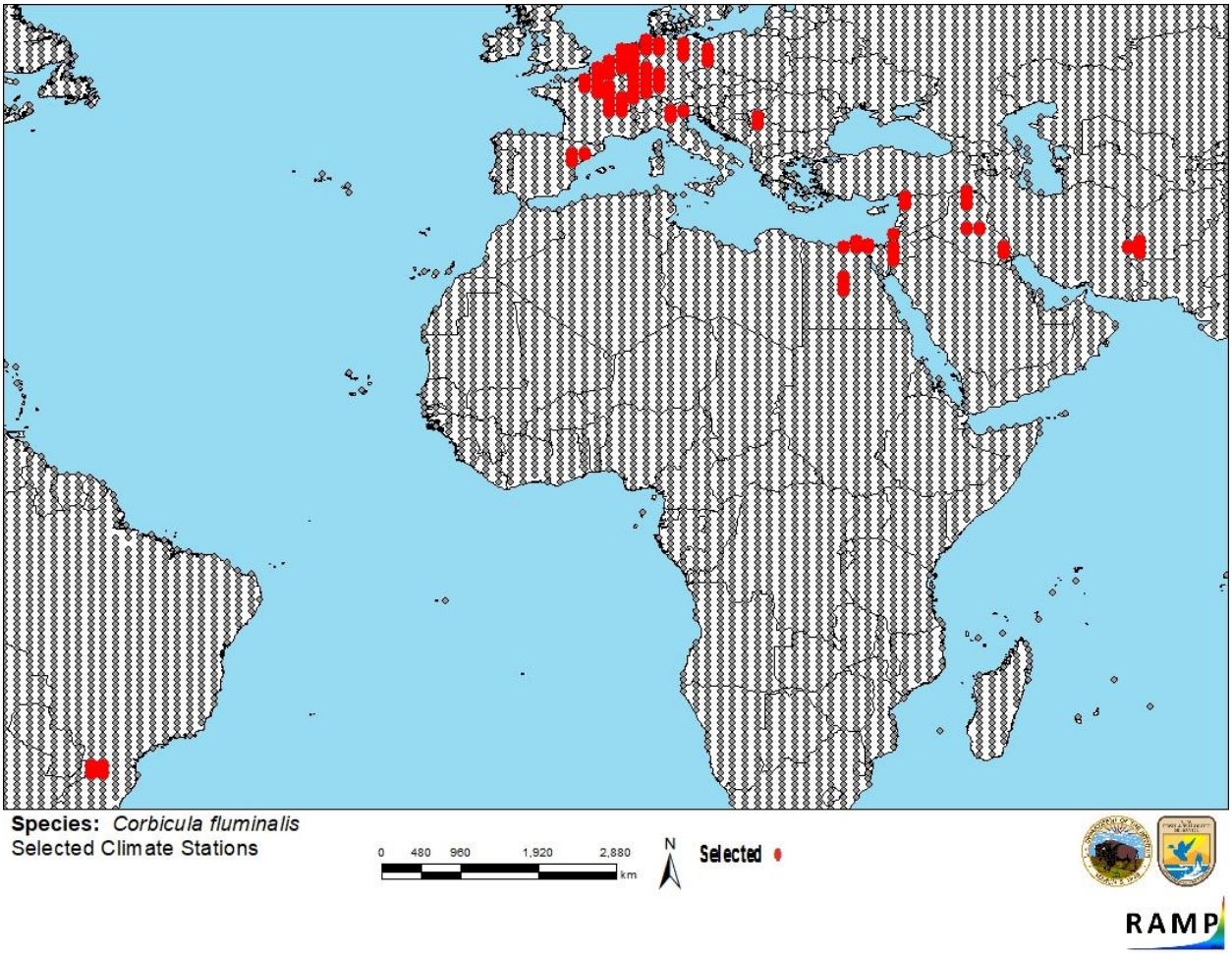

Figure 2. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red; Brazil, Spain, France, Belgium, Netherlands, Germany, Italy, Serbia, Egypt, Israel, Turkey, Iraq, Afghanistan) and non-source locations (gray) for *Corbicula fluminalis* climate matching. Source locations from GBIF Secretariat (2017). Additional source locations from Paunović et al. (2007; Serbia), Ciutti and Cappelletti (2009; Italy), and Agudo-Padrón et al. (2017; Brazil).

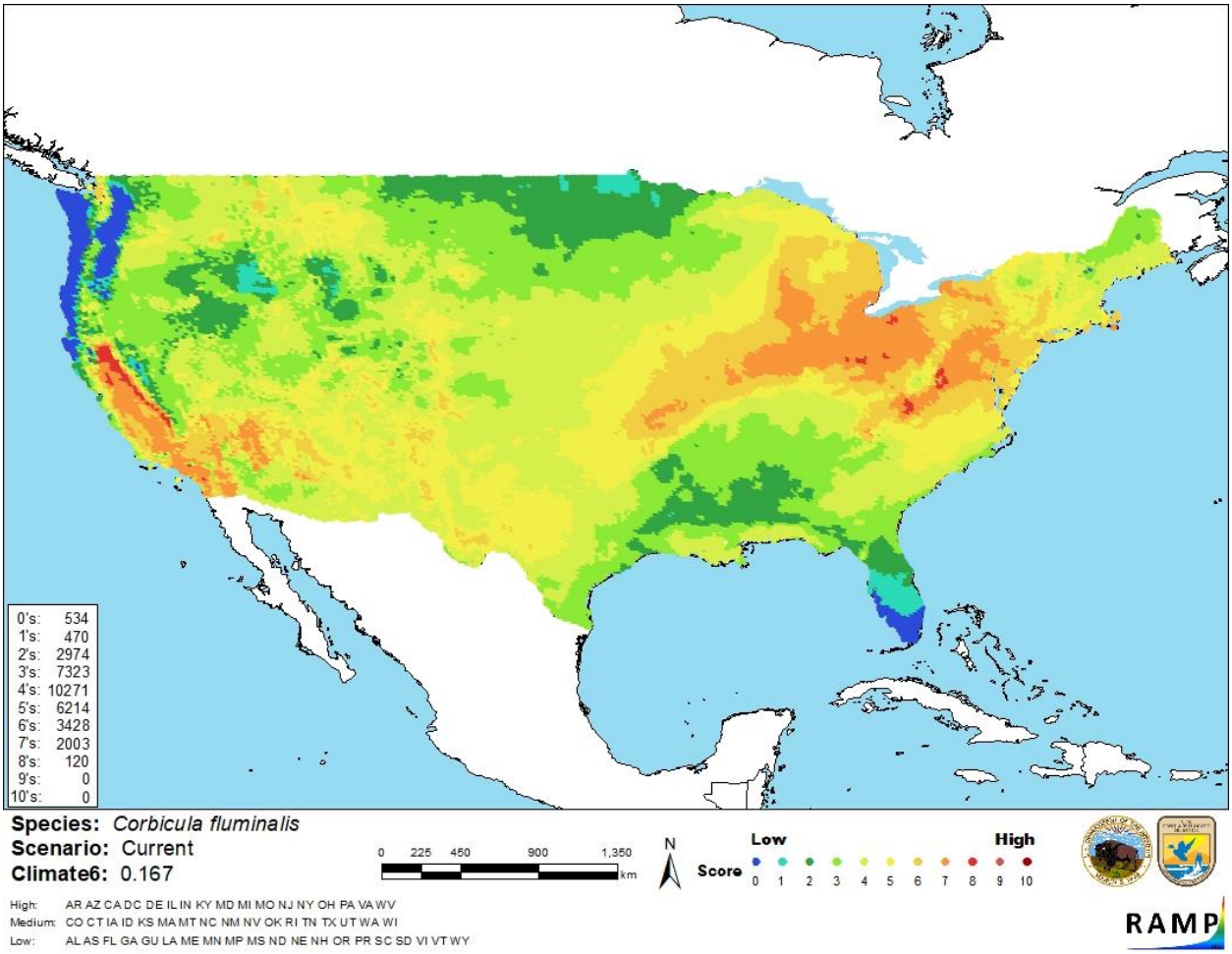

Figure 3. Map of RAMP (Sanders et al. 2018) climate matches for *Corbicula fluminalis* in the contiguous United States based on source locations reported by GBIF Secretariat (2017), Paunović et al. (2007), Ciutti and Cappelletti (2009), and Agudo-Padrón et al. (2017). 0=Lowest match, 10=Highest match.

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

Taxonomic uncertainty in the genus *Corbicula* contributes much uncertainty and confusion to the available information about *C. fluminalis*. More research is needed to clarify taxon discrepancies, which would help to clarify the species' native range and global distribution, and then determine which biological and ecological information is applicable to *C. fluminalis* as opposed to a congener. Although *C. fluminalis* has a lengthy record of introductions and establishments

outside of its native range, it is often found with congener *C. fluminea*, so impacts of introduction are difficult to determine at a species level. Certainty of this assessment is low.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Corbicula fluminalis is a bivalve with a wide and uncertain native range. The reported native range includes parts of Asia, the Middle East, and Africa. The species has been introduced and is now established in several European countries and in one location in South America. Distributional uncertainty is primarily due to unresolved morphological issues within the *Corbicula* genus. Discovery of *C. fluminalis* beyond its native range is typically after it has established a population. *C. fluminalis* can exist at high abundances, but no research has yet shown a connection between *C. fluminalis* abundance and negative ecological, human health, or economic effects. *C. fluminalis* is a poorly understood species and more research is needed to better understand introduction pathways, morphological traits, and distribution. Climate match within the contiguous United States is high overall, with few areas of low match. Because of the high degree of taxonomic uncertainty surrounding this genus and existing knowledge gaps, risk assessment for *Corbicula fluminalis* within the contiguous United States is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): None Documented**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): Low**
- **Overall Risk Assessment Category: Uncertain**

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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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