**Potamopyrgus antipodarum**

System: Freshwater

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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 establish 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.

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, 2003; 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/m² have been recorded (Ponder 1988; Schriever et al., 1998). In the United States densities of 200,000, 500,000 and even 800,000 snails/m² have been recorded in several locations (Davidson et al., 2008; Dorgelo, 1987 in Brown et al., 2008; Crosier et al., undated; Hall et al., 2003; Levi 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 NH4 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⁻² yr⁻¹), 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 C02 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 hydribid snail *Taylorconcha serpenticola* (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 (Lyssne & 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 *Pyriulopsis 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 hydriboid snails in Tasmania (Poner, 1988).

*P. antipodarum* directly affects fish by being a poor and mostly undigestible food source. Although rainbow trout (*Oncorhynchus 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 undisgested (NZMS Working Group, 2006). Not only does *P. antipodarum* replace energetic food sources, but it is believed to inflect 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 found 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).

Educatung 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. Benzenthionium 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, benzenthionium 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 to 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 existing 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 NZWS 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 be isolated from drainages or chemical treatment for chemical treatment. Chemical methods used to eradicate P. antipodarum include: Bayer 73 copper sulfate, and 4-nitro-3-trifluoromethylphenylen 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 effectivenes 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 (Dybdaahl et al. 2005 in NZMS Working Group, 2006; Embedge 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 (Dybdaahl & Lively, 1998 in NZMS Working Group, 2006; Dybdahl & Lively, 1998 in NZMS Working Group, 2006).
FULL ACCOUNT FOR: *Potamopyrgus antipodarum*

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


Frances E. Lucy and Thaddeus K. Graczyk (Guest Editors)

Crosier, Danielle M.; Daniel P. Molloy; David C. Richards, undated. New Zealand Mudsnail - *Potamopyrgus antipodarum*. [Compiler: National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG)]

**Review:** Dr Sabine Schreiber, Arthur Rylah Institute for Environmental Research Department of Sustainability and Environment. Australia

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**ALIEN RANGE**


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

- *Alzoniella delmastroi* EN
- *Pseudamnicola gasulli* VU
- *Dianella thiesseana* CR
- *Salenthydrobia ferreri* EN

**BIBLIOGRAPHY**

81 references found for *Potamopyrgus antipodarum*

Management information
**Global Invasive Species Database**

**FULL ACCOUNT FOR: Potamopyrgus antipodarum**

**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 Belarussian 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/.


**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 Villuzzi, 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 guidance document is available from http://www.cefas.co.uk/media/118009/fisk_guide_v2.pdf [Accessed 13 January 2009].


Gerard, Claudia; Poullain, Virginie, 2006. 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


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


General information
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


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 - Moluscos is available from:


Spanish:

La lista de especies del Sistema de informaci?n sobre especies invasoras en M?xico cuenta actualmente con informaci?n acerca de nombre cient?fico, familia, grupo y nombre com?n, as? como h?bitat, estado de la invasi?n en M?xico, rutas de introducci?n y ligas a otros sitios especializados. Algunas de las especies de mayor riesgo ya tienen una liga directa a la p?gina de alertas. Es importante resaltar que estas listas se encuentran en constante proceso de actualizaci?n, por favor consulte la portada (http://www.conabio.gob.mx/invasoras/index.php/Portada), en la secci?n novedades, para conocer los cambios.

Especies invasoras - Moluscos is available from:


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

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


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:


**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. 2008. Comparison of desert valvata snail growth at three densities of the invasive New Zealand mudsnail. Western American Naturalist. 88(1). MAR 2008. 103-106


**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].


FULL ACCOUNT FOR: *Potamopyrgus antipodarum*

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


