New Zealand Mudsnail - *Potamopyrgus antipodarum*

The gastropod, *Potamopyrgus antipodarum*, is a small aquatic snail. It has a history of becoming a pest species in many parts of the world, and its recent introduction into North American waters is cause for concern. Since the mid-1980's, North American population densities in some infested streams have reached up to 3/4 million individuals per m^2.

Taxonomy

Phylum	▪ Mollusca
Class	▪ Gastropoda
Order	▪ Mesogastropoda
Family	▪ Hydrobiidae

General Biology

Adult Morphology

- Reaches maturity at 3 mm in length in rivers in western Montana and Idaho
- Shell usually consists of a right-handed coiling of 5-6 whorls (Fig. 1)
- Relatively small (average length of 4-5 mm in western USA), maximum of 11 mm in native habitat) (Fig. 1)
- Shell varies in color (gray, light to dark brown) (Fig. 1)
- Operculum (i.e., plate) covers the opening of the shell (Fig. 2)
- Triploid, parthenogenetic female populations (asexual females born with developing embryos in their reproductive system)
- Diploid, sexual male and female populations extremely rare in western USA
- Asexual females generally produce twice the number of daughters as sexual females

Behavior

- Can move at >1 m/hr (Fig. 3)

Fig. 1 North American populations of the New Zealand mud snail have an average shell length of 4-5 mm.[1]

Fig. 2 The operculum, common to all prosobranchs, blocks the shell aperture when the snail is withdrawn.[2]

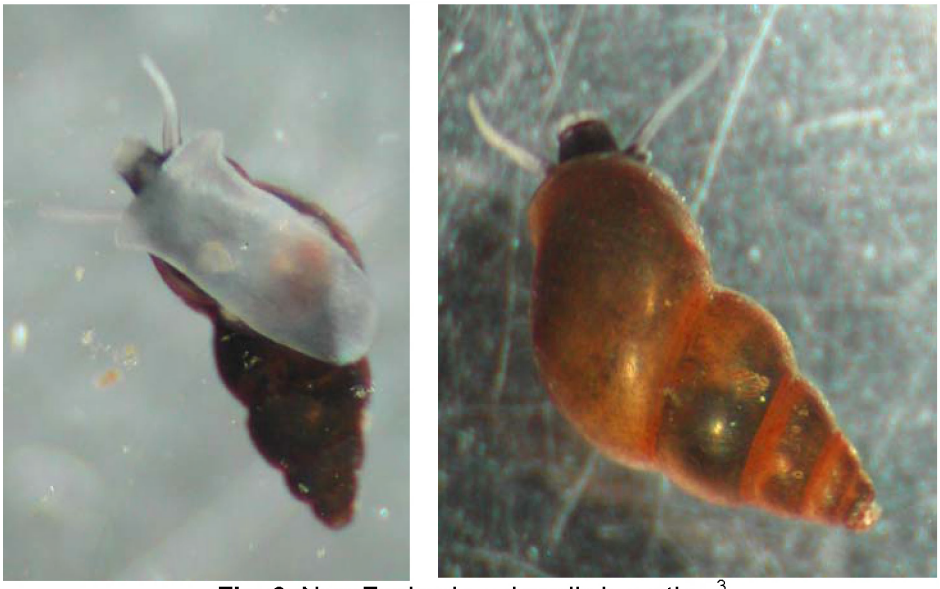


Fig. 3 New Zealand mud snails in motion.[3]

Identification

Distinguishing Characteristics

- The adult New Zealand mud snail may easily be confused with various native and exotic species which can be similar in appearance, and all newly discovered populations should be verified by experts (Fig. 4)

[1] http://www.fcsc.usgs.gov/Nonindigenous_Species/New_Zealand_Mudsnail/new_zealand_mudsnail.html
[2] http://www.fcsc.usgs.gov/Nonindigenous_Species/New_Zealand_Mudsnail/new_zealand_mudsnail.html
[3] http://www2.montana.edu/nzms/

- The shell of the New Zealand mud snail is narrower, longer, and has more whorls (5-6) than most hydrobiid snails native to the United States (Fig. 4)
- Males are a rarity in United States populations, and therefore, the absence of males may be used as an indicator of a possible population of New Zealand mud snails (Fig. 5); to determine if snails are males requires relaxing, fixing, and microscopic determination which is very difficult in the field; it is better to examine for embryos by crushing larger ones and verifying that they are live-bearing females.
- New Zealand mud snails are live bearers (they release embryos and not eggs), and therefore, the presence of newly released young may indicate a possible population (Fig. 6) (other genera which include live-bearing snails in the western United States are *Tryonia*, *Eremopyrgus*, and *Melanoides*)

P. antipodarum

Amnicola limosa

Colligyrus sp.

Pyrgulopsis sp.

Fluminicola sp.

Pristinicola hemphilli

Tryonia sp.

Eremopyrgus eganensis

Juturnia tularosae

Physidae sp.

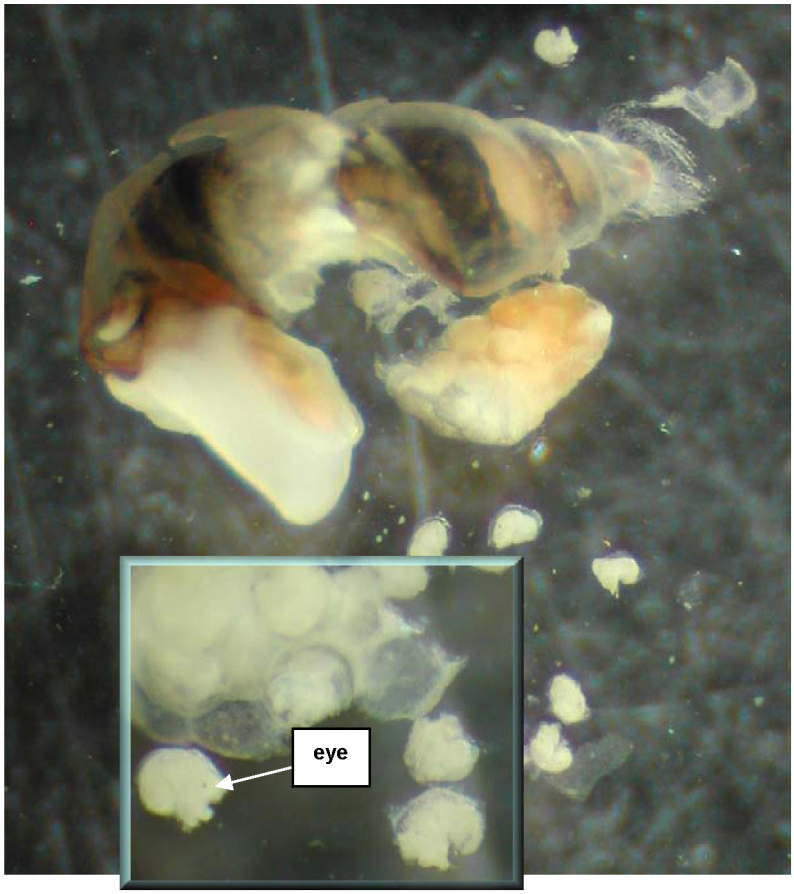
Bithynia tentaculata

Melanoides tuberculatus

Lymnaeidae sp.

Fig. 4 Other similar species located in the United States make identification of the New Zealand mud snail difficult.[4]

Fig. 5 Male New Zealand mud snails are very rare in the western United States and most populations consist of parthenogenetic females.[5]



[4] http://www2.montana.edu/nzms/
[5] http://www2.montana.edu/nzms/

Fig. 6 Developing embryos of the New Zealand mud snail are exposed by submersing a relaxed female snail into a solution of weak acid which quickly dissolves the shell. These embryos can be distinguished from eggs by their curved appearance and the presence of eyes.[6]

Life Cycle

Juveniles
- Live born

Maturity
- Females reach maturity at 3-6 months of age; beginning to produce embryos at 3-mm shell length, with larger size producing more embryos

Reproduction
- Dioecious (i.e., male reproductive organs present in one individual and females reproductive organs in another) and ovoviviparous (i.e., producing eggs that develop inside female)
- An individual female may brood between 10 - 90 embryos
- All known populations from the western United States have been parthenogenic females, males being a rarity
- All known populations from the western United States are able to produce young throughout the year (with favorable conditions), although most reproduction occurs between the months of March and October

Habitat Characteristics

Preferred Environment
- From eutrophic mud bottoms to rocky bottomed, clear running waters
- Lakes, ponds, streams, rivers, lagoons, estuaries, canals, ditches, water tanks, and reservoirs
- Occupies a wide variety of substrates including silt, sand, mud, concrete, vegetation, cobble, and gravel

Temperature
- Capable of tolerating a wide range of temperatures with upper thermal limits of 28°C and lower thermal limits near freezing

Salinity
- Wide range tolerance from saline and brackish to fresh
- Salinity tolerance of <26.4%
- Populations in saline conditions produce fewer offspring, grow more slowly, and undergo longer gestation periods

Water Quality
- Able to tolerate turbidity, clear water, and degraded conditions (including sewage and may pass through the digestive tracts of many fish species)

Distribution

Native Range
- Fresh and brackish habitats of New Zealand and adjacent islands
- Naturalized in Europe and Australia

North American Distribution
- See Fig. 8; additional current records of distribution in western USA at http://www2.montana.edu/aim/mollusca/nzms/

Means of Introduction
- Unknown, but possibly with transfer of fish eggs and live gamefish and in ballast

[6] Adapted from http://www.esg.montana.edu/aim/mollusca/nzms/id.html

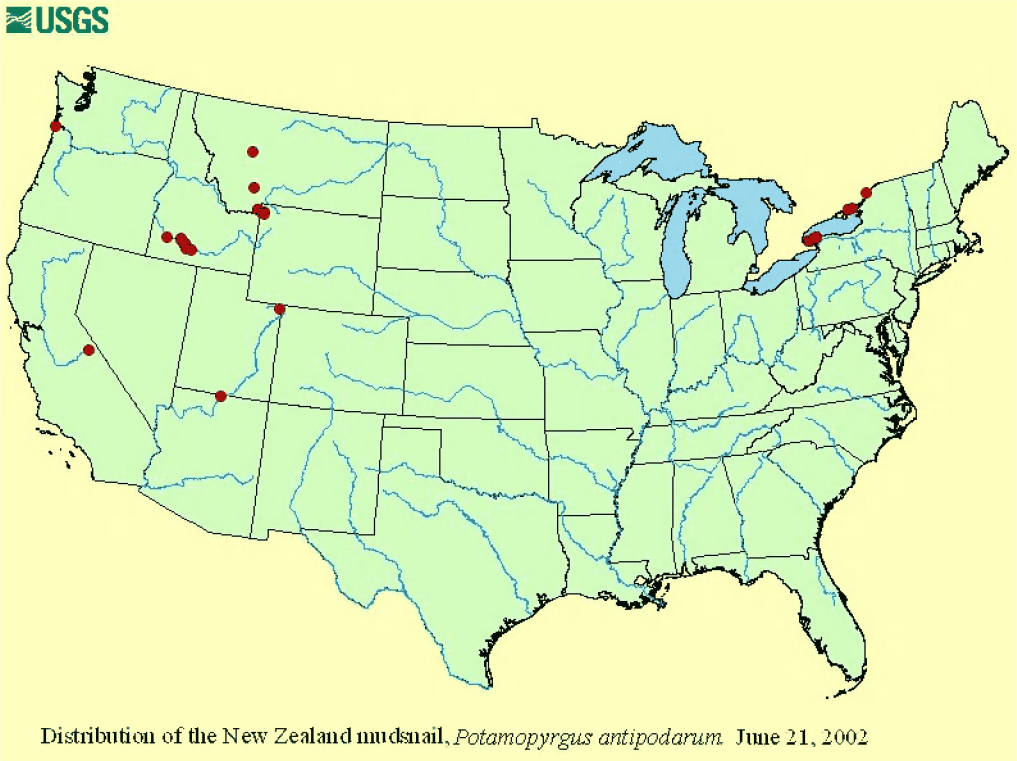


Fig. 8 The New Zealand mud snail was first discovered in the United States in the Snake River, Idaho in 1987. A later introduction into Lake Ontario was documented in 1991.[7]

Diet

Adults

- Prefers diatoms, plant and animal detritus, and attached periphyton

Impacts

Negative

- Possible displacement of native invertebrates; five species of molluscs (all native to the Snake River) have recently been listed as "endangered" in part due to the establishment of the New Zealand mud snail and its potential impacts
- Establishment is expected to have negative impacts on native fauna (e.g., decrease in densities of herbivorous invertebrates, decrease in attached filter-feeding organisms)
- Negative correlation between populations of mayflies, stoneflies, caddisflies, and chironomids and New Zealand mud snail densities of <28,000/m^2 in a spring creek in south western Montana
- May have the potential to impact the food chain of native trout and other fish species
- Have the potential to disrupt the physical characteristics of invaded ecosystems (e.g., reduction in the biomass of periphyton and the

[7] http://www.fcsc.usgs.gov/Nonindigenous_Species/New_Zealand_Mudsnail/new_zealand_mudsnail.html

resulting interactions can have wide-ranging affects on stream ecosystem processes)
- Have the potential to become a pest species of freshwater supplies (in Australia actually emerged from domestic water taps)

Management

Control Measures

- Heat, desiccation, and subjecting them to a hard freeze will kill the New Zealand mud snail (http://www.esg.montana.edu/aim/mollusca/nzms/SimpleControl.pdf for further information)
- Trematode native to New Zealand may be of assistance in the development of a biological control, but further research is needed
- Transportation is believed to occur mainly via contaminated equipment of recreational boaters and anglers, and therefore, the following will assist in containing the spread:
    - Scrub and thoroughly rinse boat, gear, and equipment before exiting an infested area. Allow to dry in low humidity for at least 24 hr before entering another body of water.
    - Scrub and thoroughly rinse off all mud and debris (e.g., aquatic vegetation) which may be adhering to boots, waders, clothing, etc. before leaving an infested area. Allow to dry in low humidity and high temperature > 30C for at least 24 hr before entering another body of water.

Literature

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Web Sites

http://www.jncc.gov.uk/marine/dns/d2_2_6_3.htm
National Museums of Scotland – *Potamopyrgus antipodarum*

http://www2.montana.edu/nzms/
New Zealand Mudsnail in the Western USA

http://sunflower.bio.indiana.edu/~clively/Research/about%20the%20snail.html
Potamopyrgus antipodarum

http://www.esg.montana.edu/aim/mollusca/nzms/SimpleControl.pdf
Simple Control Method to Limit Spread of New Zealand Mudsnail, *Potamopyrgus antipodarum*

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