Ecological Risk Screening Summary for Maryland:

Chinese Pond Mussel *(Sinanodonta woodiana)*

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Department of Natural Resources
Resource Assessment Service

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

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Foreword

The following document summarizes a risk assessment for the Chinese Pond Mussel (*Sinanodonta woodiana*) conducted by staff of the Maryland Department of Natural Resources. The risk assessment tools used in this analysis were developed elsewhere but adopted to assess potentially invasive animals in Maryland by the Maryland Department of Natural Resources' Invasive Species Matrix Team in 2020 (Kilian and Harbold 2020). The AS-ISK screening tool is one of the most widely applied, tested, and calibrated tools available for assessing invasive risk (Vilizzi et al. 2019). It has been adapted to assess various taxa including amphibians, reptiles, marine and freshwater fishes, and marine and freshwater invertebrates in a wide range of environments. The Invasive Species Matrix Team also adopted the Great Lakes Assessment Framework (Fusaro et al. 2017) as a more comprehensive assessment to be used in conjunction with the AS-ISK screening tool when appropriate. The results of both tools are summarized below along with a climate suitability analysis using the CLIMATCH model (Australian Bureau of Rural Sciences 2010). The ecological risk screening summary format used in this report was adapted from the Ecological Risk Screening Summary template developed by the U.S. Fish and Wildlife Service (USFWS 2018a).

1. Background and Description

The Chinese Pond Mussel, *Sinanodonta woodiana*, is a large freshwater unionid mussel native to eastern Asia, primarily the Amur and Yangtze River basins (Sousa et al. 2014). Adults can grow to over 30 mm (Pou-Rovira et al. 2009). Now widely introduced, the first record of *S. woodiana* outside its native range came from Romania in 1979 (Sárkány-Kiss 1986). It is currently found throughout Europe, as well as in Indonesia, Central America, and North America (Sousa et al. 2014). It is tolerant of both water pollution and low oxygen, and thrives in ponds, canals, reservoirs, lakes, cooling channels, and rivers with slow to moderate water velocities and soft sediments (Donrovich et al. 2017). *Sinanodonta woodiana* disperses via parasitic glochidia (larvae) that temporarily attach (encyst) on fins, bodies, and gills of fish. Glochidia range in size from 0.25 mm to 0.30 mm (Labecka and Domagala 2018) and are visible to the naked eye when encysted on fish tissues. It has spread outside its native range via the stocking of commercially important fish species for fisheries or aquaculture that were infested with encysted glochidia. It is most commonly associated with Asian carp species but is a host generalist that successfully utilizes many fish species for glochidia transformation, including various minnows, gobies, cichlids, mosquitofish, and sunfishes (Bogan et al. 2011).

2. Distribution

Figure 1. Known global distribution of *Sinanodonta woodiana*. Map from GBIF Secretariat (2020).

Native Range

Sinanodonta woodiana is native to eastern Asia, primarily the Amur and Yangtze River basins in China, Korea, Japan, Taiwan, and eastern Russia (Sousa et al. 2014).

Nonnative Range

Outside the United States

Sinanodonta woodiana has been introduced in Europe (Spain, France, Italy, Germany, Austria, Slovakia, Hungary, Czech Republic, Poland, Croatia, Serbia, Romania, Moldova, Ukraine and Sweden), Central

America (Dominican Republic and Costa Rica), Indonesia and recently North America (fish farm in Franklin Township, New Jersey, USA) (Sousa et al. 2014).

Within the United States

There is a single record of *S. woodiana* from the United States, from a former fish farm in New Jersey in 2010 (Bogan et al. 2011, Sousa et al. 2014).

Within Maryland

To date, there are no records of *S. woodiana* from Maryland.

3. Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2020):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Protostomia
Superphylum Lophozoa
Phylum Mollusca
Class Bivalvia Linnaeus, 1758
Subclass Palaeoheterodonta Newell, 1965
Order Unionoida Stoliczka, 1871
Superfamily Unionoidea Rafinesque, 1820
Family Unionidae Rafinesque, 1820
Subfamily Unioninae Rafinesque, 1820
Tribe Anodontini Rafinesque, 1820
Genus Sinanodonta Modell, 1945
Species Sinanodonta woodiana (Lea, 1834)

The current taxonomic status is valid.

Size, Weight, and Age

Sinanodonta woodiana reaches a maximum length of 30 cm (Pou-Rovira et al. 2009). It can reproduce in as little as one year at 3-4 cm. Reported lifespan is 12 to 14 years (Dudgeon and Morton 1983).

Preferred Climate and Habitat

Sinanodonta woodiana is found in temperate, sub-tropical, and tropical fresh waters in Asia, Europe, North America, and Central America (Sousa et al. 2014). It is found in lowland waterways with soft benthic substrates including ponds, oxbow lakes, canals, floodplains, and slow to moderately flowing rivers

(Donrovich et al. 2017). It is tolerant of both pollution and low dissolved oxygen (Sárkány-Kiss et al. 2000).

Biology

Sinanodonta woodiana is a filter-feeder with a larval stage (glochidia) that parasitizes fishes. It competes with native unionid mussels for space, nutrients, and host fish. It is a host generalist, with glochidia capable of developing on nearly any species of fish (Sárkány-Kiss et al. 2000). Each time *S. woodiana* glochidia encyst on a host fish, that host develops an increased resistance to future glochidia infestations from any unionid mussel. *Sinanodonta woodiana* produces multiple broods per year, and repeated exposure to its glochidia increases resistance in the host fish population and decreases the pool of receptive hosts available to native species (Douda et. al 2012). As such, it is a successful competitor that may compose up to 90% of the total unionid biomass in systems where it has been established, completely replacing some native species (Benkő-Kiss et al. 2013). It may alter habitats via the capture of suspended material, production of feces, and biomagnification of pollutants (Douda et al. 2018). Additionally, mortality events during high temperatures and low water levels may lead to rotting carcasses of dead mussels, which degrade water quality, increase mortality, and minimize the recreational value of the waterbody (Cilenti et al. 2019). Potential benefits of *S. woodiana* establishment include improved water clarity through increased filtration and increased deposition of organic and inorganic particulates in sediments as feces and pseudofeces. It also may provide an important food resource for fish species (Sousa et al. 2014).

Human uses

Human uses are limited. *Sinanodonta woodiana* has been used to culture freshwater pearls and has been marketed as biological filtration for ponds (Beran, 2008).

Diseases

There are no known reports of *S. woodiana* transmitting diseases or pathogens.

Threat to humans

There are no known reports of *S. woodiana* being poisonous or otherwise posing risks to human health.

4. Introductions

Means of Introduction

Outside the United States

Sinanodonta woodiana is introduced with fish imported and stocked for aquaculture. Glochidia are encysted on fish tissues at the time of stocking.

Within the United States

Sinanodonta woodiana is introduced with fish imported and stocked for aquaculture. Glochidia are encysted on fish tissues at the time of stocking.

Within Maryland

To date, *S. woodiana* has not been introduced in Maryland.

Impacts of Introduction

Outside the United States

Sinanodonta woodiana is a fish parasite in its juvenile form, and infestations may reduce the fitness of parasitized individuals. It outcompetes native unionid mussels for resources and has caused documented reductions in native species (Cilenti et al. 2019, Douda et al 2012). It may amount to as much as 50−80% of the total unionid biomass and has reduced or fully replaced native unionids in Lake Balaton in Hungary (Benkő-Kiss et al. 2013, Cilenti et al. 2019, Douda et al. 2012).

Within the United States

There has been one known introduction in the United States in a pond in a former fish farm in New Jersey. The pond was drained, and the mussels were destroyed (Bogan et al. 2011). No further impacts are known or reported.

Within Maryland

To date, *S. woodiana* has not been introduced in Maryland.

5. Climate Matching

Summary of Climate Matching Analysis

The Climate 6 score (Australian Bureau of Rural Sciences 2010; 16 climate variables; Euclidean Distance) for Maryland was 1.000, High.

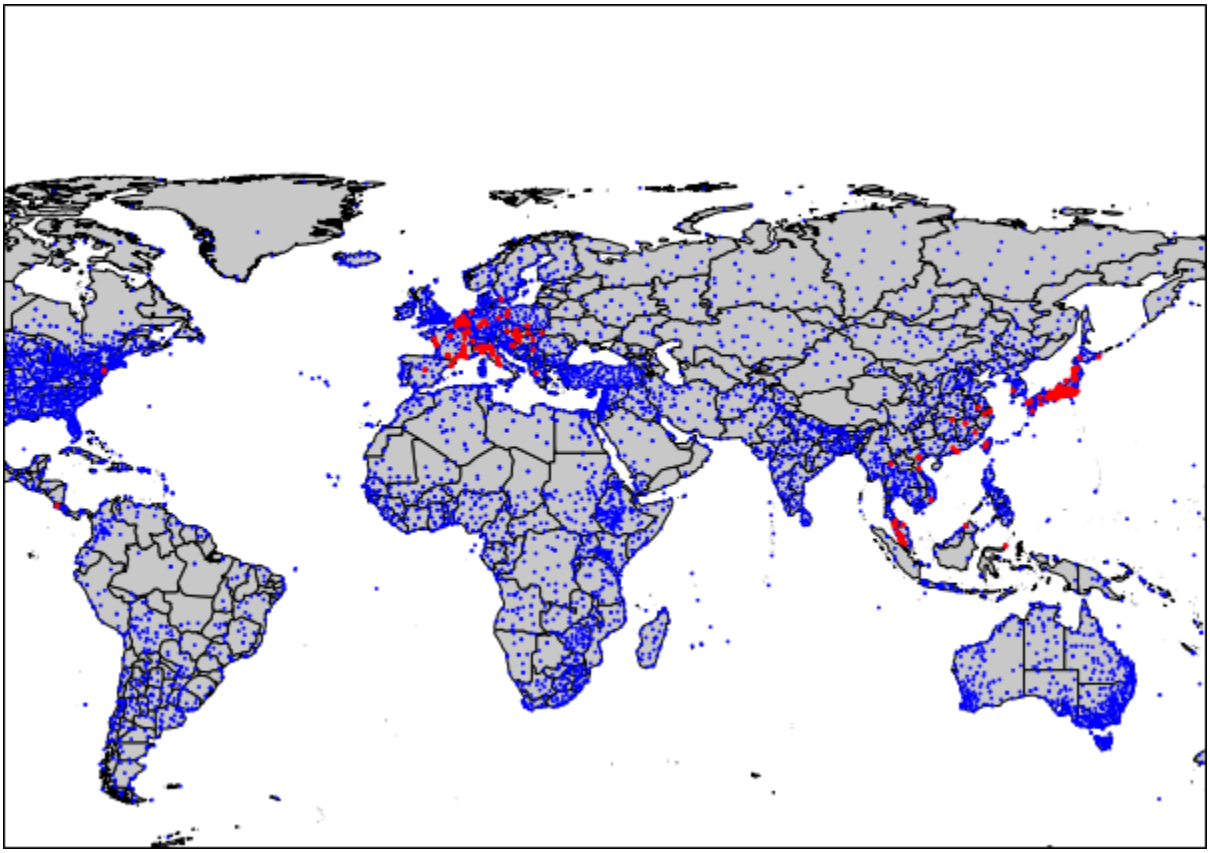

Figure 2: Climatch (Australian Bureau of Rural Science 2010) source map showing weather stations selected as source locations (red) and non-source locations (blue) for *S. woodiana* climate matching. Source locations from GBIF.org (13 May 2020) GBIF Occurrence Download Climatch https://doi.org/10.15468/dl.gekqsf.

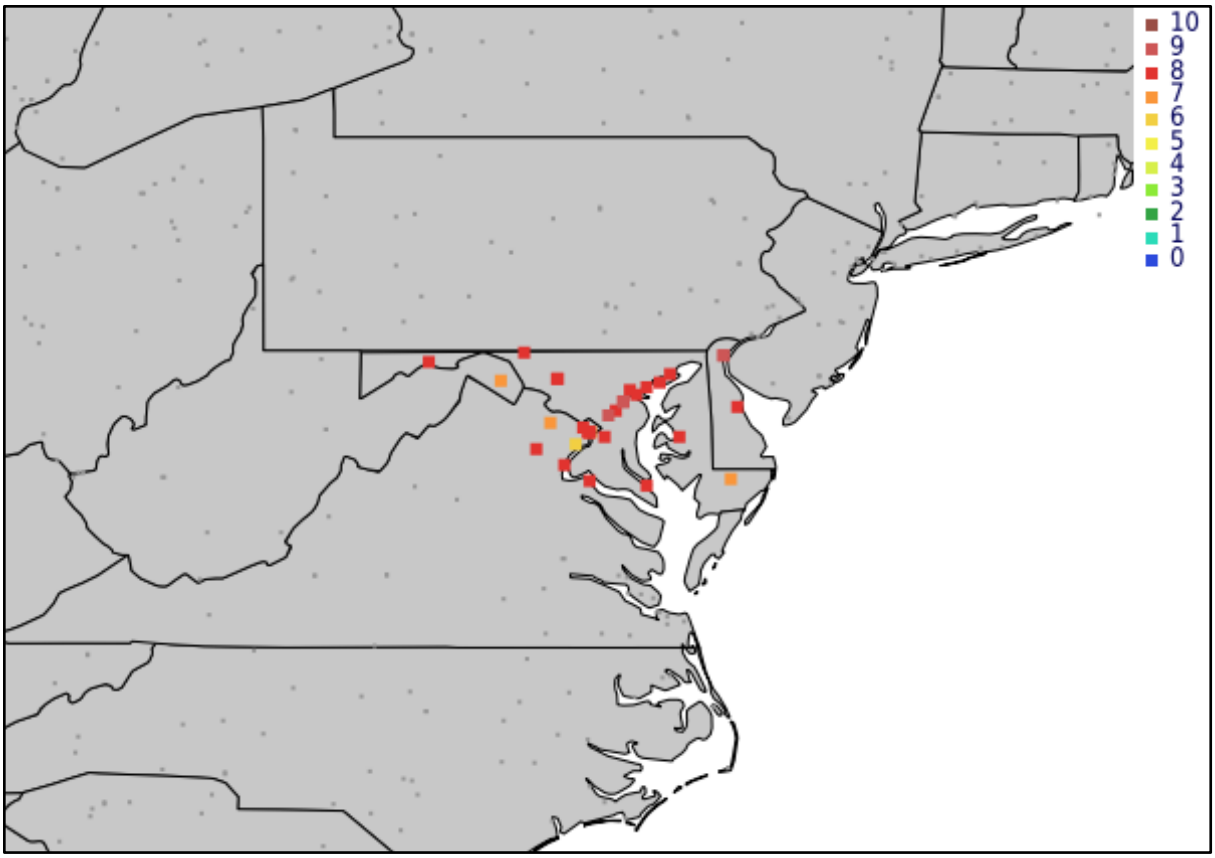

Figure 3: Map of Climatch (Australian Bureau of Rural Science 2010) climate matches for *S. woodiana* in Maryland based on source locations reported by GBIF.org (13 May 2020) GBIF Occurrence Download https://doi.org/10.15468/dl.gekqsf. 0= Lowest match, 10=Highest match.

Table 1: Climatch (Australian Bureau of Rural Science 2010) climate match scores for *S. woodiana* for Maryland.

Climate Match	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Count	0	0	0	0	0	0	1	4	22	5	0
Climate 6 Proportion = (Sum of Climate Score 6-10) / (Sum of Total Climate Scores) = 1.000: High											

Table 2: Basis for High, Medium, and Low Climate Match Categories.

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

6. Risk Assessment

Summary of Risk to Maryland

Sinanodonta woodiana is native to eastern Asia and Russia in the Yangtse and Amur River basins. It has been widely introduced and established throughout Asia and Europe, but to a lesser degree in North and Central America. There is limited intentional movement of this species (freshwater pearls and water garden filtration are two uses) and it is instead most commonly moved and introduced in its larval form. Its larvae (glochidia) are parasitic, and hitchhike while encysted on the tissues of imported and stocked fishes. *Sinanodonta woodiana* is a highly tolerant habitat and host generalist. It is a successful competitor and can quickly dominate the unionid mussel community in waters where it is established. It reduces both the available nutrients in the water column and the number of host fish available for native mussels' own glochidia. In some instances, it has fully replaced native mussel species in invaded systems. Though not yet introduced or established in Maryland, it has been recorded in nearby New Jersey. A high climate match score combined with this highly fecund species' generally high tolerance of disturbance and pollution indicates that *S. woodiana* could establish in Maryland if it were introduced. Its success as a competitor would be detrimental to stocks of native Maryland unionid mussels, many of which are already imperiled. The certainty of the assessment is high. The overall risk category is medium. The likelihood of introduction is low, but if *S. woodiana* is introduced, establishment is likely, and the likelihood of negative environmental impacts is high.

Assessment Elements

- AS-ISK Risk Screening (Basic Risk + Climate Change): High
- Great Lakes Aquatic Invaders Risk Assessment:
    - Potential for Introduction: Low
    - Potential For Establishment: Moderate
    - Potential for Impact
        - Environmental: High
        - Socio-Economic: Low
        - Beneficial: Moderate

Full assessments are included as appendices at the end of this document.

7. Certainty of Assessment

The certainty of assessment is high. There is quality information on the biology and ecology of the species, traits that lead to invasiveness, and several documented instances of invasiveness in introduced populations. There are many records of introduction with established populations on multiple continents.

8. References

Australian Bureau of Rural Sciences. 2010. Climatch. Available: https://climatch.cp1.agriculture.gov.au/climatch.jsp.

Benson, A. J. 2015. *Sinanodonta woodiana*. USGS Nonindigenous Aquatic Species Database, Gainesville, Florida. Available: http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=2824. (July 2015).

Benkő-Kiss, Á., Ferincz, Á., Kováts, N., & Paulovits, G. (2013). Spread and distribution pattern of *Sinanodonta woodiana* in Lake Balaton. Knowledge and Management of Aquatic Ecosystems, 408, 09.

Beran, L. 2008. Expansion of Sinandonta woodiana (Lea, 1834) (Bivalvia: Unionidae) in the Czech Republic. Aquatic Invasions 3(1):91-94.

Bogan, A.E., J. Bowers-Altman, and M.E. Raley. 2011. The first confirmed record of the Chinese Pond Mussel (*Sinanodonta woodiana*) (Bivalva:Unionidae) in the United States. The Nautilus 125(1):41-43.

Cappelletti, C., S. Cianfanelli, M.E. Beltrami, and F. Ciutti. 2009. *Sinanodonta woodiana* (Lea, 1834) (Bivalvia: Unionidae): a new non-indigenous species in Lake Garda (Italy). Aquatic Invasions 4(4):685-688.

Cilenti, L., G. Mancinelli, T. Scirocco, and A. Specchiulli. First record of *Sinanodonta woodiana* (Lea, 1834) in an artificial reservoir in the molise region, Southeast Italy. 2019. BioInvasions Records 8 (2): 320–328.

Donrovich, S.W., K. Douda, V. Plechingerová, K. Rylková, P. Horký, O. Slavík, H-Z Liu, M. Reichard, M. Lopes-Lima, R. Sousa. 2016. Invasive Chinese pond mussel *Sinanodonta woodiana* threatens native mussel reproduction by inducing cross-resistance of host fish. Aquatic Conservation: Marine and Freshwater Ecosystems 27(6):1325-1333.

Douda, K., Vrtílek, M., Slavík, O. and Reichard, M. 2012. The role of host specificity in explaining the invasion success of the freshwater mussel *Anodonta woodiana* in Europe. Biological Invasions 14(1):.127-137.

Douda, K., and Z. Čadková. 2018. Water clearance efficiency indicates potential filter-feeding interactions between invasive *Sinanodonta woodiana* and native freshwater mussels. Biological Invasions 20(5):1092-1098. https://link.springer.com/article/10.1007/s10530-017-1615-x.

Dudgeon D, Morton B (1983) The population dynamics and sexual strategy of *Anodonta woodiana* (Bivalvia: Unionacea) in Plover Cove Reservoir, Hong Kong. Journal of Zoology (London) 201: 161–183, http://dx.doi.org/10.1111/j.1469-7998.1983.tb04268.x

Fusaro, A., E. Baker, W. Conard, A. Davidson, K. Dettloff, J. Li, G. Núñez-Mir, R. Sturtevant, and Rutherford. 2017. A Risk Assessment of Potential Great Lakes Aquatic Invaders. NOAA Technical Memorandum GLERL-169.

GBIF.org (13 May 2020) GBIF Occurrence Download https://doi.org/10.15468/dl.gekqsf

Kraszewski, A., and B. Zdanowski. 2007. *Sinanodonta woodiana* (Lea, 1834) (Mollusca) - a new mussel species in Poland: occurrence and habitat preferences in a heated lake system. Polish Journal of Ecology 55(2):337-356.

Kilian, J.V., and W. Harbold. 2020. A comparison of risk assessment tools to assess the potential invasiveness of aquatic animals in Maryland: Results and recommendations. Technical Memorandum. Prepared for the MDNR Invasive Species Matrix Team. 44 pp.

Labecka, A. M., and J. Domagala 2018. Continuous reproduction of *Sinanodonta woodiana* (Lea, 1824) females: an invasive mussel species in a female-biased population. Hydrobiologia 810:57-76.

Pou-Rovira, Q., R. Araujo, D. Boix, M. Clavero, C. Feo., M. Ordeix, and L. Zamora. 2009. Presence of the alien Chinese pond mussel *Anodonta woodiana* (Lea, 1834) (Bivalvia, Unionidae) in the Iberian Peninsula. Graellsia 65(1):67-70.

Sárkány-Kiss A .1986. *Anodonta woodiana woodiana* (Lea, 1834) a new species in Romania (Bivalvia: Unionacea). Extrait des Travaux du Museum d'Histoire naturelle "G. Antipa" 28: 15–17

Sárkány-Kiss, A., Sîrbu, I., & Hulea, O. 2000. Expansion of the adventive species *Anodonta woodiana* (Lea, 1834) (Mollusca, Bivalvia, Unionoidea) in central and eastern Europe. Acta Oecologica, 7, 49–57.

Soroka, M., and B. Zdanowski. 2001. Morphological and genetic variability of the population of *Anodonta woodiana* (Lea, 1834) occurring in the heated Konin Lakes system. Archives of Polish Fisheries, 9(2): 239-252.

Sousa, R. A. Novais, R. Costa, and D.L. Strayer. 2014. Invasive bivalves in fresh waters: impacts from individuals to ecosystems and possible control strategies. Hydrobiologia 735:233-251.

USFWS (U.S. Fish and Wildlife Service). 2018a. Standard operating procedures for the rapid screening of species' risk of establishment and impact in the United States. https://www.fws.gov/injuriouswildlife/pdf_files/ERSS-SOP-FinalVersion.pdf

Vilizzi, L., G.H. Copp, B. Adamovich, D. Almeida, J. Chan, P.I. Davison, S. Dembski, F.G. Ekmekci, A. Ferincz, S.C. Forneck, et al. 2019. A global review and meta-analysis of applications of the freshwater Fish Invasiveness Screening Kit. Reviews in Fish Biology and Fisheries 29:529-568.

9. Appendices

1. AS-ISK Risk Assessment Screening
2. Great Lakes Aquatic Invaders Risk Assessment