Corbicula largillierti (a clam, no common name)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, August 2011
Revised, August 2018
Web Version, 2/4/2019

Photo: M. Coltro/ Femorale (2014). Licensed under Creative Commons (CC BY-NC 3.0). Available: http://www.eol.org/data_objects/29482211. (October 2018).

1 Native Range and Status in the United States

Native Range

From Azevêdo et al. (2016):

"*C. largillierti* belongs to the Corbiculidae family (Bivalvia, Heterodonta, Veneroida), originary to China's Yangtze Kiang lake system (Mansur et al., 2004)."

From Graf and Cummings (2018):

"Yangtze River, China."

Status in the United States

According to USGS (2019), *C. largillierti* has been reported within the United States 51 times from 2008 to 2015. Occurrences were reported in the States of Arizona, Florida, Iowa, Illinois, Kentucky, and Missouri; establishment status is reported as "unknown" for all locations.

There is no indication this species is in trade in the United States.

Means of Introductions in the United States

From Tiemann et al. (2017):

"*Corbicula* clams typically colonize new areas via human mediation (Isom 1986; Mackie 2007). Once established, they can continue to spread via human vectors or passive dispersal, such as water currents, mucus thread droguing behavior [using a thread of mucus called a "drogue" to drift through the water] in juveniles (Prezant and Chalermwat 1984), or intestinal passage through fishes (Isom 1986; Tiemann et al. 2011)."

Remarks

From Tiemann et al. (2017):

"The lack of taxonomic clarity, phylogenetic resolution, and presence of clonal lineages has resulted in considerable uncertainty in the literature regarding the number of distinct New World invading lineages and their respective taxonomic identities. Literature reports vary from an invasion of only a single species, *Corbicula fluminea* (Britton and Morton 1986), to invasions of multiple species, identified variously as *C. fluminea*, *C. fluminalis* (Hillis and Patton 1982), *C. largillierti* (Ituarte 1994), or *C. leana* (based upon a mitochondrial DNA sequence match; Siripattrawan et al. 2000)."

Graf and Cummings (2018) list *Cyrena largillierti* Philippi, 1844; *Corbicula sulcatina* Deshayes, 1854; and *Corbicula vulgaris* Prime, 1867 as synonyms for *Corbicula largillierti*.

Review of *Corbicula largillierti* included searches of synonymous species.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From MolluscaBase (2018):

"Biota> Animalia (Kingdom)> Mollusca (Phylum)> Bivalvia (Class)> Heterodonta (Subclass)> Euheterodonta (Infraclass)> Imparidentia (Superorder)> Venerida (Order)> Cyrenoidea (Superfamily)> Cyrenidae (Family)> *Corbicula* (Genus)> *Corbicula largillierti* (Species)"

"Status accepted
Rank Species"

Size, Weight, and Age Range

From Torre and Reyna (2013):

"The shell morphometry results are the following (in mm): Shell length range: 6.96-19.57 (mean 12.31 ± 3.29), shell width range: 3.23-10.1 (mean 6.25 ± 1.94) and shell height range 5.84-17.17 (mean 10.55 ± 3.04)."

These results are based on specimens collected from the Del Valle Central basin in Argentina.

Environment

Torre and Reyna (2013):

"Ituarte (1981) stated that in fact, this species prefers to inhabit sandy rather than muddy areas, where most native Argentinean bivalves usually are (see Ituarte 1981 in Darrigan 1992b). Nevertheless, Darrigan (1992a) found that this species also inhabits muddy bottoms. It is probable that upon arriving to a new ecosystem, *C. largillierti* prefers sandy bottoms until population starts to grow and interspecific competition becomes strong enough to displace some individuals to the muddy habitats."

Climate/Range

From Azevêdo et al. (2016):

"[…] neotropic ecozone […]"

From Tiemann et al. (2017):

"[…] temperate/tropical regions […]"

Distribution Outside the United States

Native

From Azevêdo et al. (2016):

"*C. largillierti* belongs to the Corbiculidae family (Bivalvia, Heterodonta, Veneroida), originary to China's Yangtze Kiang lake system (Mansur et al., 2004)."

Introduced

From Azevêdo et al. (2014):

"It has latter [*sic*] been recorded in Uruguay (Ituarte 1984) and again in Argentina (Ituarte 1994). In Brazil, *Corbicula largillierti* was first recorded in the Pantanal, Mato Grosso (Callil & Mansur 2002) and latter [*sic*] in the Sinos River basin, Rio Grande do Sul (Mansur & Pereira 2006).

Recently, the species was recorded in Minas Gerais, Espírito Santo, Santa Catarina and Ceará states (Silva & Barros 2011). In a recent review, Pereira et al. (2012) reported *C. largillierti* for the Brazilian northeastern coastal basins, the São Francisco River, eastern, southern and southeastern basins, as well as the Paraná/Paraguay and Uruguay basins."

From Graf and Cummings (2018):

"Introduced to Brazil."

From Vigliano and Darrigran (2002):

"Both *C. fluminea* and *C. largillierti* were detected for the first time at the beginning on the 1980s in Argentina by Ituarte (1981) in the Río de la Plata, and by Veitenher-Mendez (1981) in Brazil. Since then a series of papers by various authors summarize the actual knowledge about the species in Argentina (Darrigran 1991, 1992a, 1992b; Darrigran and Colautti 1994; Cazzaniga 1997). The original introductions to both countries probably occurred at the end of the 1960s or the beginning of the 1970s. From then on both species seemed to initially have gone through an expansion phase settling on the Río de la Plata shores."

"The actual confirmed distribution covers the Río de la Plata, Parana and Uruguay rivers (Darrigran 1992b) main tributaries of the Plata basin (Figure 3), which means that the genus has probably extended to the vast and intricate network of flowing waters that form the basin. The genus *Corbicula* has also been found outside the Plata basin on the Colorado River (Cazzaniga 1997) (Figure 3)."

Means of Introduction Outside the United States

From Azevêdo et al. (2016):

"*C. largillierti* recordings have shown that this mollusk species has reached reservoirs through tributaries, as most of the specimens were observed near confluences."

From Vigliano and Darrigran (2002):

"[…] seem to have been introduced accidentally from Southeast Asia trough [*sic*] the Río de la Plata river (Darrigran and Ezcurra de Drago 2000)."

From Ludwig et al. (2014):

"*Corbicula* clams and *L. fortunei* (the "golden mussel") were accidentally introduced to South America, most likely by ballast water (Darrigran and Pastorino 1993)."

Short Description

From Prime (1867):

"The shell [of *Corbicula largillierti*] is trigonal, subequilateral, and somewhat compressed. The anterior side is broad and rounded, the posterior side is narrow, produced, and obtuse. The beaks

are full, raised, inclined, curved inwardly and approximate. The lunula is indistinct. The striae are close, light, numerous, and irregular. The epidermis is olive color. The interior is white with violet on the margins and on the lateral teeth. The hinge is broad and very much curved."

"This species is easily recognised by the elevation and protrusion of the beaks, which are also very much inclined. Compared with *Corbicula chemnitziana*, the beaks are more raised, the shell is more trigonal, the hinge is more angular, and the coloring and disposition of the striae are different."

Biology

From Azevêdo et al. (2016):

"Recordings of increase in density and in the number of sampling sites with *C. largillierti* showed colonization progression in only six months (December 2011 to June 2012). Differently from other freshwater bivalve genera, *Corbiculidae* present high ecological and physiological plasticity, enabling their survival in a wide range of habitat conditions (Lucy et al. 2012), particularly in disturbed environments."

From Tiemann et al. (2017):

"The genus has both sexual and asexual forms (Lee et al. 2005 and references therein; Hedtke et al. 2011; Pigneur et al. 2011, 2014a). The known sexual forms are restricted to Asia whereas the invasive populations appear to be exclusively composed of asexual lineages. These clones, which have invaded freshwater ecosystems in North and South America and Europe, have become major aquatic pests."

"Most clonal lineages in nature are gynogenetic with the female nuclear genome being passed on to offspring (summarized by Schlupp 2005). In contrast, *Corbicula* clones reproduce by androgenesis where the maternal nuclear genome is extruded when the unreduced sperm fertilizes the egg, retaining only the unreduced paternal pronucleus (Konishi et al. 1998; Ishibashi et al. 2003; Lee et al. 2005; Hedtke et al. 2008; summarized by Pigneur et al. 2014a). The only maternal genetic signature that remains in asexually produced *Corbicula* clams is the mitochondrial genome of the egg. In addition to being clonal, the invasive lineages of *Corbicula* also are primarily hermaphroditic (Komaru et al. 2012) compared to their sexual counterparts that are dioecious. The presence of these characteristics means only a single asexual individual is required to establish a new population, likely aiding the overall invasion success. The success of *Corbicula* clams in new environments also can be related to other life history characteristics, such as rapid growth, high fecundity, short time to sexual maturity, and dispersal capability (Sousa et al. 2008)."

Human Uses

This species is not currently in trade within the United States.

Diseases

No information available. No OIE-reportable diseases were associated with this species.

Threat to Humans

No direct threat to humans has been attributed to this species.

3 Impacts of Introductions

From Vigliano and Darrigran (2002):

"Impacts of both species have not been reported for Argentina except in terms of dietary changes of a native fish (Darrigran and Colauti 1994). Problems due to macrofouling phenomena by this genus have been reported only for southern Brazil (Darrigran and Ezcurra de Drago 2000)."

The following quotation pertains to the genus *Corbicula*, rather than the particular species that is the subject of this report.

From Tiemann et al. (2017):

"While there has been no specific study to determine negative effects of *Corbicula* in the Illinois River, previous studies elsewhere have demonstrated that the cumulative biomasses of the three morphs could interfere with native mussels (Strayer 1999; Cherry et al. 2005) and have negative effects on restoration efforts of threatened and endangered species. Also, *Corbicula* clams have been described as a hyper-invasive alien with substantial biofouling capabilities, particularly affecting complex power plant, irrigation canals, and drinking water supplies (Isom 1986; Morton 1986). Infestations of *Corbicula* individuals have yielded billions of dollars (USD) annually in damage to industry and infrastructure (Pimentel et al. 2005)."

4 Global Distribution

Figure 1. Known global distribution of *Corbicula largillierti.* Map by GBIF Secretariat (2018). A point in Germany was removed and excluded from the climate matching analysis because it represented a museum specimen.

5 Distribution Within the United States

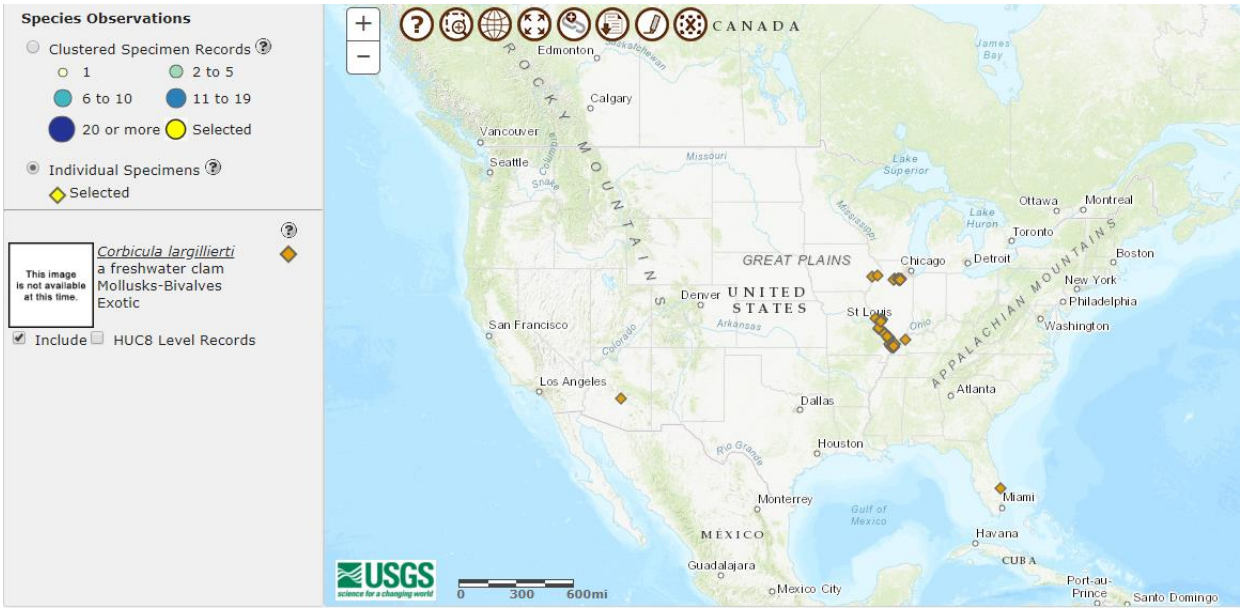

Figure 2. Known distribution of *Corbicula largillierti* in the United States. Map from USGS (2019). Orange diamonds represent reported occurrences. Current status for all occurrences is unknown, so they were not included in the climate matching analysis.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2018; 16 climate variables; Euclidean Distance) for *Corbicula largillierti* within the contiguous United States was high overall, represented by a Climate6 proportion of 0.207. Scores of 0.103 and above are classified as high match. High matches were concentrated along the Atlantic and Gulf coastlines from Virginia to Texas, along the U.S.-Mexico border from Texas to southeastern Arizona, and in scattered locations in the eastern Rocky Mountains. Low matches were concentrated in the northeastern United States, and the western United States from the Rocky Mountains to the Pacific coast. The remainder of the contiguous United States had a medium match.

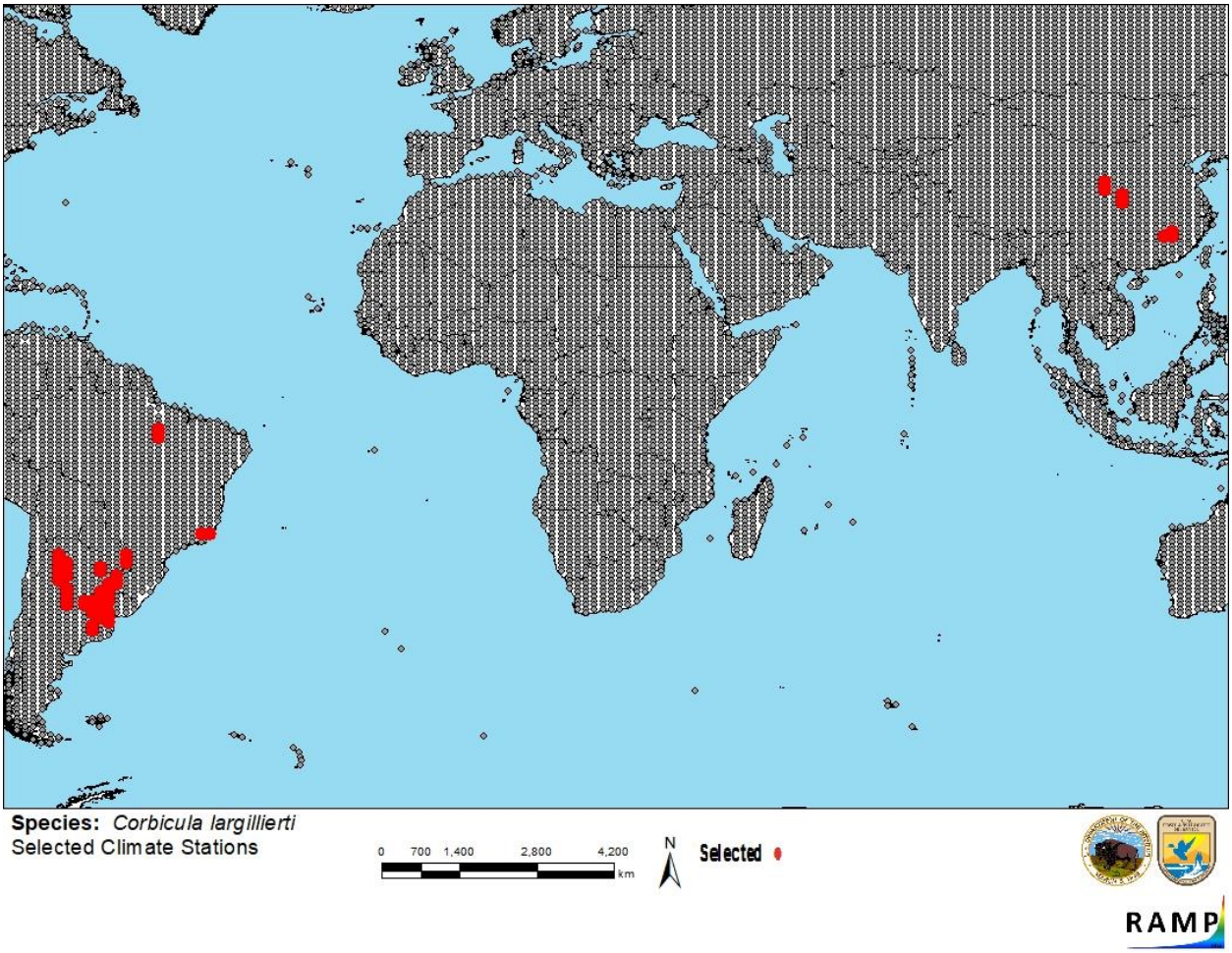

Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations selected as source locations (red) and non-source locations (gray) for *Corbicula largillierti* climate matching from GBIF Secretariat (2018). Source locations for the United States are based on reports provided by USGS NAS (2018).

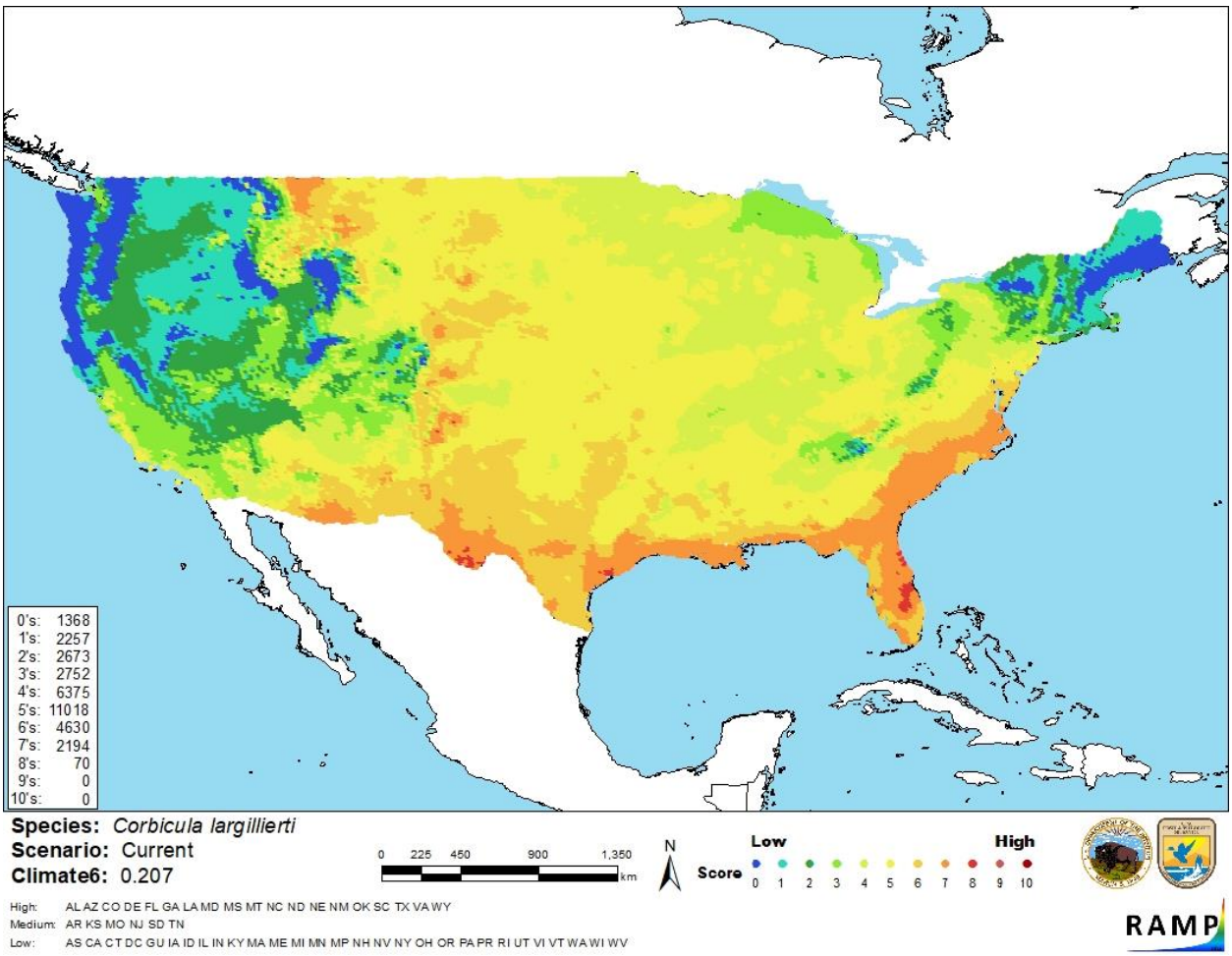

Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Corbicula largillierti* in the contiguous United States based on source locations reported by GBIF Secretariat (2018). 0=Lowest match, 10=Highest match.

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

Considerable information is available on the *Corbicula* genus, but substantial gaps currently exist at the species level. More research is needed to adequately assess the distribution, biology, and impacts of introduction for *Corbicula largilllierti*. Until these gaps are addressed, the certainty of assessment for *C. largillierti* is low.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Corbicula largillierti is a clam (a mollusk) indigenous to the Yangtze River region in China. *C. largillierti* has been recorded in Argentina, Brazil, and Uruguay, where it was likely accidentally introduced. *C. largillierti* has also been reported within the United States, with 51 reports between 2008 and 2015, but no established populations have been documented. Much research has addressed the *Corbicula* genus, but many information gaps persist at the species level due to taxonomic uncertainty and the presence of clonal lineages. As a result, *C. largillierti* remains a species in need of more study. Macrofouling and other negative impacts have been associated with the presence of members of the genus *Corbicula*, but these impacts have not been specifically attributed to *C. largillierti*. It is possible, perhaps likely, *Corbicula largillierti* could have negative impacts where it occurs outside of its native range, but more research is needed to adequately assess its distribution and impacts of introduction. Climate match within the contiguous United States is high, with favorable climate occurring throughout much of the United States. Given the cryptogenic nature of *Corbiculas* and existing information gaps, the overall risk for *C. largillierti* 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**
- **Important additional information: The invasive populations appear to be exclusively composed of asexual lineages.**
- **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.

Azevêdo, E. L., J. E. L. Barbosa, T. H. D. A. Vidigal, M. Callisto, and J. Molozzi. 2014. First record of *Corbicula largillierti* (Philippi 1844) in the Paraíba River Basin and potential implications from water diversion of the São Francisco River. Biota Neotropica 14(4):1-4.

Azevêdo, E. L., J. E. L. Barbosa, T. H. D. A. Vidigal, J. C. Marques, M. Callisto, and J. Molozzi. 2016. Potential ecological distribution of alien mollusk *Corbicula largillierti* and its relationship with human disturbance in a semi-arid reservoir. Biota Neotropica 16(1):e0109.

Graf, D. L., and K. S. Cummings. 2018. The freshwater mussels (Unionoida) of the world (and other less consequential bivalves), updated 30 March 2018. MUSSEL Project Web Site. Available: http://www.mussel-project.net/. (August 2018).

Ludwig, S., M. K. Tschá, R. Patella, A. J. Oliveira, and W. A. Boeger. 2014. Looking for a needle in a haystack: molecular detection of larvae of invasive *Corbicula* clams. Management of Biological Invasions 5(2):143-149.

MolluscaBase. 2018. *Corbicula largillierti* (Philippi, 1844). *In* World Register of Marine Species. Available: http://www.marinespecies.org/aphia.php?p=taxdetails&id=992070. (October 2018).

Prime, T. 1867. Notes on species of the family *Corbiculidae*, with figures. Pages 57-92 *in* Annals of the Lyceum of Natural History of New York, volume 8. Lyceum of Natural History, New York.

Sanders, S., C. Castiglione, and M. H. Hoff. 2018. Risk Assessment Mapping Program: RAMP, version 3.1. U.S. Fish and Wildlife Service.

Tiemann, J. S., A. E. Haponski, S. A. Douglass, T. Lee, K. S. Cummings, M. A. Davis, and D. O. Foighil. 2017. First record of a putative novel invasive *Corbicula* lineage discovered in the Illinois River, Illinois, USA. BioInvasions Records 6(2):159-166.

Torre, L., and P. B. Reyna. 2013. Bivalvia, Veneroidea, Corbiculidae, *Corbicula largillierti* (Philippi, 1844): new distribution record in the Del Valle Central basin, Catamarca Province, Argentina. Check List 9(1):165-166.

USGS (U.S. Geological Survey). 2019. *Corbicula largillierti* [map]. U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, Florida. Available: https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=2985#. (February 2019).

Vigliano, P. H., and G. Darrigran. 2002. Argentina's freshwater systems, aliens in Wonderland. Pages 25-44 *in* Proceedings of the 11th international conference on aquatic invasive species. The Professional Edge, Pembroke, Ontario.

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.

Callil, C. T., and M. C. D. Mansur. 2002. Corbiculidae in the Pantanal: history of invasion in southern and South America and biometrical data. Amazoniana 17(1):153-167.

Cazzaniga, N. 1997. Asiatic clam, *Corbicula fluminea*, reaching Patagonia (Argentina). Journal of Freshwater Ecology 12(4):629-630.

Darrigran, G. 1991. Competencia entre dos especies de Pelecípodos invasores: *Corbicula fluminea* (Müller1774) y *C. largillierti* (Philippi1844) en el litoral argentino del estuario del Río de la Plata. Biología Acuática 15(2):214-215.

Darrigan, D. G. 1992a. Nuevos datos acerca de la distribución de las especies del género *Corbicula* (Bivalvia, Sphaaeriacea) en el área del Río de la Plata, República Argentina. Nota Museo La Plata 21(210):143-148.

Darrigran, G. 1992b. Variación temporal y espacial de la distribución de las especies del género *Corbicula* Megerle, 1811 (Bivalvia, Corbiculidae) en el estuario del Río de la Plata, República Argentina. Neotropica 38(99):59-63.

Darrigran, G., and D. Colautti. 1994. Potencial control biológico del molusco invasor *Corbicula fluminea* (Müller 1774) en el Río de la Plata. Comunicaciones de la Sociedad Malacológica del Uruguay 7(66-67):368-373.

Darrigran, G, and I. Ezcurra de Drago. 2000. Invasion of *Limnoperna fortunei* (Dunker 1857) (Bivalvia: Mytilidae) in America. Nautilus 2:69-74.

Darrigran, G., and G. Pastorino. 1993. Bivalvos invasores en el Rio de Plata, Argentina. Comunicaciones de la Sociedad Malacológica del Uruguay 64:64–65.

Ituarte, C. 1981. Primera noticia acerca de la introducción de pelecípodos asiáticos en el área rioplatense. Neotropica 27(77):79-82.

Ituarte, C. F. 1984. Aspectos biológicos de las poblaciones de *Corbicula largillierti* (Philippi, 1844) (Mollusca, Pelecypoda) en el Rio de La Plata. Revista del Museu de La Plata 13(143):231-247.

Ituarte, C. F. 1994. *Corbicula* y *Neocorbicul*a (Bivalvia: Corbiculidae) in the Paraná, Uruguay and Río de la Plata Basins. Nautilus 107:12-135.

Mansur, M. C. D., C. T. Callil, F. R. Cardoso, and J. A. A. Ibarra. 2004. Uma retrospectiva e mapeamento da invasão de espécies de *Corbicula* (Mollusca, Bivalvia, Veneroida, Corbiculidae) oriundas do sudeste asiático, na América do Sul. Pages 39-58 *in* J. S. V. da Silva, and R. C. C. L. de Souza, editors. Agua de Lastro e Bioinvasão. Interciência, Rio de Janeiro, Brazil.

Mansur, M. C. D., and D. Pereira. 2006. Bivalves límnicos da bacia do rio dos Sinos, Rio Grande do Sul, Brasil (Bivalvia, Unionoida, Veneroida e Mytiloida). Revista Brasileira de Zoologia 23(4):1123-1147.

Pereira, D., M. C. D. Mansur, and D. M. Pimpão. 2012. Identificação e diferenciação dos bivalves límnicos invasores dos demais bivalves nativos do Brasil. Pages 75-94 *in* M. C. D. Mansur, C. P. Santos, D. Pereira, I. C. P. Paz, M. L. L. Zurita, M. T. R. Rodriguez, M. V. Nehrke, and P. E. A. Bergonci, editors. Moluscos límnicos invasores no Brasil: biologia, prevenção, controle. Redes Editora, Porto Alegre, Brazil.

Santos, S. B., S. C. Thiengo, M. F. Ammon, I. C. Miyahira, M. C. Mansur, and D. Pereira. 2012. Espécies de moluscos límnicos invasores no Brasil. Pages 24-49 *in* M. C. D. Mansur, C.

P. Santos, D. Pereira, I. C. P. Paz, M. L. L. Zurita, M. T. R. Rodriguez, M. V. Nehrke, and P. E. A. Bergonci, editors. Moluscos límnicos invasores no Brasil: biologia, prevenção e controle. Redes, Porto Alegre, Brazil.

Silva, E. C., and F. Barros. 2011. Macrofauna bentônica introduzida do Brasil: lista de espécies marinhas e dulcícolas e distribuição atual. Oecologia Australis 15(2):326-344.

Veitenheimer Mendes, I. 1981. *Corbicula manilensis* (Philippi 1844) molusco asiático, na bacia do Jacuí e do Guaíba, Río Grande do Sul, Brasil (Bivalvia, Corbiculidae). Iheringia Série Zoologia 60:63-74.