



# Minnesota Department of Natural Resources (DNR) Classification Summary for Invasive Species

Template last updated February 2020

DRAFT: Minnesota Department of Natural Resources Invasive Species Program, March 2020

## Classification Screening for Golden mussel, *Limnoperna fortunei*

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### Introduction

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This document is a guide to the Minnesota DNR’s authority under *Minnesota Statutes*, chapter 84D, to designate invasive species as prohibited or regulated invasive species. The conclusions and recommendations in this document are for information purposes only and do not require the DNR or any other entity to take a specific action.

More information about classifications of invasive species can be found on the [DNR website](http://www.dnr.state.mn.us/invasives/laws.html) (<http://www.dnr.state.mn.us/invasives/laws.html>) and in *Minnesota Statutes*, [chapter 84D](https://www.revisor.mn.gov/statutes/?id=84D) (<https://www.revisor.mn.gov/statutes/?id=84D>). Prohibited, regulated, and unregulated species are listed in Minnesota Rules, [chapter 6216](https://www.revisor.mn.gov/rules/?id=6216) (<https://www.revisor.mn.gov/rules/?id=6216>).

## How to fill out this classification screening

For more detailed guidance on completing this document, see the DNR's "Guidance for Invasive Species Classification Summaries". The following is a brief guide:

- Fill out the Species Summary section with the species name and a brief description of the species and its current regulatory status in Minnesota.
- Answer the questions in the Eligibility Screening section to determine whether the species is eligible for regulation under *Minnesota Statutes*, chapter 84D.
- If the species is eligible for regulation under *Minnesota Statutes*, chapter 84D, continue to answer the questions in the Classification Screening section and characterize the certainty of the answer for each question.
- At the end of the classification screening questions, summarize the most important points from the answers and judge the overall certainty of the screening.
- Finally, you should make a recommendation for classifying the species, based on the findings of the classification screening.
- Update the table of contents when the document is completed.

## Species Summary

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**Common name:** golden mussel

**Scientific name:** *Limnoperna fortunei*

**Brief description:** The golden mussel is a small bivalve, an animal with two connected half shells that grows to 0.75-1.25 inches long, with occasional large specimens up to around 2 inches long. It is dark brown to yellow-brown, is similar in shape to zebra mussels, and produces byssal threads.

**Present classification in Minnesota:** unlisted nonnative species

**Proposed classification:** prohibited invasive species

**Current distribution of species:** Golden mussels are native to China but have been introduced and established in Hong Kong, Taiwan, Japan, Argentina, Uruguay, Paraguay, Bolivia, and Brazil.

## Eligibility Screening

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These three questions determine whether the DNR has authority to regulate the species under *Minnesota Statutes*, chapter 84D.

1. Is the species an aquatic plant or wild animal? For the purposes of this question, “species” includes “subspecies, genotypes, cultivars, hybrids, or genera” (*Minnesota Statutes*, section 84D.04 subd. 1).
  - Choose  Yes or  No; if yes, continue.
2. Is the species a pathogen or terrestrial arthropod regulated under *Minnesota Statutes*, sections 18G.01 to 18G.15? (*Minnesota Statutes*, section 84D.14(1))
  - Choose  Yes or  No; if no, continue.
3. Is the species a mammal or bird defined as livestock in statute? (*Minnesota Statutes*, section 84D.14(1)).
  - Choose  Yes or  No; if no, continue.

## Classification Screening

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### Is it nonnative?

*To be classified as an invasive species under Minnesota Statutes, the species must be “nonnative”; that is, not “native” as defined in Minnesota Statutes, section 84D.01, subd. 11. This has two components.*

#### 1. Is the species nonnative in Minnesota?

**1.1. Is the species naturally present or reproducing in Minnesota?** No. The golden mussel is native to China and possibly also neighboring countries such as Vietnam, Thailand, and Cambodia.

**1.2. Does the species naturally expand from its historic range into Minnesota?** No. The native range is not in North America.

**How certain are these answers?** Very certain, supported by peer-reviewed literature.

### Likelihood of introduction

*This is a criterion for classification of an invasive species under Minnesota Statutes, section 84D.04, subd. 2(1). The terms “introduce” and “introduction” are defined in Minnesota Statutes, section 84D.01.*

#### 2. Is the species likely to be introduced to Minnesota if it is allowed to enter or exist in the state?

Possibly. Previous introductions of golden mussels were likely via ballast water. Adult golden mussels are able to tolerate fluctuating salinities, which aids in their survival in ballast tanks (Sylvester et al. 2013). Once they enter water systems via ballast waters, people may additionally spread them via recreational equipment. A potential pathway of introduction into Minnesota are shipments from invaded regions of Asia or South America arriving in the Great Lakes region. However, the Great Lakes Aquatic Nonindigenous Species Information System indicates this risk is

relatively low, given that South American and Asian vessels rarely, if ever, arrive at the Great Lakes (Fusaro et al. 2019).

**How certain is this answer?** Moderately certain. The golden mussel shares many of the life stage aspects of zebra mussels (such as attachment by byssal threads and veliger larval stage) so actions that could move zebra mussels could also move golden mussels if they were introduced to Minnesota waters.

## Likelihood of survival

*This is a criterion for classification of an invasive species under Minnesota Statutes, section 84D.04, subd. 2(2). The term “naturalize” is defined in Minnesota Statutes, section 84D.01 as “to establish a self-sustaining population...in the wild.”*

**3. Is the species likely to naturalize in Minnesota if it were introduced?** Likely. The golden mussel has broader tolerance for different environmental factors than zebra mussels (Karatayev et al. 2007, Oliveira et al. 2010). For example, the golden mussel can tolerate lower dissolved calcium levels and thus may be able to survive in waters where zebra mussels may not survive. Thus, distribution in Minnesota waters of golden mussel is unlikely to be limited by water chemistry parameters.

The golden mussel’s minimum temperature tolerance may or may not be limiting in Minnesota waters, as there is not agreement in the literature on that temperature. A risk assessment for Ontario for this species suggested that the probability of survival there was low, as previous studies have suggested ~40 degrees Fahrenheit as the lower temperature limit (Mackie and Brinsmead 2017). Another study suggested that this mussel may invade southern reaches of major river systems in North America, but upper reaches of such rivers as the Mississippi would be too cold for too long a duration to support this taxa (Oliveira et al. 2010). However, Karatayev et al. (2007) suggested that the minimum temperature limits for the golden mussel may be more similar to zebra mussels and thus water temperature in winter may not play a limiting factor.

**How certain is this answer?** Reasonably uncertain; conflicting opinions in published literature on minimum temperature levels.

## Potential negative impacts

*For a nonnative species to be defined as “invasive” under Minnesota Statutes, section 84D.01, subd. 9a, the species must: cause, or have the potential to cause economic or environmental harm, harm to human health; or threaten or have the potential to threaten the use of natural resources in the state. This question has four components: economic, environmental, health, and natural resources.*

**4. Is the nonnative species an invasive species as defined under Minnesota law?**

**4.1. Does the species cause, or may it cause, economic harm?** Yes. The golden mussel is similar to zebra mussels in that it attaches to objects in the water and can achieve high population densities. Thus, we would expect golden mussel populations to cause economic impacts similar to zebra mussels; for example, clogging of intakes for water supply or power plants.

**How certain is this answer?** Reasonably certain; based on observed impacts elsewhere.

**4.2. Does the species cause, or may it cause, environmental harm?** Yes. The golden mussel is very similar to zebra mussels in that it attaches to objects in the water and can achieve high population densities. Therefore, we would expect golden mussels to have environmental impacts similar to zebra mussels; for example, alterations in food webs and changes in algal communities including potential increases in harmful algal blooms. Previous invasions indicate golden mussels can colonize native mussels' shells, potentially leading to further decrease in native freshwater mussel populations. Additionally, the potential to invade waters where the zebra mussels cannot survive, such as low-calcium waters in northeast Minnesota, may allow the golden mussel to establish in a broader or different range than zebra mussels.

**How certain is this answer?** Reasonably certain; based on observed impacts elsewhere.

**4.3. Does the species cause, or may it cause, harm to human health?** Possibly. Experimental results suggests that golden mussels may impact algal communities and increase the frequency or abundance of harmful algal blooms; through that mechanism, golden mussel could have indirect human health impacts (Cataldo 2011).

**How certain is this answer?** Reasonably certain; published literature.

**4.4. Does the species threaten, or may it threaten, the use of natural resources in the state?** Yes. The golden mussel is very similar to zebra mussels in that it attaches to objects in the water and can achieve high population densities. Therefore, we would expect the golden mussel to have impacts on natural resources similar to zebra mussels; for example, impacts on recreation and possible food web impacts that could in turn impact some sportfish populations.

**How certain is this answer?** Reasonably uncertain; based on impacts observed elsewhere, but the golden mussel has not yet invaded North American waters so there is uncertainty about whether the impacts realized elsewhere would be the same in North America.

## Natural resource impacts

*This is a criterion for classification of an invasive species under Minnesota Statutes, section 84D.04, subd. 2(3).*

**5. Would the species have potential adverse impacts in Minnesota, in particular on: native species, outdoor recreation, commercial fishing, and other uses of natural resources in the state?**

- Choose  Yes or  No; if yes, continue to 5.1.

**5.1. If so, what would be the magnitude of these adverse impacts?** This species could have impacts similar to zebra mussels, due to their life history similarities as well as the expanded potential range of this species in Minnesota waters.

**How certain is this answer?** Reasonably uncertain; the golden mussel has not yet invaded North American waters so there is uncertainty about whether the impacts realized elsewhere would be the same in North America.

## Management options

*This is a criterion for classification of an invasive species under Minnesota Statutes, section 84D.04, subd. 2(4).*

**6. Would we be able to eradicate, or control the spread of, the species once it is introduced in Minnesota?** Possibly, but only in rare situations. No viable ecological control methods have been documented. A study suggested that control using a molluscicide was feasible (Darrigran et al. 2007); however, the control agent they used is not registered for use in open waters and has significant non-target impacts. Thus, as with the zebra mussel, control methods might exist that are viable for industry in closed systems, but not for resource managers. It is conceivable that current control methods that have been used against zebra mussels, such as copper-based pesticides, might be also effective against golden mussels. However, as with zebra mussels, these are likely only viable in situations where a small, spatially limited population of mussels are discovered. Once a population of golden mussels is established and spread throughout a water, there is little chance to eradicate them.

**How certain is this answer?** Moderately certain.

## Other relevant information

*This is a criterion for classification of an invasive species under Minnesota Statutes, section 84D.04, subd. 2(5). Information that may be included here includes, but is not limited to: economic impacts; regulations in other jurisdictions; and ongoing monitoring programs.*

**7. Are there other criteria the DNR commissioner deems appropriate? If so, discuss.**

- In 2013, the Great Lakes St. Lawrence Governors & Premiers AIS Task Force released a “least wanted” list of invasive species (<http://www.gsgp.org/media/1156/least-wanted-press-release-and-listing-6-1-13.pdf>; accessed May 11, 2018), which included golden mussel.
- Regulations in other jurisdictions:

- *Corbicula fluminea* is regulated in the following Great Lakes jurisdictions (date): Indiana (1998); Wisconsin (2009); and New York (2014) (Tucker et al. 2017).

## Summary

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*Summarize the findings of the screening form, including whether the species is nonnative and invasive as defined by Minnesota Statutes, chapter 84D, and characterize the overall certainty of the answers provided above.*

Note that certain answers in the screening form may indicate that the species is not a good candidate for designating as a prohibited or regulated invasive species under *Minnesota Statutes*, chapter 84D:

- If you answered “Yes” to **either** 1a or 1b, the species is not “nonnative” as defined under *Minnesota Statutes*, chapter 84D; consider regulation under other authorities.
- If you answered “No” to **all** of 4a, 4b, 4c, and 4d, then the species is nonnative but may not be “invasive” as defined under *Minnesota Statutes*, chapter 84D; consider whether proposed introductions of this species should follow *Minnesota Rules*, part 6216.0290.

**Summary:** Because the golden mussel has life history traits similar to zebra mussels, combined with a broader tolerance to most environmental parameters, the golden mussel has the potential to be a problematic invasive species in Minnesota. Ballast water introductions are likely to be the primary pathway into the Great Lakes and Lake Superior (Mackie and Brinsmead 2017). Introduction may be less likely due to current ballast water management regimes. It is possible that golden mussels would not survive current winter temperatures in Minnesota; however, climate change may create more opportunities for the species to establish in the state.

**How certain is this classification summary, overall?** Reasonably certain; published literature available for economic and ecological potential impacts and life history; however, the species’ temperature requirements are reasonably uncertain.

## Recommendation

*The DNR may choose to recommend whether to designate the species as a prohibited invasive species, a regulated invasive species, or whether the species should be an unlisted nonnative species (Minnesota Statutes, section 84D.06). Briefly justify this recommendation and include any additional information such as recommended deadlines for updating this screening form and revisiting this decision and gaps in our knowledge that could be addressed by researchers.*

**Recommendation:** Designate as a prohibited invasive species.

## Appendix

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### Qualitative uncertainty ratings

Uncertainty rating	Description	Abbreviation
Very certain	As certain as I am going to get	VC
Reasonably certain	Reasonably certain	RC
Moderately certain	More certain than not	MC
Reasonably uncertain	Reasonably uncertain	RU
Very uncertain	A guess	VU

Uncertainty ratings from: “Generic Nonindigenous Aquatic Organisms Risk Analysis Review Process”, Risk Assessment and Management Committee report to the Aquatic Nuisance Species Task Force, 1996. Available [online](http://www.anstaskforce.gov/Documents/ANSTF_Risk_Analysis.pdf) (www.anstaskforce.gov/Documents/ANSTF\_Risk\_Analysis.pdf; accessed February 14, 2020).

### Version notes

References to Minnesota Statutes are to the 2019 version.

### References Cited

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## **Additional References**

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