Cipangopaludina chinensis **System:** Freshwater

Kingdom	Phylum	Class	Order	Family
Animalia	Mollusca	Gastropoda	Architaenioglossa	Viviparidae

Common name Chinese mysterysnail (English), trapdoor snail (English), Chinese mystery snail (English), mystery snail (English), Oriental mystery snail (English), Asian freshwater snail (English), Asian apple snail (English)

Synonym
Viviparus malleatus
Viviparus japonicus , (von Martens)
Viviparus stelmaphora
Paludina malleata
Paludina japonicus
Cipangopaludina malleata
Cipangopaludina chinensis malleata
Viviparus chinensis malleatus
Bellamya chinensis , (Gray, 1834)

Similar species *Bellamya japonica*

Summary
Bellamya (=Cipangopaludina) chinensis or Chinese mystery snail is a freshwater gastropod native to southeast Asia, Japan, China, Korea and eastern Russia. It has been introduced to Canada and much of the United States probably via the aquarium trade, water gardening industry or for culinary purposes and first documented in Chinese markets of San Francisco, and has recently been discovered in the Netherlands which represents the first record for Europe. It may outcompete native snails and transmit human parasites, but very little is known about its ecological impacts in invaded systems and more research is necessary.

view this species on IUCN Red List

Species Description
Bellamya chinensis is a large freshwater snail that may reach a shell length of up to 70 mm (measured from the apex to the basal inflection of the aperture) and dry tissue mass of ~1 g (Olden *et al*., 2009; Solomon *et al*., 2010). It exhibits a robust morphology with a width to height ratio of 0.74-0.82. The shell is globose and has 6 to 7 whorls that are convex and have a clear suture. It exhibits light coloration as a juvenile, which darkens to olive green, greenish brown, brown or reddish brown as an adult. The inner coloration is white to pale blue and the lip is a black colour. *B. chinensis* have a thick outer shell and a hard operculum flap or trapdoor covering the shell opening (aperture) that affords a high degree of protection from predators and unfavourable environmental conditions. \r\n
In juveniles the last shell whorl displays a distinct cartilaginous ridge (carina) and the shell contains grooves with 20 striae/mm between each groove. Juveniles also have a detailed pattern on their periostracum consisting of 2 apical and 3 body whorl rows of hairs with long hooks on the ends, distinct ridges and many other hairs with short hooks.\r\n
Considerable variation between individuals exists, and distinct shell variations have been designated as morphotypes assumed to reflect variations in allometric shell growth in different environmental regimes (AIS, 2005; Prezant *et al*., 2006; Benson, 2007; Kipp & Benson, 2011; Soes *et al*., 2011).

Notes
Oriental mystery snails include the closely related Japanese mystery snail (*Bellamya japonica*) and the Chinese mystery snail (*Bellamya chinensis*). However the taxonomy of introduced populations of Oriental mystery snails is confusing and there are many scientific names in use. In older literature the genus name *Cipangopaludina* is commonly used for both species. Smith (2000) argues that *Cipangopaludina* is a subgenus of *Bellamya*. The current literature has preferred the name *Bellamya* (Soes *et al*., 2011), which is used throughout this document.\r\n
Two subspecies or variations of *Bellamya chinensis* are recognized: *chinensis* and *malleata* (AIS, 2005; IT IS, 2009).

Lifecycle Stages
All stages of development (from newly fertilized ova to 5 mm long fully shelled juveniles) are found simultaneously within the uterine sac of females (Prezant *et al*., 2006). Changes in the parent's environment, including exposure to predators may be reflected in biochemical, physiological and morphological changes in developing young. For example, females in the presence of crayfish gave birth to higher numbers of smaller young that had higher organic content of shells (Prezant *et al*., 2006).
Young are born live and fully formed and growth is allometric (the height of the shell increases more rapidly than the width). The lifespan is four to five years (Jokinen, 1982), and individuals have the potential to overwinter in cold conditions (Rixon *et al*., 2005).

Uses
Bellamya chinensis is edible and is sold in Chinese food markets in the United States (Benson, 2007). *B. chinensis* may also be useful in eliminating sewage sludge and heavy metals in rice paddy soil (Kurihara & Suzuki, 1987).

Habitat Description
Bellamya chinensis occurs in large lentic or slow-moving lotic systems with soft, muddy or silty bottoms (Benson, 2007; Distler, 2003). Such suitable freshwater bodies include rivers, streams, ponds, lakes, rice paddies, roadside ditches and irrigation canals (Jokinen, 1982; AIS, 2005). Adults are typically found on surfaces or partially buried under mud or silt, while juveniles are often found in crevices or under rocks (Prezant *et al*., 2006). It is a temperate species with a lower limit of 0 °C and upper limit of 30 °C (Kipp & Benson, 2008 in Karatayev *et al*., 2009), and thus cannot tolerate high summer temperatures in the United States (Karatayev *et al*., 2009).\r\n
It has been found in depths of 0.2-3 m and waters with pH of 6.5-8.4, conductivity of 63–400 µmhos/cm, and concentrations of calcium (5-97 ppm), magnesium (13-31 ppm), oxygen (7-11ppm), and sodium (2–49 ppm) (Jokinen 1982; Jokinen 1992 in Kipp & Benson, 2011). It can tolerate conditions in stagnant waters near septic tanks (Perron & Probert, 1973 in Kipp & Benson, 2011). A recent study also suggests that *B. chinensis* is highly resistant to desiccation, giving potential for overland transport via boats (Havel, 2010).

Reproduction
Bellamya chinensis is viviparous, giving birth to fully developed juveniles (Dillon, 2000). Females continuously release small numbers of juveniles (Havel, 2010), reportedly producing in the order of 65 live offspring per year (Keller *et al*., 2006). Males of *B. chinensis* can be identified by the presence of a modified right tentacle that acts as a penis.\r\n
Prezant *et al*. (2006) found that in the presence of crayfish predators *B. chinensis* may exhibit predator-induced defensive responses. Females in the presence of crayfish released significantly more juveniles than control females, and juveniles were smaller, more variable in size and had higher organic content of shells. The generally smaller size of juveniles released in the presence of a predator reflects a faster rate of generation and passage through the uterus.

Nutrition
Bellamya chinensis is a filter feeder and detritivore, but also browses on microalgae (Dillon, 2000).. Based on examination of gut contents it feeds non-selectively on inorganic-organic debris and epiphytic-benthic algae, predominantly diatoms (Jokinen, 1982). It does not feed readily on plants; snails fed on spinach were found to perform poorly compared to those fed with detritus (Mohrman, 2007 in Soes *et al*., 2011). Carbon stable isotope ratios of *B. chinensis* collected from one Wisconsin lake lakes suggest heavy reliance on benthic resources and little if any reliance on pelagic resources (Solomon *et al*., 2010), although this has not been tested.

General Impacts
Bellamya chinensis is a relatively large snail species that can reach very high densities of up to 40 per m² (Soes *et al*., 2011; Johnson *et al*., 2009). While negative impacts on native snail species and ecosystems are expected (Bury *et al*., 2007) very little is known about its ecological impacts and significance in invaded systems (Johnson *et al*., 2009; Solomon *et al*., 2010; Soes *et al*., 2011)\r\n
Competition: Presence of *B. chinensis* was found to cause substantial declines in the growth and abundance of native *Physella gyrina* and *Lymnaea stagnalis* snails in mesocosm experiments, probably through competition for food (Johnson *et al*., 2009). However such negative impacts on native gastropod assemblages have not yet been confirmed in field studies. Solomon *et al*. (2010) found no difference in snail assemblage structure associated with *B. chinensis* presence or abundance at the scale of an entire lake, although some native snail species tended not to occur at sites where B. chinensis was abundant.\r\n\r\n
Ecosystem change: In a mesocosm experiment *B. chinensis* grazing was found to reduce algal biomass, algal species composition and increase the N: P ratio in the water column. Such effects may have important ecological consequences (Johnson *et al*., 2009). \r\n\r\n
Interaction with other invasive species: In a mesocosm experiment in Wisconsin, the dual effects of predation by an invasive crayfish (*Orconectes rusticus*) and competition by *B. chinensis* were found to have more severe impacts on native snail species than either invader alone. Due to its large size and thicker shell B. chinensis was less vulnerable to predation by this crayfish. The combined impact of both invasive species was found to extirpate one native snail species and reduce the abundance of a second by >95%. This may be because *O. rusticus* reduces native snail abundance via predation but has limited effects on *B. chinensis*, thus promoting additional food resources for *B. chinensis* (Johnson *et al*., 2009).\r\n
An experimental study in Washington suggests that *B. chinensis* may facilitate establishment and exacerbate the establishment success and ecological impacts of an invasive crayfish (*Orconectes virilis*) by providing an abundant prey resource (i.e. invasional meltdown). This hypothesis requires further research and testing (Olden *et al*., 2009).\r\n\r\n
Human health: *B. chinensis* is also the host for several helminth parasites that affect humans in native Asia. Thus it may serve as a vector for parasites and diseases, including human intestinal fluke (Chung & Jung, 1999; Havel, 2010; NAPIS, 2010). However there is little data to support this (Soes *et al*., 2011), and there have been no reported cases involving human intestinal fluke transmitted by *B. chinensis* in the United States (Bury *et al*., 2007). \r\n
Human nuisance: Shells may clog the screens of water intake pipes and thus inhabit the flow of water (AIS, 2005). Additionally, dead and decaying shells can form large windrows on lake shores, which is viewed as a nuisance by residents in some regions (Bury *et al*., 2007). In the Laurentian Great Lakes, fisherman often made seine hauls containing “2 tons” of snails, which were likely *B. chinensis* or *B. japonica* (Wolfert & Hiltunen, 1968).\r\n
Other: *B. chinensis* were found to provide a novel food resource for both native and invasive crayfish in Washington, despite their thick shell and trapdoor defense behaviour. For all snail size classes native *Pacifastacus leniusculus* was able to consume greater numbers of snails than an invasive crayfish species. Whether this translates into *P. leniusculus* having a competitive advantage over invasive crayfish in a natural setting is unknown (Olden *et al*., 2009).

Management Info

Preventative measures: It is currently legal to own *B. chinensis* in the United States. Rixon *et al*. (2005) recommend the erection of trade restrictions regarding the sale, importation or breeding of high-risk species in areas where they have potential for establishing populations. In particular, vectors of invasion such as live fish marks and the aquarium industry should be addressed (Rixon *et al*., 2005; Strecker *et al*., 2011). It does not feed on macrophytes, making it popular with aquarists and water gardeners.\r\n
B. chinensis is thought to be spread overland by attachment to macrophytes on boat hulls. Changing human behaviour such as encouraging removal of macrophytes may reduce the spread of this snail, as well as other invasive species of concern (Havel, 2010).
Chemical control: Copper sulfate is approved by the U.S. Environmental Protection Agency as a snailicide commonly used for control of other invasive snail species. It has recently been used for the first time against *B. chinensis* in Jackson County, Oregon. While 100% eradication has not been achieved, it may be a successful method for controlling populations (Freeman, 2010).

Pathway

B. chinenis may have been transported to the United States as a passive attachment on ornamental lotus plants (Smith, 1995 in Martin, 1999).Recreational boaters may tranport this snail to new locations as it attaches to macrophytes which often infest boat hulls. *B. chinensis* can survive for long periods of air exposure, making transport between lakes on overland vectors such as trailered boats likely (Havel, 2010). Indeed, a survey of 21 lakes found that this snail was more likely to occur at sites near boat launches (Solomon *et al*., 2009).Deliberate release from aquariums is a potential vector for the spread of *Bellamya chinensis*. Rixon *et al*. (2005) found that it was only sold in 10% of aquarium stores surveyed in the Great Lakes region, although it was the only mollusc species in the study predicted to survive Great Lakes winter temperatures. By contrast, a survey of aquarium stores in Seattle, Washington did not find *B. chinenis* (Strecker *et al*., 2011).This species is thought to have been brought to the United States from Japan as a food source for humans (Wood, 1892).

Principal source:

Compiler: National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG)

Review: Julian Olden, School of Aquatic and Fishery Sciences, University of Washington

Pubblication date: 2011-04-15

ALIEN RANGE

[1] CANADA
[1] NETHERLANDS
[1] GREAT LAKES
[33] UNITED STATES

BIBLIOGRAPHY

34 references found for **Cipangopaludina chinensis**

Managment information

Freeman, M. 2010, October 30. Invasive snails pose threat if not eradicated.Mail Tribune.
Summary: Availble from: http://www.mailtribune.com/apps/pbcs.dll/article?AID=/20101030/NEWS/10300304 [Accessed 8 March 2011]
Havel E. John, 2010. Survival of the exotic Chinese mystery snail (*Cipangopaludina chinensis malleata*) during air exposure and implications for overland dispersal by boats. Hydrobiologia DOI 10.1007/s10750-010-0566-3
Keller P. Reuben, John M. Drake and Davod M. Lodge, 2006. Fecundity as a Basis for Risk Assessment of Nonindigenous Freshwater Molluscs. Conservation Biology Volume 21, No. 1, 191�200 2006.
Rixon, Corinne A.M., Ian C. Duggan, Nathalie M.N. Bergeron, Anthony Ricciardi and Hugh J. Macisaac, 2005. Invasion risks posed by the aquarium trade and live fish markets on the Laurentian Great Lakes. Biodiversity and Conservation 14: 1365�1381, 2005.
US Fish and Wildlife Service, 2010. Freshwater Invasive Mollusk Prevention at Roadway Border Crossings into Alaska. Alaska Fisheries Technical Report Number 107. Fairbanks Fish and Wildlife Field Office Fairbanks, Alaska May 2010
Summary: Available from: http://alaska.fws.gov/fisheries/fish/Technical_Reports/t_2010_107.pdf [Accessed 17 July 2010]

General information
Aquatic Invasive Species (AIS). 2005. Chinese mystery snail.
Summary: Available from: http://www.in.gov/dnr/files/CHINESE_MYSTERY_SNAIL.pdf [Accessed 8 March 2011]
Benson, A., 2007. *Bellamya (Cipangopaludina) chinensis*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL.
Summary: Available from: http://nas.er.usgs.gov/queries/FactSheet. asp?speciesID=1044 [Accessed 8 March 2011]
Branson B. A., 1977. The Chinese apple snail *Cipangopaludina chinensis* on Orcas Island Washington USA. Nautilus. 91(2). 1977. 76-77.
Summary: Abstract: A very large population of *C. chinensis* (Gray, 1834) is reported from Lake Cascade on Orcas Island in the Puget Sound region of western Washington [USA].
Branson B. A.; Batch D. L; CALL S. M., 1987. Distribution of aquatic snails Mollusca Gastropoda in Kentucky USA with notes on fingernail clams Mollusca Sphaeriidae Corbiculidae. Transactions of the Kentucky Academy of Science. 48(3-4). 1987. 62-70.
Bury, Jennifer A.; Sietman, Bernard E..; Karns, Byron N., 2007. Distribution of the non-native viviparid snails, *Bellamya chinensis* and *Viviparus georgianus*, in Minnesota and the first record of *Bellamya japonica* from Wisconsin. Journal of Freshwater Ecology. 22(4). DEC 2007. 697-703.
Chiu, Y-W.; Chen, H-C.; Lee, S-C.; Chen, C.A. 2002. Morphometric Analysis of Shell and Operculum Variations in the Viviparid Snail, *Cipangopaludina chinensis* (Mollusca: Gastropoda), in Taiwan. Zoological Studies. 41(3). JUNE 2002. 321-331.
Chung, P.R. & Jung, Y. 1999. *Cipangopaludina chinensis malleata* (Gastropoda: Viviparidae): A New Second Molluscan Intermediate Host of a Human Intestinal Fluke *Echinostoma cinetorchis* (Trematoda: Echinostomatidae) in Korea. The Journal of Parasitology. 85(5). OCT 1999. 963-964.
Clarke, A. H., 1978. The Asian apple snail *Cipangopaludina chinensis* Viviparidae in Oneida Lake New York. Nautilus. 92(3). 1978. 134.
Summary: Abstract: On Sept. 11, 1977, about 60 specimens of *C. chinensis* (Gray 1834) (= *Viviparus japonicas* (von Martens) and *V. molleatus* (Reeve)) were found washed up along a quarter mile stretch of beach at Sylvan Beach, Oneida County, New York [USA], at the eastern end of Oneida Lake. Many of the specimens contained decaying soft parts but circumstances prevented a proper search for live animals. On April 30, 1978, the site was revisited and additional, apparently freshly-dead, specimens were found. On this occasion, diving for live specimens could not be attempted but the presence of an established colony in Oneida Lake, and probably at Sylvan Beach, appears certain. Although *C. chinensis* occurs elsewhere in New York State, i.e., near Niagara Falls and near New York City, it was not found previously in Oneida Lake nor in the Finger Lakes region. Expansion of its distribution throughout central New York, by way of the Erie Barge Canal, should probably be expected.
Cowie H. Robert, 1998. Patterns of introduction of non-indigenous non-marine snails and slugs in the Hawaiian Islands. Biodiversity and Conservation 7, 349�368 (1998)
Cowie, Robert H., 2005. Alien non-marine molluscs in the islands of the tropical and subtropical Pacific: A review. American Malacological Bulletin. 20(1-2). APR 27 2005. 95-103.
Dillon, R.T. Jr. 2000. The ecology of freshwater molluscs. Cambridge University Press, Cambridge.
Distler, Donald A., 2003. Occurrence of the mystery snail *Cipangopaludina chinensis* (Gastropoda: Viviparidae) in the Walnut River basin, Kansas. Transactions of the Kansas Academy of Science. 106(3-4). Fall 2003. 215.
Integrated Taxonomic Information System (ITIS), 2009. *Cipangopaludina chinensis* (Gray, 1834)
Summary: Available from: http://www.cbif.gc.ca/pls/itisca/next?v_tsn=70329&taxa=&p_king=every&p_string=containing&p_ifx=&p_lang= [Accessed 7 March 2011]
Johnson, Pieter T. J., Julian D. Olden, Christopher T. Solomon and M. Jake Vander Zanden, 2009. Interactions among invaders: community and ecosystem effects of multiple invasive species in an experimental aquatic system. Oecologia (2009) 159:161-170
Summary: Available from: http://limnology.wisc.edu/personnel/jakevz/pdf/2009_Oecologia_Johnsonetal%20CMS.pdf [Accessed 17 July 2010]
Jokinen, E. H., 1982. *Cipangopaludina chinensis* Gastropoda Viviparidae in North America review and update. Nautilus. 96(3). 1982. 89-95.
Summary: Abstract: The Asian freshwater viviparid snail, *C. chinensis* (Gray), was introduced into North America in the 1890 s. The species has spread across the USA and southern Canada and is well-established in the northeastern USA. Connecticut populations are limited to lakes and ponds of medium-hard to hard waters of Ca levels > 5 ppm. The shell growth of *C. chinensis* is allometric with the young snails having a lower shell height to shell width ratio than the adults. The growth patterns and radular cusp number of the typical *C. chinensis* and the *C. japonicas* morph differ from each other. A literature review notes the 5 yr life span, diatom diet, the importance of quality food sources in regulating population parameters and the role of *C. chinensis* as a possible host for Asian helminths.
Karatayev, Alexander Y.; Burlakova, Lyubov E.; Karatayev, Vadim A.; Padilla, Dianna K., 2009. Introduction, distribution, spread, and impacts of exotic freshwater gastropods in Texas. Hydrobiologia. 619 FEB 2009. 181-194.
Kipp, Rebekah M. & Amy Benson. 2011. *Cipangopaludina chinensis malleata*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL.
Summary: Available from: http://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=1045 [Accessed 17 July 2010]
Kurihara, Y. & Suzuki, T. 1987. Removal of heavy metals and sewage sludge using the mud snail, *Cipangopaludina chinensis malleata* REEVE, in paddy fields as artificial wetlands. Water Science and Technology. 19(12). 281-286.
Summary: Abstract: The effects of the application of reed-sewage sludge compost on the heavy metal incorporation and the growth of young snails born from the adult mud snails, *Cipangopaludina chinensis malleata* REEVE, put into submerged paddy soil were investigated. The biomass and growth of the snails in paddy soil with compost were superior to those in soil without compost. The Zn and Cu concentrations in the flesh portion of snails were extremely high as compared with those in the paddy soil surrounding the snails. This may be because snails ingest sewage sludge which is a main organic component of the composts and sewage sludge usually contains large amounts of Zn and Cu, suggesting that this type of snail may be useful in eliminating sewage sludge and Zn and Cu in paddy soil when composted sewage sludge has been applied.
Martin, Scott M., 1999. Freshwater snails (Mollusca: Gastropoda) of Maine. Northeastern Naturalist. 6(1). Feb. 15, 1999. 39-88.
Mills, Edward L.; Leach, Joseph H.; Carlton, James T.; Secor, Carol L. 1993. Exotic Species in the Great Lakes: A History of Biotic Crises and Anthropogenic Introductions. Journal of Great Lakes Research. 19(1). 1-54.
National Agricultural Pest Information System (NAPIS), 2010. Chinese Mystery Snail (*Cipangopaludina chinensis*) Pest Tracker National Agricultural Pest Information System
Summary: Available from: http://pest.ceris.purdue.edu/searchpest.php?selectName=IGDUAFA [Accessed 17 July 2010]

Olden, Julian D.; Larson, Eric R.; Mims, Meryl C., 2009. Home-field advantage: native signal crayfish (*Pacifastacus leniusculus*) out consume newly introduced crayfishes for invasive Chinese mystery snail (*Bellamya chinensis*). Aquatic Ecology. 43(4). DEC 2009. 1073-1084.
Summary: Available from: http://www.fish.washington.edu/research/oldenlab/pdf/2009/AquaticEcology_2009.pdf [Accessed 15 April 2011]
Prezant, R. S.; Chapman, E. J.; McDougall, A., 2006. In utero predator-induced responses in the viviparid snail *Bellamya chinensis*. Canadian Journal of Zoology. 84(4). APR 2006. 600-608.
SeaLifeBase, 2010. *Cipangopaludina chinensis* (Gray, 1834)
Summary: Available from: http://sealifebase.org/summary/speciessummary.php?id=3397 [Accessed 17 July 2010]
Smith, Douglas G., 2000. Notes on the taxonomy of introduced *Bellamya* (Gastropoda: Viviparidae) species in northeastern North America. Nautilus. 114(2). June 6, 2000. 31-37.
Soes D. Menno, Gerard D. Majoor and Stef M.A. Keulen, 2011. *Bellamya chinensis* (Gray, 1834) (Gastropoda: Viviparidae), a new alien snail species for the European fauna. Aquatic Invasions (2011) Volume 6, Issue 1
Summary: Available from: http://www.majoor.eu/Slakkenfiles/Soes_etal.pdf [Accessed 18 February 2011]
Solomon, Christopher T., Julian D. Olden, Pieter T. J. Johnson, Robert T. Dillon Jr., M. Jake Vander Zanden, 2010. Distribution and community-level effects of the Chinese mystery snail (*Bellamya chinensis*) in northern Wisconsin lakes. Biol Invasions (2010) 12:1591�1605
Summary: Available from: http://www.fish.washington.edu/research/oldenlab/pdf/2010/BiologicalInvasions_2010.pdf [Accessed 15 April 2011]
Strecker, A.L.; Campbell, P.M. & J. D. Olden. 2011. The aquarium trade as an invasion pathway in the Pacific Northwest. Fisheries 36.74-85.
Wolfert, D. R. & J. K. Hiltunen. 1968. Distribution and abundance of the Japanese snail *Viviparus japonicas*, and associated macrobenthos in Sandusky bay, Ohio. Ohio Journal of Science. 68(1). 32-40.