



SAINT MARY'S
UNIVERSITY SINCE 1802

ENVIRONMENTAL SCIENCE
FACULTY OF SCIENCE

Chinese Mystery Snail Project

mystery.snail.reports@gmail.com
ap.smu.ca/~lcampbel/CMS.html

923 Robie Street Halifax NS Canada B3H 3C3

smu.ca

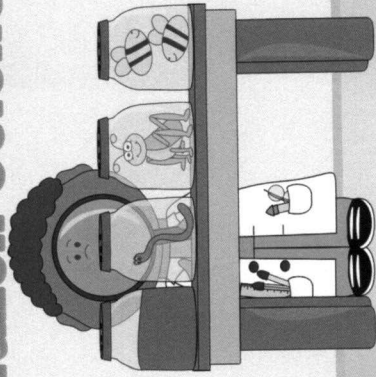
Get Involved!

We need your help to identify which lakes within the Maritimes have Chinese mystery snail populations.

If you find a Chinese mystery snail, please:

- * Record the name of the waterbody and the nearest road. If you can, record GPS coordinates from your phone or GPS unit.
- * If you have a camera or a cell phone, take a photograph of the snail in your hand or put a coin or pen beside the snail so we can see how large it is. Also please take a photograph of the site where you found the snail.
- * Download our app to post your information or email mystery.snail.reports@gmail.com.
- * Even if you cannot provide all information or photographs, still tell us! We will try to follow up and check the site for verification.

Citizen Science



Thank you to Fisheries and Oceans Canada and Saint Mary's University Faculty of Graduate Studies and Research for funding the design and implementation of these brochures!

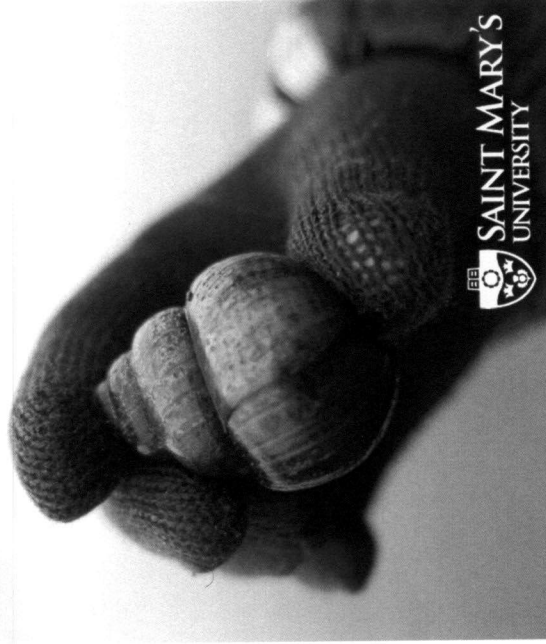
For more information on the Chinese Mystery Snail Project and to download our reporting app, please visit our website at: <http://bit.do/mysterysnails> or scan this QR code:



Dynamic Environment & Ecosystem Health
Research Group

Saint Mary's University
923 Robie St.
Halifax, NS
B3H 3C3
Email: Mystery.Snail.Reports@gmail.com

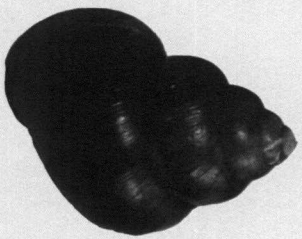
The Chinese Mystery Snail Project



SAINT MARY'S
UNIVERSITY

An Aquatic Invasive Species Present
in the Maritimes

Photograph by: Royal Ontario Museum



What is the Chinese Mystery Snail Project?

The Chinese Mystery Snail Project is a graduate thesis project on Chinese mystery snails, an aquatic invasive species. The aim of the project is to determine where Chinese mystery snails (CMS) are located throughout the Maritimes through habitat suitability modeling, lake surveys, and reports collected from helpful citizens.

Habitat suitability modeling is the process of taking habitat characteristics (e.g. maximum lake depth) of waterbodies with known CMS presence and applying those predictive characteristics to other waterbodies to see where CMS are likely to occur.

However, no computer model can perfectly predict where CMS will be. Therefore, we need the public's help to find where CMS are. Help us monitor waterbodies in Atlantic Canada so that we can better manage the spread of this invasive species!

What are Chinese Mystery snails?

Chinese mystery snails (CMS), *Cipangopaludina chinensis*, are a mollusc species that is native to Eastern Asia. They first came to North America in the 1890s via the Asian food market and since have spread across the United States of America and Southern Canada. In Canada, CMS are mostly concentrated in the South-Eastern portion of the country.

CMS can tolerate a range of water temperatures (0-45°C) and can survive up to 4 weeks of air exposure (i.e. remaining outside of water). Females give birth to live, fully -developed young and can have over 100 offspring per brood. The life expectancy is 5 years for females and 3 years for males.

These snails are likely spreading throughout North America accidentally via boater movements and transfer between lakes by recreational fishermen. CMS may be introduced purposefully to waterbodies by aquarium releases and individuals wishing to establish a fresh food source.

Why are Chinese Mystery snails Invasive?

Chinese mystery snails (CMS) are not easily eradicated. Chemical management strategies and other snail control methods are usually not effective because those snails are very resistant to heat and chemicals. CMS are much larger than native snail species in Nova Scotia. Due to their trap door shells, they are more resistant to predation than native species. CMS have been known to clog drain pipes and screens on intake pipes which negatively affect irrigation systems. CMS can reproduce very rapidly and can out-compete native snails and mussels for food in differing conditions. This can lead to possible alteration of lake environments and nutrient cycling in lakes. CMS have a high probability of spreading through connected water systems and can be very difficult to get rid of. Therefore, it is important to limit their spread as much as possible.



Photograph by: Dr. Linda Campbell

Bill 116 : Law Amendments Meeting

Meeting Location: Committee Room at One Government Place (1713 Barrington St.)

Presentation Time: 16:00

Hello, thank you so much for having me here today and for allowing me to present. My name is Sarah Kingsbury. I am a graduate student at Saint Mary's University studying aquatic invasive species.

I am so pleased to get the opportunity to discuss Bill 116. I think that the Province has taken a very positive step forward by creating a *Biodiversity Act*, but I believe that we need to be mindful in the way things are worded and in the implementation of Bill 116.

Today, I want to talk about invasive species. Invasive species are a serious threat to biodiversity which is why the one line in the Bill 116 for invasive species under section 46(1), "46 (1) The Governor in Council may make regulations: (o) respecting the prevention and management of invasive or alien species" may not be sufficient.

Who knows what this is (holding up a Chinese mystery snail shell)?

This is a Chinese mystery snail shell. You may have seen it in lakes around Nova Scotia, you could have walked by it one thousand times and never have known that this is an aquatic invasive species.

This snail entered Nova Scotian waters without anyone being aware of its potential risk. The snails likely continued to spread throughout Nova Scotian lakes through illegal aquarium dumping and by accidental boater transfers. The extent and the impact of this snail remains unknown.

My thesis project is based upon creating a computer model that merges habitat suitability modeling, public education, reports of Chinese mystery snail occurrence from helpful citizens, and lake surveys to predict where Chinese mystery snails have become established throughout the Maritimes. My supervisor, DR. Linda Campbell, is here with me to support my presentation to the Law Amendments Committee.

The Chinese mystery snail is not the only species that entered Nova Scotia undetected. This is also happening with many invasive species, both aquatic and terrestrial with potential harmful impacts.

Invasive species are considered the second greatest cause of species endangerment and extinction. The Department of Fisheries and Oceans Canada define aquatic invasive species as non-indigenous species that may threaten natural biodiversity through competition, predation, degradation of natural habitat, or destruction of invaded ecosystems.

Invasive species can have huge financial implications too. Aquatic invasive species have an estimated \$128 billion to \$131 billion US dollar negative impact on the US economy annually.

So, how can we prevent the introduction and spread of invasive species?

First of all, Nova Scotia needs to establish and support a invasive species network to monitor threats of potential and current invasive species. There are already excellent monitoring programs in other provinces and states. We can use the information from other areas to develop predictive models and risk assessments.

Also, the invasive species network can assess potential presence of invasive species already in Nova Scotia and search for those.

Education and training is important. Nova Scotians need to be aware of the risk invasive species present, how to identify the most important invasive species and how to prevent their spread.

Let's use the Chinese mystery snails as a case study for invasive species.

Chinese mystery snails are aquatic freshwater snails native to central Asia. It was first introduced to North America in the 1890s via the Asian food markets and, since, has spread across North America. In Canada, CMS have been documented in British Columbia, Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Without monitoring we have no idea which lake or which system have been impacted by this snail species.

It is possible for female Chinese mystery snails to have more than 100 offspring per year, and so it is possible to establish a population of Chinese mystery snails from one fertile female. Once in a new habitat, invasive species can experience a population boom which leads to the displacement of native species.

Chinese mystery snails can alter the native microbe and algal communities important for the health of our freshwater lakes. Chinese mystery snails can alter nitrogen and phosphorous water concentrations which leads to concerns for toxic algae blooms in our lakes.

Again, the Chinese mystery snail is only one example of an invasive species. Nova Scotia has dozens of invasive species, most of which are not being adequately monitored. Without proper funding, monitoring programs, public education programs, and governmental regulation/oversight, Nova Scotia will continue to be a hot-bed for invasives.

Currently, our situation is poor. There is no consistent sources of training, funding or education which we can point to and say, "this is for invasive species research or for monitoring the threat and spread of invasive species."

The funding that exists is often tied to rare or endangered species, but waiting for an invasive species to negatively impact an endangered species before funding the research and management needed to control the species can be too little too late.

Nova Scotia needs a more robust definition and mandate for action. That is why I would ask that Bill 116 be amended to specifically expand on the definition of aquatic and terrestrial invasive species, must include a statement on the urgency for oversight and monitoring programs to be established, and to support education, monitoring and research programs to assess the threats and impacts of invasive species in our beautiful province.

Thank you

Bibliography:

"Aquatic Invasive Species." Chinese Mystery Snail. Kemongsa, 23 Mar. 1993. Web. 1 June 2011. Retrieved from www.in.gov/dnr/files/CHINESE_MYSTERY_SNAIL.pdf

British Columbia Ministry of Environment, Lands and Parks (2000). Freshwater Molluscs. BC Conservation Data Centre. https://www2.gov.bc.ca/assets/gov/environment/plants_animals-and-ecosystems/species-ecosystems-at-risk/brochures/freshwater_mollusc.pdf.

Burnett, J.L., Pope, K.L., Wong, A., Allen, C.R., Haak, D., Stephen, B.J., and Uden, D.R. (2018). Thermal tolerance limits of the Chinese mystery snail (*Bellamya chinensis*): Implications for management. *Nebraska Cooperative Fish & Wildlife Research Unit-Staff Publications*. 254.

"Canada Population. (2018-09-17). Retrieved 2018-11-02, from <http://worldpopulationreview.com/countries/canada/>.

Clarke, A.H. (1981). The freshwater molluscs of Canada. *National Museum of Science*. Ottawa: Canada. p. 38

- Collas, F.P.L., Breedveld, S.K.D., Matthews, J., van der Velde, G., and Leuven, R.S.E.W. (2017). Invasion biology and risk assessment of the recently introduced Chinese mystery snail *Bellamya (Cipangopaludina) chinensis* (gray, 1834), in the Rhine and Meuse River basins in Western Europe. *Aquatic Invasions* 12(3).p. 275-286.
- College SImply (2018). College Search in Wisconsin. Accessed 2 Nov 2018 from <https://www.collegesimply.com/colleges/search/?state=wisconsin>.
- Cui, J., Shan, B., Tang, W. (2012). Effect of periphyton community structure on heavy metal accumulation in mystery snail (*Cipangopaludina chinensis*): A case study of the bai River, China. *Journal of Environmental Sciences* 24(10).p. 1723-1730.
- Davis, E., Caffrey, J.M., Coughlan, N.E., Dick, J.T.A., Lucy, F.E. (2018). Communications, outreach and citizen science: spreading the word about invasive alien species. *Management of Biological Invasions* 9(4).p. 515-525.
- EINFO (2018). Get to Know Ontario's Universities. Accessed 2 Nov 2018 from <http://www.electronicinfo.ca/universities>.
- Fisheries and Oceans Canada (2019). Aquatic invasive species. Accessed 26 Feb 2019 from <http://www.dfo-mpo.gc.ca/species-especies/ais-eae/index-eng.html>.
- Haak, D. (2015). Bioenergetics and habitat suitability models for the Chinese mystery snail (*Bellamya chinensis*). University of Nebraska-Lincoln Dissertations & Theses in Natural Resources. <https://digitalcommons.unl.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=108&context=natresdiss>.
- Haak, D.M., Fath, B.D., Forbes, V.E., Martin, D.R., and Pope, K.L. (2017). Coupling ecological and social network models to assess "transmission" and "contagion" of an aquatic invasive species. *Journal of Environmental Management* 190.p. 243-251.
- Haak, D.M., Stephen, B.J., Kill, R.A., Smeenk, N.A., Allen, C.R., and Pope, K.L. (2014). Toxicity of copper sulfate and rotenone to Chinese mystery snail (*Bellamya chinensis*). *Management of Biological Invasions* 5 (4).p. 371-375.
- Harried, B., Fischer, K., Perez, K.E., and Sandland, G.J. (2015). Assessing infection patterns in Chinese mystery snails from Wisconsin, USA using field and laboratory approaches. *Aquatic Invasions* 10 (2).p.169-175.

Havel, J.E. (2011). Survival of the exotic Chinese mystery snail (*Cipangopaludina chinensis malleata*) during air exposure and implications for overland dispersal by boats. *Hydrobiologia* 668.p. 195-202.

Johnson, P.T.J., Olden, J.D., Solomon, C.T., and Vander Zanden, M.J. (2009). Interactions among invaders: community and ecosystem effects of multiple invasive species in an experimental aquatic system. *Oecologia International Association for Ecology* 159.p.161-170.

Jokinen, E.J. (1982). *Cipangopaludina chinensis* (Gastropoda: Viviparidae) in North America, Review and Update. *The Nautilus* 96(3).p. 89-95.

Karatayev, A.Y., Burlakova, L.E., Karatayev, V.A., and Padilla, D.K. (2009). Introduction, distribution, spread, and impacts of exotic freshwater gastropods in Texas. *Hydrobiologia* 619 (1).p. 181-194.

Kipp, R.M., A.J. Benson, J. Larson, and A. Fusaro, 2018, *Cipangopaludina chinensis* (Gray, 1834): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, <https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=1044>, Revision Date: 5/18/2017, Access Date: 11/2/2018

Köhler, F., Do, V. & Jinghua, F. 2012. *Cipangopaludina chinensis*. *The IUCN Red List of Threatened Species*2012: e.T166265A1124988. <http://dx.doi.org/10.2305/IUCN.UK.2012.L.RLTS.T166265A1124988.en>. Downloaded on 07 November 2018.

Latzka, A.W., Crawford, J.T., Koblings, A.S., Caldeira, Y., Hilts, E., and Vander Zanden, M.J. (2015). Representing calcification in distribution models for aquatic invasive species: surrogates perform as well as CaCO₃ saturation state. *Hydrobiologia* 746(1).p. 197-208.

Matthews, J., Collas, F.P.L., de Hoop, L., van der Velde, G., and Leuven, R.S.E.W. (2017). Management approaches for the alien Chinese mystery snail (*Bellamya chinensis*). Radboud University Institute for Water and Wetland Research.

McAlpine, D.F., Lepitzki, D.A.W., Schueler, F.W., McAlpine, F.J.T., Hebda, A., Forsyth, R.G., Nicolai, A., Maunder, J.E., and Noseworthy, R.G. (2016). Occurrence of the Chinese mystery snail, *Cipangopaludina chinensis* (Gray, 1834) (Mollusca: Viviparidae) in the Saint John River system, New Brunswick, with review of status in Atlantic Canada. *BioInvasions Records* 5(3).p. 149-154.

McCann, M.J. (2014). Population dynamics of the non-native freshwater gastropod, *Cipangopaludina chinensis* (Viviparidae): a capture-mark-recapture study. *Hydrobiologia* 730(1).p. 17-27.

Minnesota Sea Grant (2016). Mystery Snails (Chinese, Japanese and Banded). Accessed 7 November 2018 from <http://www.seagrant.umn.edu/ais/mysterysnail>.

Olden, J.D., Ray, L., Mims, M.C., and Horner-Devine, M.C. (2013). Filtration rates of the non native Chinese mystery snail (*Bellamya chinensis*) and potential impacts on microbial communities. *Limnetica* 32(1).p. 107-120.

Papes, M., Havel, J.E., and Vander Zanden, M.J. (2016). Using Maximum entropy to predict the potential distribution of an invasive freshwater snail. *Freshwater Biology* 61.p. 457-471.

Pejchar, L., and Mooney, H.A. (2009). Invasive species, ecosystem services and human well-being. *Trends in Ecology and Evolution* 24(9).p. 497-504.

Rothlisberger, J.D., Chadderton, W.L., McNulty, J., and Lodge, D.M. (2010). INTRODUCED SPECIES Aquatic Invasive Species Transport via Trailered Boats: What Is Being Moved, Who Is Moving It, and What Can Be Done. *Fisheries* 35(3).p. 121-132.

Shaw, J.L.A., Weyrich, L., and Cooper, A. (2016). Using environmental (e)DNA sequencing for aquatic biodiversity surveys: a beginner's guide. *Marine and Freshwater Research*.

Sohn, W-M., Na, B.K.(2017). *Echinostoma macrorchis* (Digenea: Echinostomatidae): Metacercariae in *Cipangopaludina chinensis malleata* Snails and Adults from Experimental Rats in Korea. *Parasitology* 55(5).p. 541-548.

Stephen, B.J., Allen, C.R., Chaine, N.M., Fricke, K.A., Haak, D.M., Hellman, M.L., Kill, R.A., Nemec, K.T., Pope, K.L., Smeenk, N.A., Uden, D.R., Unstad, K.M., VanderHam, A.E., and Wong, A. (2013). Fecundity of the Chinese mystery snail in a Nebraska reservoir. *Journal of Freshwater Ecology* 28 (3).p.439-444.

Sura, S.A., and Mahon, H.K. (2011). Effects of Competition and Predation on the Feeding Rate of the Freshwater Snail, *Helisoma trivolvis*. *American Midland Naturalist* 166(2).p. 358 -368.

Twardochleb, L.A., and Olden, J.D. (2016). Non-native Chinese mystery snail (*Bellamya chinensis*) supports consumers in urban lake food webs. *Ecosphere* 7(5)

Van den Neucker, T., Schildermans, T., and Scheers, K. (2017). The invasive Chinese mystery snail *Bellamya chinensis* (Gastropoda: Viviparidae) expands its European range to Belgium. *Knowledge & Management of Aquatic Ecosystems* 418(8).p. 1-3.

Waltz, J. (2008). Chinese Mystery Snail (*Bellamya chinensis*) Review. Accessed 11 Sept 2018 from <http://sheltontrails.blogspot.com/2008/08/black-rock-state-park.html>

Questions and Answers:

Other government led programs for invasive species:

Ontario's Invading Species Awareness Program

Invasive Species Council of Manitoba (which have a 5 year strategic plan)

British Columbia: government led working groups (the Invasive Species Working Group), programs (Invasive Species Plant Program), and framework (Invasive Alien Species Framework for BC: Identifying and Assessing threats to biodiversity). Also, in BC the BC Conservation Data Centre has a list of invasives which are tracked and monitored.

Nova Scotia has the Invasive Species Alliance of Nova Scotia.

Other invasive species already established in Nova Scotia:

- green crab
- Chain pickerel
- smallmouth bass

Invasive Species that will likely invade Nova Scotia soon:

- Chinese mitten crab
- zebra mussels
- silver carp