

**Potamopyrgus antipodarum** 正體中文

**System:** Freshwater

| Kingdom  | Phylum   | Class      | Order           | Family      |
|----------|----------|------------|-----------------|-------------|
| Animalia | Mollusca | Gastropoda | Neotaenioglossa | Hydrobiidae |

**Common name** Jenkin's spire shell (English), New Zealand mudsnail (English)

**Synonym** *Hydrobia jenkinsi* , (Smith, 1889)  
*Potamopyrgus jenkinsi* , (Smith, 1889)

**Similar species**

**Summary** *Potamopyrgus antipodarum* is an aquatic snail native to New Zealand that has invaded Australia, Europe, and North America. It can inhabit a wide range of ecosystems, including rivers, reservoirs, lakes, and estuaries. *P. antipodarum* may established extremely dense populations that can comprise over 95% of the invertebrate biomass in a river, alter primary production, and compete with or displace native molluscs and macroinvertebrates. They can spread rapidly in introduced areas and are able to withstand desiccation, a variety of temperature regimes, and are small enough that many types of water users could be the source of introduction to new areas.



[view this species on IUCN Red List](#)

**Species Description**

*Potamopyrgus antipodarum*, the New Zealand mudsnail, is a very small, aquatic snail whose elongate shell consists of 5 to 6 dextral, or right handed, whorls. It is often described as horn colored or light to dark brown. It has an operculum that covers its shell aperture. The average length of *P. antipodarum* is usually 4-6 mm in introduced locations but may reach 12 mm in its native range. Some populations bear a weak keel located mid whorl (Crosier *et al*, undated; Levri *et al*, 2007; NZMS Working Group, 2006; Ponder, 1988; Richards *et al*, 2002; Zaranko *et al*, 1997).

**Notes**

*Potamopyrgus antipodarum* was reported in some locations of Europe as *Potamopyrgus jenkinsi* by Smith (1989) (Gaino *et al*, 2008). Non-native populations of *P. antipodarum* are parthenogenetic and consist almost exclusively of female, clonal individuals. In the United States most western populations are a single clone, with a second in a short section of the Snake River, Idaho, and a third in eastern United States (NZMS Working group, 2006).

**Lifecycle Stages**

*Potamopyrgus antipodarum* may live more than a year and has been observed to grow at a rate of up to 0.1 mm/day at 21°C in laboratory conditions (Richards *et al*, 2002). It may reach sexual maturity in at 3.0-3.5 mm or in about six to nine months (Crosier *et al*, undated; Richards *et al*, 2002; Dybdahl & Kane, 2005; Moller *et al*, 1994 in Alonso & Castro-Diaz, 2008).

**Habitat Description**

*Potamopyrgus antipodarum* is an extremely tolerant species that is capable of inhabiting many aquatic conditions. It colonizes a wide range of habitats including rivers, lakes, streams, estuaries, reservoirs, lagoons, canals, ditches, and even water tanks (Brown *et al*, 2008; Crosier *et al*, undated). Reported depths range from 4-25, even 45 meters, but it most often occurs in the littoral zone and moderate depths of around 10 m (Cejka *et al*, 2008; Zaranko *et al*, 1997; Grigoorvich *et al*, 2003). *P. antipodarum* tolerates a wide range of temperatures, salinities, trophic conditions, water conditions, and current speeds (Gaino *et al*, 2008; Levri *et al*, 2007; Crosier *et al*, undated). It may occupy silt, sand, mud, concrete, vegetation, cobble, and gravel (Crosier *et al*, undated; Richards *et al*, 2002). Its densities are reported highest in systems with high primary productivity, constant temperatures, cobble substrate, and constant flow (Richards *et al*, 2002; Holomuzki & Biggs, 2007), and it thrives in disturbed watersheds (Cejka *et al*, 2008). Its upper thermal limits are around 28°C and lower limits are around freezing (Crosier *et al*, undated). It may reproduce at salinities of 0-15 ppt and tolerate 30-35 ppt for short periods of time (Cejka *et al*, 2008). It can withstand moderate desiccation and drought for several days (National Park Service, undated; Gaino *et al*, 2008).

## Reproduction

Within its native range *Potamopyrgus antipodarum* reproduces sexually and asexually while non-native populations are parthenogenetic and consist almost exclusively of triploid females (Alonso & Castro-Diaz, 2008; Lively, undated). Reproduction is ovoviviparous and offspring are brooded by females in a brood pouch until they reach a mobile stage (Alonso & Castro-Diaz, 2008). Broods are reported to range from 20-120 embryos per female and they produce an average of 230 juveniles per year (Richards *et al*, 2002; Alonso & Castro-Diaz, 2008). *P. antipodarum* may reproduce year-round in favorable conditions, but the majority of its reproduction occurs in the spring and summer (Crosier *et al*, undated; Richards *et al*, 2002).

## Nutrition

*Potamopyrgus antipodarum* grazes on periphyton, diatoms, and plant and animal detritus (Richards *et al*, 2002; Alonso & Castro-Diaz, 2008; Brown *et al*, 2008; Levri *et al*, 2008).

## General Impacts

*Potamopyrgus antipodarum* may establish very dense populations, consume large amounts of primary production, alter ecosystem dynamics, compete with and displace native invertebrates, and negatively influence higher trophic levels. Its ecological plasticity, high competitive ability, high reproductive rate, high capacity for various dispersal methods, and ability to avoid predation make it a formidable colonizer capable of establishing abundant populations with significant effects on ecosystems (Alonso & Castro-Diaz, 2008). *P. antipodarum* and its impacts are similar to that of the extremely problematic invasive Zebra Mussel (*Dreissena polymorpha*) (National Park Service, undated).

*P. antipodarum* can establish extremely dense populations of tens to hundreds of thousands of individuals per square meter in introduced environments. In Australia densities of 50,000 snails/m<sup>2</sup> have been recorded (Ponder 1988; Schrieber *et al*, 1998). In the United States densities of 200,000, 500,000 and even 800,000 snails/m<sup>2</sup> have been recorded in several locations (Davidson *et al*, 2008; Dorgelo, 1987 in Brown *et al*, 2008; Crosier *et al*, undated; Hall *et al*, 20003; Levri *et al*, 2007).

These large populations undoubtedly have significant effects on ecosystems. *P. antipodarum* can consume up to 75% of gross primary production, dominate secondary production by composing up to 97% of invertebrate biomass, and excreting 65% of total NH<sub>4</sub> thereby dominating C and N cycles as in the case of Polecat Creek, Wyoming. Its secondary productivity is one of the highest ever reported (194 g AFDM m<sup>-2</sup> yr<sup>-1</sup>), being 7-40 times higher than that of any macroinvertebrate in Greater Yellowstone area (Hall *et al*, 2003; Hall *et al*, 2006; Richards *et al*, 2002). Such alteration of ecosystems likely results in far reaching cascading ecological impacts (Crosier *et al*, undated; Davidson *et al*, 2008; Alonso & Castro-Diaz, 2008). It has also been indicated that it may increase CO<sub>2</sub> levels by precipitating calcium bicarbonate to calcium carbonate to produce shells (Chavaud *et al*, 2003 in NZMS Working Group, 2006).

*P. antipodarum* may displace, inhibit growth in, and compete with native invertebrates for resources in introduced locations (Alonso & Castro-Diaz, 2008; Cowie *et al*, 2009; Davidson *et al*, 2008; Hall *et al*, 2006; Kerans *et al*, 2005). High densities of *P. antipodarum* were believed to have negative interactions with native macroinvertebrates in several locations in Montana (Kerans *et al*, 2005). In the Snake River, Idaho, its site of initial introduction in the United States, it is believed to be a major cause of five species of native mollusks recently becoming endangered (Crosier *et al*, undated). This includes the endangered hydrobiid snail *Taylorconcha serpentina* (Richards *et al*, 2004 in Brown *et al*, 2008). It is believed to limit absolute growth and the growth rate of the native desert valvata snail (*Valvata utahensis*) in the Snake River as well (Lysne & Koetsier, 2008). It dominates the Mont Saint-Michael Bay in western France and represented 80% of gastropods collected from all sites (Gerard *et al*, 2003). Similarly, *P. antipodarum* made up 83% of the mollusk community in a reservoir near an industrial area in Poland (Lewen & Smolski, 2006). *P. antipodarum* has been found to significantly inhibit growth in endemic snail *Pyrulopsis robusta* in Polecat Creek, Wyoming (Riley *et al*, 2008). A negative correlation has been demonstrated with *P. antipodarum* and important invertebrate species mayflies, stoneflies, caddisflies, and chironomids (Crosier *et al*, undated). It has also been to have a negative correlation with native hydrobiid snails in Tasmania (Poner, 1988).

*P. antipodarum* directly affects fish by being a poor and mostly un-digestible food source. Although rainbow trout *Onchorynchus mykiss* and brown trout *Salmo trutta* were found to feed on *P. antipodarum* in a study, about 80% of those consumed passed through their system undigested (NZMS Working Group, 2006). Not only does *P. antipodarum* replace energetic food sources, but it is believed to inflict poor health and reduce survivorship in fish that consume it based the significantly worse condition of fish with *P. antipodarum* in their guts (Vinsen & Baker, 2008). These direct as well as indirect impacts on fish by *P. antipodarum* threaten fisheries in locations where it has established.

Additionally, *P. antipodarum* has fouling potential as it is known to pass through water pipes, emerge from domestic traps, and may block water pipes, meters, or irrigation systems (Ponder, 1988; Cotton, 1942 in Zaranko, 1997; NZMS Working Group, 2006). *P. antipodarum* has also been found to be infected by blood fluke *Sanguinicola* sp. in Europe and represents a possible vector to new locations (Gerard & LeLannic, 2003).

## Management Info

**Preventative measures:** Once *Potamopyrgus antipodarum* establishes eradication is improbable in most locations and often impractical in those where possible. Prevention of its introduction and containing existing populations is important for minimizing its spread and impacts. Its populations are likely to expand throughout its introduced range. The present distributions of *P. antipodarum* in North America and Australia specifically are predicted to expand. In North America, it is believed to continue to spread through western watersheds and in the Great Lakes. If it reaches the rivers of the Mississippi basin, it will spread rapidly and abundantly. In Australia it is thought to continue to spread along the east coast and may establish in the southwest if a suitable vector is provided (Loo *et al*, 2007a).

Educating anglers, hunters, boaters, aquaculturalists, and the general public about *P. antipodarum*, methods of its spread, its potential impacts, and control methods is important. Because its spread to new locations is the result of human activity public awareness about *P. antipodarum* is necessary. The expansion of present efforts and new initiatives to slow the spread of *P. antipodarum* by environmental and governmental agencies such as the National Parks Service is essential to conservation (NZMS Working Group, 2006).

Local and federal governments should also take steps to legally prohibit the importation, possession, and transport of *P. antipodarum*. In the United States California, Colorado, Kansas, Montana, Utah, Washington, and Wyoming have already done so, while Alaska, Hawaii, Idaho, Nevada, Oregon require prior authorization for its importation, possession, or transport. Colorado and California quarantined and closed fishing access to certain locations in attempts to curb its spread. Alaska, Hawaii, Indiana, Kansas, Montana, Oregon, and Washington have all developed state aquatic nuisance management plans that include *P. antipodarum* (NZMS Working Group, 2006).

Transportation via contaminated aquatic equipment, such as wading gear, is a major method of spread of *P. antipodarum* (Crosier, undated; Davidson *et al*, 2008; Richards *et al*, 2004; NZMS Working Group, 2006). Several methods of removing *P. antipodarum* have been recommended including desiccation, heating, freezing, washing, and chemical treatment. The laying out and drying of equipment at 30°C for at least 24 hours or at 40°C for 2 hours has proven effective (Davidson *et al*, 2008; Richards *et al*, 2004; Crosier *et al*, undated). Submerging it in water at about 50 °C for a few minutes is also effective as *P. antipodarum* can survive at 43 °C for short periods (Medhurst, 2003 in NZMS Working Group, 2006). Freezing gear for 6-8 hours will also kill *P. antipodarum* (Davidson *et al*, 2008; Richards *et al*, 2004; Medhurst, 2003 in NZMS Working Group, 2006). Scrubbing and thoroughly rinsing may effectively remove it as well (Crosier *et al*, undated). Finally, chemical treatment is also effective. Benzethonium chloride, chlorine bleach, Formula 409, Pine-Sol, ammonia, and copper sulfate all effectively kill *P. antipodarum*. However, bleach and Pine-Sol were found to damage some materials. The use of copper sulfate, benzethonium chloride, or Formula 409 disinfectant immersion baths or in dry sacks are believed to provide the most acceptable chemical methods of removing *P. antipodarum* (Hosea & Finlayson, 2005).

Ballast water and hull fouling is believed to be the most common vector of introducing *P. antipodarum* to new locations (Alonso & Castro-Diaz, 2008). Adhering to local, federal, and international ballast water regulations such as those provided by GloBallast is essential to reducing the discharge of contaminated ballast water and helping prevent the establishment of *P. antipodarum* (NZMS Working Group, 2006). Although due to its very small size, it may not be practical to clean *P. antipodarum* off of large hulls or recreational craft in every instance, promoting information and resources to clean water craft before visiting certain contaminated sites would help reduce its spread. Additionally, the cleaning of anchors may also reduce its spread (NZMS Working Group, 2006).

**Physical:** Control of *P. antipodarum* is possible in certain isolated locations such as small lakes, ponds, irrigation canals, and fish hatcheries. Draining waters and allowing substrate to heat and dry completely in the summer or freeze in the winter will kill *P. antipodarum*. Irrigation canals are routinely shut down for plant control and may be treated for snails as well (NZMS Working Group, 2006). The use of flame throwers on the walls and raceways has been effectively employed in hatcheries (Richards *et al*, 2004; Dwyer *et al*, 2003 in NZMS Working Group, 2006). It has also been suggested that barriers such as copper stripping or electrical weirs may limit the movement of *P. antipodarum* particularly in keeping it from high risk areas (NZMS Working group, 2006).

**Chemical:** Chemical treatment of aquatic systems poses risks to surrounding drainages and native species. Small lakes and ponds may be isolated from drainages may isolated from drainages for chemical treatment. Chemical methods used to eradicate *P. antipodarum* include: Bayer 73 copper sulfate, and 4-nitro-3-trifluoromethylphenol sodium salt (TFM). The only molluscicide known to have been tested against *P. antipodarum* is Bayluscide (a.i. niclosamide). This test, conducted by Montana Fish, Wildlife, and Parks (FWP), was conducted in small spring creek along the lower Madison River. One hundred percent mortality was achieved after 48 exposure units, which consisted of 1 ppm Bayluscide for 1 hour (Don Skarr, Montana FWP, personal communication in NZMS Working Group, 2006). Application of GreenClean® PRO, a non-copper-based algaecide, was found to be an effective means to prevent and possibly eliminate *P. antipodarum* in the lab. Mortality was 100% within 72 hours of exposure to a 0.5% concentration for 2 and 4 minutes, 1% concentration for 30 seconds, and minimum of 0.33% concentration for 8 minutes. Mortality was also 100%, 48 hours after exposure to a 4% concentration for 2 minutes and 0.55% concentration for 8 minutes. Although effective in the lab, its effectiveness in the remains uncertain (NZMS Working Group, 2006).

**Biological control:** Parasites of *P. antipodarum* are another potential method of control. Studies of the efficacy and specificity of a trematode parasite from its native range as a biological control have demonstrated promising results ((Dybdahl *et al*. 2005 in NZMS Working Group, 2006; Emblidge and Dybdahl *in prep* in NZMS Working Group, 2006). Also the parasite *Micophallus* sp. has been found to highly specific and effective in most genotypes of *P. antipodarum* including those in the western US (Dybdahl and Lively, 1998 in NZMS Working Group, 2006; Dybdahl & Lively, 1998 in NZMS Working Group, 2006).

**Integrated management:** An integrated management and control plan for *P. antipodarum* should be implemented in locations that are colonized and those that may potentially be invaded. This plan should include preventive measures, public education, monitoring, and appropriate treatment to slow its spread and eradicate where possible and practical. Plans should account for the specific needs of individual locations and follow the guidelines provided by the Aquatic Nuisance Species Task Force (ANSTF) (NZMS Working Group, 2006).

## Pathway

The most frequently cited method of long distance dispersal of *Potamopyrgus antipodarum* is through ship ballast water (Alonso & Castro-Diaz, 2008).

**Principal source:** [New Zealand Mudsail Management and Control Working Group, 2006](#). National Management and Control Plan for the New Zealand Mudsail (*Potamopyrgus antipodarum*) DRAFT. Prepared for the Aquatic Nuisance Species Task Force by the New Zealand Mudsail Management and Control Plan Working Group Draft August 2006

[Davidson, Timothy M., Valance E. F. Brenneis, Catherine de Rivera, Robyn Draheim and Graham E. Gillespie, 2008](#). Northern range expansion and coastal occurrences of the New Zealand mud snail *Potamopyrgus antipodarum* (Gray, 1843) in the northeast Pacific. Aquatic Invasions (2008) Volume 3, Issue 3: 349-353. Special issue "Invasive Aquatic Molluscs – ICAIS 2007 Conference Papers and Additional Records" Frances E. Lucy and Thaddeus K. Graczyk (Guest Editors)

[Crosier, Danielle M.; Daniel P. Molloy; David C. Richards, undated](#). New Zealand Mudsail - *Potamopyrgus antipodarum*.

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

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## ALIEN RANGE

[1] ATLANTIC - NORTHEAST

[1] AUSTRIA

[1] BELGIUM

[1] CZECH REPUBLIC

[1] ESTONIA

[1] FRANCE

[1] GREECE

[1] ITALY

[1] LAKE ERIE

[1] LAKE SUPERIOR

[1] LEBANON

[2] MEDITERRANEAN & BLACK SEA

[1] NORWAY

[1] ROMANIA

[1] SLOVAKIA

[1] SPAIN

[1] SWEDEN

[1] TURKEY

[5] UNITED KINGDOM

[4] AUSTRALIA

[1] BELARUS

[1] CANADA

[1] DENMARK

[1] FINLAND

[1] GERMANY

[1] IRAQ

[1] JAPAN

[1] LAKE ONTARIO

[1] LATVIA

[1] LITHUANIA

[1] NETHERLANDS

[1] POLAND

[1] RUSSIAN FEDERATION

[1] SLOVENIA

[1] ST. LAWRENCE RIVER

[1] SWITZERLAND

[1] UKRAINE

[11] UNITED STATES

**Red List assessed species 4: CR = 1; EN = 2; VU = 1;**

[Alzoniella delmastroi](#) **EN**

[Pseudamnicola gasulli](#) **VU**

[Dianella thiesseana](#) **CR**

[Salenthydrobia ferrerii](#) **EN**

## BIBLIOGRAPHY

**81** references found for *Potamopyrgus antipodarum*

### Managment information

[Aquatic Invaders of Belarus., 2007. Alien Species Database \*Potamopyrgus antipodarum\*](#)

**Summary:** This database is of alien aquatic animals inhabiting waterbodies of the Republic of Belarus. It allows to search the species by scientific taxonomy and to get information on their origin, distribution and potential ecological impacts. The database was composed in result of the analysis of literature published during the last century and authors unpublished data. One can find some general information on Belarusian waterbodies, history of construction and functioning of the interbasin shipping canals, links to related sites, etc. The site is under testing and only an English version is available, a Russian version is expected shortly.

The database is available from: <http://www.aliensinbelarus.com/content/view/12/28/>.

This page is available from: [http://www.aliensinbelarus.com/index.php?option=com\\_database&Itemid=27&id=37&task=one\\_dat](http://www.aliensinbelarus.com/index.php?option=com_database&Itemid=27&id=37&task=one_dat) [Accessed 28 May 2007]



Arndt, Erik; Fiedler, Stephan; Boehme, Dirk, 2009. Effects of invasive benthic macroinvertebrates on assessment methods of the EU Water Frame Work Directive. *Hydrobiologia*. 635(1). NOV 2009. 309-320

[Centre for Environment, Fisheries & Aquaculture Science \(CEFAS\)](#), 2008. [Decision support tools-Identifying potentially invasive non-native marine and freshwater species: fish, invertebrates, amphibians](#).

**Summary:** The electronic tool kits made available on the Cefas page for free download are Crown Copyright (2007-2008). As such, these are freeware and may be freely distributed provided this notice is retained. No warranty, expressed or implied, is made and users should satisfy themselves as to the applicability of the results in any given circumstance. Toolkits available include 1) FISK- Freshwater Fish Invasiveness Scoring Kit (English and Spanish language version); 2) MFISK- Marine Fish Invasiveness Scoring Kit; 3) MI-ISK- Marine invertebrate Invasiveness Scoring Kit; 4) FI-ISK- Freshwater Invertebrate Invasiveness Scoring Kit and AmphISK- Amphibian Invasiveness Scoring Kit. These tool kits were developed by Cefas, with new VisualBasic and computational programming by Lorenzo Vilizzi, David Cooper, Andy South and Gordon H. Copp, based on VisualBasic code in the original Weed Risk Assessment (WRA) tool kit of P.C. Pheloung, P.A. Williams & S.R. Halloy (1999).

The decision support tools are available from:

<http://cefas.defra.gov.uk/our-science/ecosystems-and-biodiversity/non-native-species/decision-support-tools.aspx> [Accessed 13 October 2011]

[The guidance document](#) is available from [http://www.cefas.co.uk/media/118009/fisk\\_guide\\_v2.pdf](http://www.cefas.co.uk/media/118009/fisk_guide_v2.pdf) [Accessed 13 January 2009].

Cowie, Robert H.; Dillon, Robert T. Jr.; Robinson, David G.; Smith, James W., 2009. Alien non-marine snails and slugs of priority quarantine importance in the United States: A preliminary risk assessment. *American Malacological Bulletin*. 27(1-2). JUL 29 2009. 113-132

Dwyer, W. P.; Kerans, B. L.; Gangloff, M. M., 2003. Effect of acute exposure to chlorine, copper sulfate, and heat on survival of New Zealand mud snails. *Intermountain Journal of Sciences*. 9(2-3). September 2003. 53-58.

Gerard, Claudia; Poullain, Virginie, 2005. Variation in the response of the invasive species *Potamopyrgus antipodarum* (Smith) to natural (cyanobacterial toxin) and anthropogenic (herbicide atrazine) stressors. *Environmental Pollution*. 138(1). NOV 2005. 28-33

Hosea, Robert C. and Brian Finlayson, 2005. Controlling the spread of New Zealand mud snails on wading gear. State of California The Resources Agency Department of Fish and Game.

Loo, Sarina E.; Keller, Reuben P.; Leung, Brian, 2007. Freshwater invasions: using historical data to analyse spread. *Diversity & Distributions*. 13(1). JAN 2007. 23-32

Loo, Sarina E.; Mac Nally, Ralph; Lake, P. S., 2007. Forecasting New Zealand mudsnail invasion range: Model comparisons using native and invaded ranges. *Ecological Applications*. 17(1). JAN 2007. 181-189.

[National Park Service \(NPS\)](#), 2003. [New Zealand Mud Snail, Baseline Distribution and Monitoring Study](#). Department of the Interior.

**Summary:** Information on the identification, impacts and management of species.

Available from: <http://www.nps.gov/yell/planvisit/todo/fishing/mudsnail.htm> [Accessed 11 October 2003]

[New Zealand Mudsnail Management and Control Working Group](#), 2006. [National Management and Control Plan for the New Zealand Mudsnail \(\*Potamopyrgus antipodarum\*\) DRAFT. Prepared for the Aquatic Nuisance Species Task Force by the New Zealand Mudsnail Management and Control Plan Working Group Draft August 2006](#)

**Summary:** Available from: [http://www.anstaskforce.gov/Documents/NZMS\\_M&C\\_Draft\\_8-06.pdf](http://www.anstaskforce.gov/Documents/NZMS_M&C_Draft_8-06.pdf) [Accessed 15 March 2010]

Oplinger, Randall W.; Brown, Pat; Wagner, Eric J., 2009. Effect of Sodium Chloride, Tricaine Methanesulfonate, and Light on New Zealand Mud Snail Behavior, Survival of Snails Defecated from Rainbow Trout, and Effects of Epsom Salt on Snail Elimination Rate. *North American Journal of Aquaculture*. 71(2). APR 2009. 157-164.

Oplinger, Randall W.; Wagner, Eric J., 2009b. Toxicity of Common Aquaculture Disinfectants to New Zealand Mud Snails and Mud Snail Toxicants to Rainbow Trout Eggs. *North American Journal of Aquaculture*. 71(3). JUL 2009. 229-237

Richards, David C., 2004. Early Detection of New Zealand mudsnail, *Potamopyrgus antipodarum*. EcoAnalysts Inc., Moscow, Idaho and Department of Ecology, Montana State University, Bozeman, MT March 3, 2004

Schisler, George J.; Vielra, Nicole K. M.; Walker, Peter G., 2008. Application of household disinfectants to control New Zealand mudsnails. *North American Journal of Fisheries Management*. 28(4). AUG 2008. 1172-1176.

## General information

Adema, C. M.; Lun, C. -M.; Hanelt, B.; Seville, R. S., 2009. Digenean Trematode Infections of Native Freshwater Snails and Invasive *Potamopyrgus antipodarum* in the Grand Teton National Park/John D. Rockefeller Memorial Parkway Area. *Journal of Parasitology*. 95(1). FEB 2009. 224-227

Alonso, A.; Castro-Diez, P., 2008. What explains the invading success of the aquatic mud snail *Potamopyrgus antipodarum* (Hydrobiidae, Mollusca)? *Hydrobiologia*. 614(1). NOV 2008. 107-116

Arango, Clay Porter; Riley, Leslie Anne; Tank, Jennifer Leah; Hall, Robert Ogden Jr., 2009. Herbivory by an invasive snail increases nitrogen fixation in a nitrogen-limited stream. *Canadian Journal of Fisheries & Aquatic Sciences*. 66(8). AUG 2009. 1309-1317.

Baur, Bruno; Ringeis, Birgit, 2002. Changes in gastropod assemblages in freshwater habitats in the vicinity of Basel (Switzerland) over 87 years. *Hydrobiologia*. 479 1 July, 2002. 1-10

[Benson, A. J. and R. M. Kipp](#), 2010. [Potamopyrgus antipodarum](#). [USGS Nonindigenous Aquatic Species Database, Gainesville, FL](#).

**Summary:** Available from: <http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=1008> [Accessed 15 March 2010]

Bersine, Karen; Brenneis, Valance E. F.; Draheim, Robyn C.; Rub, A. Michelle Wargo; Zamon, Jeannette E.; Litton, Rodney K.; Hinton, Susan A.; Sytsma, Mark D.; Cordell, Jeffery R.; Chapman, John W., 2008. Distribution of the invasive New Zealand mudsnail (*Potamopyrgus antipodarum*) in the Columbia River Estuary and its first recorded occurrence in the diet of juvenile Chinook salmon (*Oncorhynchus tshawytscha*). *Biological Invasions*. 10(8). DEC 2008. 1381-1388.

Brown, Kenneth M.; Lang, Brian; Perez, Kathryn E., 2008. The conservation ecology of North American pleurocerid and hydrobiid gastropods. *Journal of the North American Benthological Society*. 27(2). JUN 2008. 484-495

Bruce, R. Louise; Moffitt, Christine M.; Dennis, Brian, 2009. Survival and Passage of Ingested New Zealand Mudsnails through the Intestinal Tract of Rainbow Trout. *North American Journal of Aquaculture*. 71(4). OCT 2009. 287-301.

Carlsson, Ralf, 2000. The distribution of the gastropods *Theodoxus fluviatilis* (L.) and *Potamopyrgus antipodarum* (Gray) in lakes on the Åland Islands, southwestern Finland. *Boreal Environment Research*. 5(3). 25 September, 2000. 187-195.

Cejka, Tomas; Libor Dvorak & Vladimir Kosel, 2008. Present distribution of *Potamopyrgus antipodarum* (Gray, 1843) (Mollusca: Gastropoda) in the Slovak Republic. *Malacologica Bohemoslovaca* (2008), 7: 21-25

**Summary:** Available from: <http://mollusca.sav.sk/pdf/7/7.Cejka.pdf> [Accessed 15 March 2010]

CONABIO. 2008. Sistema de informaci3n sobre especies invasoras en M3xico. Especies invasoras - Moluscos. Comisi3n Nacional para el Conocimiento y Uso de la Biodiversidad. Fecha de acceso.

**Summary: English:**

The species list sheet for the Mexican information system on invasive species currently provides information related to Scientific names, family, group and common names, as well as habitat, status of invasion in Mexico, pathways of introduction and links to other specialised websites. Some of the higher risk species already have a direct link to the alert page. It is important to notice that these lists are constantly being updated, please refer to the main page (<http://www.conabio.gob.mx/invasoras/index.php/Portada>), under the section Novedades for information on updates.

Invasive species - Molluscs is available from: [http://www.conabio.gob.mx/invasoras/index.php/Especies\\_invasoras\\_-\\_Moluscos](http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Moluscos) [Accessed 30 July 2008]

**Spanish:**

La lista de especies del Sistema de informaci3n sobre especies invasoras de m3xico cuenta actualmente con informaci3n acerca de nombre cient3fico, familia, grupo y nombre com3n, as3 como h3bitat, estado de la invasi3n en M3xico, rutas de introducci3n y ligas a otros sitios especializados. Algunas de las especies de mayor riesgo ya tienen una liga directa a la p3gina de alertas. Es importante resaltar que estas listas se encuentran en constante proceso de actualizaci3n, por favor consulte la portada (<http://www.conabio.gob.mx/invasoras/index.php/Portada>), en la secci3n novedades, para conocer los cambios.

Especies invasoras - Moluscos is available from: [http://www.conabio.gob.mx/invasoras/index.php/Especies\\_invasoras\\_-\\_Moluscos](http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Moluscos) [Accessed 30 July 2008]

Crosier, Danielle M.; Daniel P. Molloy; David C. Richards, undated. New Zealand Mudsnail - *Potamopyrgus antipodarum*

**Summary:** Available from: [http://el.erdc.usace.army.mil/ansrp/potamopyrgus\\_antipodarum.pdf](http://el.erdc.usace.army.mil/ansrp/potamopyrgus_antipodarum.pdf) [Accessed 15 March 2010]

Davidson, Timothy M., Valance E. F. Brenneis, Catherine de Rivera, Robyn Draheim and Graham E. Gillespie, 2008. Northern range expansion and coastal occurrences of the New Zealand mud snail *Potamopyrgus antipodarum* (Gray, 1843) in the northeast Pacific. *Aquatic Invasions* (2008) Volume 3, Issue 3: 349-353. Special issue 3 Invasive Aquatic Molluscs 3 ICAIS 2007 Conference Papers and Additional Records 3 Frances E. Lucy and Thaddeus K. Graczyk (Guest Editors)

**Summary:** Available from: [http://www.aquaticinvasions.ru/2008/AI\\_2008\\_3\\_3\\_Davidson\\_etal.pdf](http://www.aquaticinvasions.ru/2008/AI_2008_3_3_Davidson_etal.pdf) [Accessed 15 March 2010]

Delivering Inventories of Alien Invasive Species for Europe (DAISIE), 2006. *Potamopyrgus antipodarum*

**Summary:** Available from: <http://www.europe-allens.org/speciesFactsheet.do?speciesId=53448#> [Accessed 15 March 2010]

Dybdahl, Mark F.; Kane, Stephanie L., 2005. Adaptation vs. phenotypic plasticity in the success of a clonal invader. *Ecology* (Washington D C). 86(6). JUN 05. 1592-1601.

Favilli, Leonardo; Manganelli, Giuseppe; Bodon, Marco, 1998. Distribution of *Potamopyrgus antipodarum* (Gray, 1843) in Italy and in Corsica (Prosobranchia: Hydrobiidae) Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano. 139(1). July, 1998. 23-44.

Gerard, Claudia; Blanc, Alexia; Costil, Katherine, 2003. *Potamopyrgus antipodarum* (Mollusca:Hydrobiidae) in continental aquatic gastropod communities: Impact of salinity and trematode parasitism. *Hydrobiologia*. 493 15 February, 2003. 167-172.

Gerard, Claudia; Le Lannic, Joseph, 2003. Establishment of a new host-parasite association between the introduced invasive species *Potamopyrgus antipodarum* (Smith) (Gastropoda) and *Sanguinicola* sp. Plehn (Trematoda) in Europe. *Journal of Zoology* (London). 261(2). October 2003. 213-216.

Grigorovich, Igor A.; Korniushev, Alexei V.; Gray, Derek K.; Duggan, Ian C.; Colautti, Robert I.; MacIsaac, Hugh J., 2003. Lake Superior: An invasion coldspot? *Hydrobiologia*. 499 1 June, 2003. 191-210.

Gruska, P., 1999. The river Odra estuary as a gateway for alien species immigration to the Baltic Sea basin. *Acta Hydrochimica et Hydrobiologica*. 27(5). Nov., 1999. 374-382.

Hall, Robert O. Jr., Jennifer L. Tank, Mark F. Dybdahl, 2003. Exotic Snails Dominate Nitrogen and Carbon Cycling in a Highly Productive Stream. *Frontiers in Ecology and the Environment*, Vol. 1, No. 8 (Oct., 2003), pp. 407-411

Hall, Roberto O. Jr.; Dybdahl, Mark F.; VanderLoop, Maria C., 2006. Extremely high secondary production of introduced snails in rivers. *Ecological Applications*. 16(3). JUN 2006. 1121-1131

Herbst, David B.; Bogan, Michael T.; Lusardi, Robert A., 2008. Low specific conductivity limits growth and survival of the New Zealand mud snail from the Upper Owens River, California. *Western North American Naturalist*. 68(3). SEP 2008. 324-333.

Holomuzki, Joseph R.; Biggs, Barry J. F., 2007. Physical microhabitat effects on 3-dimensional spatial variability of the hydrobiid snail, *Potamopyrgus antipodarum*. *New Zealand Journal of Marine & Freshwater Research*. 41(4). DEC 2007. 357-367.

Irikov, Alanas A.; Georgiev, Dilian G., 2008. The New Zealand Mud Snail *Potamopyrgus antipodarum* (Gastropoda : Prosobranchia) - a new invader species in the Bulgarian fauna. *Acta Zoologica Bulgarica*. 60(2). AUG 2008. 205-207

ITIS (Integrated Taxonomic Information System), 2005. Online Database *Potamopyrgus antipodarum*

**Summary:** An online database that provides taxonomic information, common names, synonyms and geographical jurisdiction of a species. In addition links are provided to retrieve biological records and collection information from the Global Biodiversity Information Facility (GBIF) Data Portal and bioscience articles from BioOne journals.

Available from:

[http://www.cbif.gc.ca/pls/itiscat/taxastep?king=every&p\\_action=containing&taxa=Potamopyrgus+antipodarum&p\\_format=&p\\_ifx=plgt&p\\_lang=](http://www.cbif.gc.ca/pls/itiscat/taxastep?king=every&p_action=containing&taxa=Potamopyrgus+antipodarum&p_format=&p_ifx=plgt&p_lang=) [Accessed March 2005]

Kerans, B. L.; Dybdahl, M. F.; Gangloff, M. M.; Jannot, J. E., 2005. *Potamopyrgus antipodarum*: distribution, density, and effects on native macroinvertebrate assemblages in the Greater Yellowstone Ecosystem. *Journal of the North American Benthological Society*. 24(1). March 2005. 123-138.

Kofler, Alois; Mildner, Paul, 2004. Third supplement on the mollusk fauna of East Tyrol (Mollusca: Gastropoda, Bivalvia). *Berichte des Naturwissenschaftlich-Medizinischen Vereins in Innsbruck*. 91 2004. 129-155.

- Kolodziejczyk, Andrzej; Lewandowski, Krzysztof; Stanczykowska, Anna, 2009. Long-term changes of Mollusc assemblages in bottom sediments of small semi-isolated lakes of different trophic state. *Polish Journal of Ecology*. 57(2). 2009. 331-339.
- Krodkiewska, Mariola; Strzelec, Malgorzata; Serafinski, Włodzimierz, 1998. *Potamopyrgus antipodarum* (Gray) (Gastropoda, Prosobranchia) a dangerous newcomer in malacofauna of Poland. *Przegląd Zoologiczny*. 42(1-2). 1998. 53-60.
- Levri, Edward P.; Dermott, Ron M.; Lunnen, Shane J.; Kelly, Ashley A.; Ladson, Thomas, 2008. The distribution of the invasive New Zealand mud snail (*Potamopyrgus antipodarum*) in Lake Ontario. *Aquatic Ecosystem Health & Management*. 11(4). 2008. 412-421
- Levri, Edward P.; Jacoby, Warren, 2008. The invasive New Zealand mud snail (*Potamopyrgus antipodarum*) found in streams of the Lake Ontario Watershed. *Journal of the Pennsylvania Academy of Science*. 82(1). AUG 2008. 7-11.
- Levri, Edward P.; Kelly, Ashley A.; Love, Eric, 2007. The invasive New Zealand mud snail (*Potamopyrgus antipodarum*) in Lake Erie. *Journal of Great Lakes Research*. 33(1). MAR 2007. 1-6.
- Lewin, Iga; Smolinski, Adam, 2006. Rare and vulnerable species in the mollusc communities in the mining subsidence reservoirs of an industrial area (The Katowicka Upland, Upper Silesia, Southern Poland) *Limnologia*. 36(3). SEP 2006. 181-191.
- [Lively, C. Undated. \*Potamopyrgus antipodarum\*. Indiana University: Department of Biology. Bloomington, IN.](#)
- Summary:** Information on reproduction and genetics of species.  
Available from: <http://sunflower.bio.indiana.edu/~clively/Research/about%20the%20snail.html> [Accessed 11 October 2003]
- Lysne, Steven; Koetsier, Peter, 2006. Experimental studies on habitat preference and tolerances of three species of snails from the Snake River of southern Idaho, USA. *American Malacological Bulletin*. 21(1-2). FEB 9 2006. 77-85.
- Lysne, Steven; Koetsier, Peter, 2008. Comparison of desert valvata snail growth at three densities of the invasive New Zealand mudsnail. *Western North American Naturalist*. 68(1). MAR 2008. 103-106
- Morley, Neil J., 2008. The role of the invasive snail *Potamopyrgus antipodarum* in the transmission of trematode parasites in Europe and its implications for ecotoxicological studies. *Aquatic Sciences*. 70(2). MAY 2008. 107-114
- Murria, Cesc; Bonada, Nuria; Prat, Narcis, 2008. Effects of the invasive species *Potamopyrgus antipodarum* (Hydrobiidae, Mollusca) on community structure in a small Mediterranean stream. *Fundamental & Applied Limnology*. 171(2). 2008. 131-143
- Polischuk V V, Travnyanko V S and Stavinskaya A M, 1976. Aquatic fauna of Pripyat Poles e and its peculiarities. In: Abstracts of the 4th zoological conference of Belarusian SSR ♦Biological background of the exploitation, restoration, and conservation of Belarusian animal world . Minsk, pp 27-28 [in Russian]
- Ponder, W. F., 1988. *Potamopyrgus antipodarum* ♦A Molluscan coloniser of Europe and Australia. *J. Moll. Stud.* (1988), 54, 271-285
- Richards, David C.; Cazier, L. Dianne; Lester, Gary T., 2001. Spatial distribution of three snail species, including the invader *Potamopyrgus antipodarum*, in a freshwater spring. *Western North American Naturalist*. 61(3). July, 2001. 375-380
- Richards, David C.; Cazier Shinn, Dianne, 2004. Intraspecific competition and development of size structure in the invasive snail *Potamopyrgus antipodarum* (Gray, 1853) *American Malacological Bulletin*. 19(1-2). OCT 14 2004. 33-37.
- [Richards, D., B. Kerans, and D. Gustafson. 2002. \*New Zealand Mudsnail in the Western USA\*. Montana State University: Department of Ecology.](#)
- Summary:** Information on identification, and life history, and habitat of species.  
Available at: <http://www.esg.montana.edu/aim/mollusca/nzms/> [Accessed 11 October 2003].
- Riley, Leslie A.; Dybdahl, Mark F.; Hall, Robert O. Jr., 2008. Invasive species impact: asymmetric interactions between invasive and endemic freshwater snails. *Journal of the North American Benthological Society*. 27(3). SEP 2008. 509-520.
- Schreiber, E. S. G.; Glaister, A.; Quinn, G. P.; Lake, P. S., 1998. Life history and population dynamics of the exotic snail *Potamopyrgus antipodarum* (Prosobranchia: Hydrobiidae) in Lake Purrumbete, Victoria, Australia. *Marine & Freshwater Research*. 49(1). 1998. 73-78.
- Schreiber, E. S. G.; Lake, P. S.; Quinn, G. P., 2002. Facilitation of native stream fauna by an invading species? Experimental investigations of the interaction of the snail, *Potamopyrgus antipodarum* (Hydrobiidae) with native benthic fauna. *Biological Invasions*. 4(3). 2002. 317-325.
- Schreiber, E. S. G.; Quinn, G. P.; Lake, P. S., 2003. Distribution of an alien aquatic snail in relation to flow variability, human activities and water quality. *Freshwater Biology*. 48(6). June 2003. 951-961.
- Shimada, Kumiko; Urabe, Misako, 2003. Comparative ecology of the alien freshwater snail *Potamopyrgus antipodarum* and the indigenous snail *Semisulcospira* spp. *Venus (Tokyo)*. 62(1-2). June 2003. 39-53.
- Soler, J.; Moreno, D.; Araujo, R.; Ramos, M. A., 2006. Diversity and distribution of freshwater molluscs of Comunidad de Madrid (Spain) *Graellsia*. 62(Sp. Iss. SI). 2006. 201-252.
- Son, O. Mikhail, 2008. Rapid expansion of the New Zealand mud snail *Potamopyrgus antipodarum* (Gray, 1843) in the Azov-Black Sea Region. *Aquatic Invasions* (2008) Volume 3, Issue 3: 335-340
- Staedler, T.; Frye, M.; Neiman, M.; Lively, C. M., 2005. Mitochondrial haplotypes and the New Zealand origin of clonal European *Potamopyrgus*, an invasive aquatic snail. *Molecular Ecology*. 14(8). JUL 05. 2465-2473.
- Strayer, David L., 1999. Effects of alien species on freshwater mollusks in North America. *Journal of the North American Benthological Society*. 18(1). March, 1999. 74-98.
- Strzelec, Malgorzata, 2000. Effect of artificially elevated water temperature on growth and fecundity of *Potamopyrgus antipodarum* (Gray) in anthropogenic water bodies in Southern Poland (Gastropoda: Prosobranchia: Hydrobiidae) *Malakologische Abhandlungen (Dresden)*. 19(2). 15 Dezember, 2000. 265-272.
- Strzelec, Malgorzata, 2005. Impact of the introduced *Potamopyrgus antipodarum* (Gastropoda) on the snail fauna in post-industrial ponds in Poland. *Biologia (Bratislava)*. 60(2). MAR 05. 159-163.
- Strzelec, Malgorzata; Aneta Spyra, and Mariola Krodkiewska, 2006. Freshwater snails of the sand-pits in Upper Silesian Industrial Area (Poland). *Teka Kom. Ochr. Kszt. Srod. Przyr.*, 2006, 3, 187-194
- Thomsen, Mads S.; Wernberg, Thomas; Silliman, Brian R.; Josefson, Alf B., Broad-scale patterns of abundance of non-indigenous soft-bottom invertebrates in Denmark. *Helgoland Marine Research*. 63(2). JUN 2009. 159-167
- Urabe, Misako, 2007. The present distribution and issues regarding the control of the exotic snail *Potamopyrgus antipodarum* in Japan. *Japanese Journal of Limnology*. 68(3). DEC 2007. 491-496

USGS-FISC (United States Geological Survey, Florida Integrated Science Center). Undated. *New Zealand Mudsnail: Potamopyrgus antipodarum*. Gainesville, Florida. Available at:

[http://www.fcsc.usgs.gov/Nonindigenous\\_Species/New\\_Zealand\\_Mudsnail/new\\_zealand\\_mudsnail.html](http://www.fcsc.usgs.gov/Nonindigenous_Species/New_Zealand_Mudsnail/new_zealand_mudsnail.html) [Accessed 11 October 2003]

**Summary:** Information on distribution, general impacts.

Vinson, Mark R.; Baker, Michelle A., 2008. Poor growth of rainbow trout fed New Zealand mud snails *Potamopyrgus antipodarum*. North American Journal of Fisheries Management. 28(3). JUN 2008. 701-709.

Vinson, Mark; Tarita Harju and Eric Dinger, 2007. Status of New Zealand Mud Snails (*Potamopyrgus antipodarum*) in the Green River downstream from Flaming Gorge Dam: Current Distribution; Habitat Preference and Invertebrate Changes; Food Web and Fish Effects; and Predicted Distributions. Final Report for Project Agreements: USFWS ♦ 601815G405 NPS ♦ J1242050058 BLM ♦ JSA041003

Weetman, David; Hauser, Lorenz; Carvalho, Gary R., 2006. Heterogeneous evolution of microsatellites revealed by reconstruction of recent mutation history in an invasive apomictic snail, *Potamopyrgus antipodarum*. Genetica (Dordrecht). 127(1-3). MAY 2006. 285-293.

Yasuhiro, Takemon, 2007. Present status of exotic freshwater benthic macro-invertebrates and challenges for their control in Japan. Japanese Journal of Limnology. 68(3). DEC 2007. 445-447

Zaranko, Danuta T.; Farara, Dennis G.; Thompson, Fred G., 1997. Another exotic mollusc in the Laurentian Great Lakes: The New Zealand Native *Potamopyrgus antipodarum* (Gray 1843) (Gastropoda, Hydrobiidae). Canadian Journal of Fisheries & Aquatic Sciences. 54(4). 1997. 809-814

Zbikowski, Janusz; Zbikowska, Elzbieta, 2009. Invaders of an invader - Trematodes in *Potamopyrgus antipodarum* in Poland. Journal of Invertebrate Pathology. 101(1). APR 2009. 67-70.

Zettler, Michael L.; Richard, Doreen, 2004. Freshwater molluscs from Corsica. Notated collections from summer 2003 with emphasis on *Theodoxus fluviatilis*. Malakologische Abhandlungen (Dresden). 22 2004. 3-16.