GLOBAL INVASIVE SPECIES DATABASE

FULL ACCOUNT FOR: ***Dreissena bugensis***

Dreissena bugensis 正體中文

System: Freshwater

Kingdom	Phylum	Class	Order	Family
Animalia	Mollusca	Bivalvia	Veneroida	Dreissenidae

Common name quagga mussel (English)

Synonym

Similar species *Dreissena polymorpha, Corbicula fluminea, Dreissena rostriformis*

Summary *Dreissena bugensis is native to parts of Ukraine. This small freshwater mussel is an active filter feeder, which competes for food resources with filter-feeding zooplankton by accelerating sedimentation of suspended matter, including organic substances. It is also a nuisance and economic problem when it grows on recreational or commercial ships/boats, potable water treatment plants and electric power stations.*

[view this species on IUCN Red List]

Species Description

Dreissena bugensis commonly has alternating light and dark brown stripes, but can also be solid light brown or dark brown. It has two smooth shells that are shaped like the letter “D”. These mussels are usually less than 2 inches in length. In new populations, most mussels are young and therefore very small (under ¼ -inch long) (California Department of Fish and Game 2008).\r\n There are two phenotypes of *D. bugensis* that have been reported in the Great Lakes: the \"epilimnetic\" form, which has a high flat shell, and the \"profunda\" form, which has an elongate modioliform shell and has invaded soft sediments in the hypolimnion. The epilimnetic form uses its byssal threads to attach to objects and particles and form druses or colonies. The profunda morph can form colonies and attach to objects with its byssal threads or it can partially bury itself in soft sediments and extend its very long incurrent siphon above itself to bring in suspended food particles (Vanderploeg *et al*. 2002).

Notes

In both North America and its original range in Europe, *D. bugensis* is replacing zebra mussel (*D. polymorpha*) populations (Domske & Oneill 2003; Diggins *et al*. 2004). Some industries build intake structures at depths too low for *D. polymorpha* to grow in; however, *D. bugensis* is able to colonise surfaces at greater depths, rendering these new structures vulnerable to mussel colonisation (Mills et al., 1999; and Richerson and Maynard, 2004).

Lifecycle Stages
After fertilisation veligers (pelagic microscopic larvae) develop within a few days and soon acquire minute bivalve shells. Free-swimming veligers drift with the currents for three to four weeks, feeding using their hair-like cilia while trying to locate suitable substrata to settle and secure byssal threads. Mortality in this transitional stage from planktonic veliger to settled juveniles may exceed 99% (Stanczykowska 1977, in Bially & MacIsaac 2000). Macrophytes, mussel colonies and pebbles were found to be more suitable substrates for settling than gravel, sand or mud (Lewandowski 1982, in Bially & MacIsaac 2000

Uses
Because they are long-lived and sessile, quagga mussels can be used as bioindicators of hazardous substances such as radionuclides (Lubianov 1972, in Orlova 2009).

Habitat Description
Adult *D. bugensis* attach to natural hard substrata including rocks, wood, and macrophytic plants and to man-made materials including concrete, metal piping, steel, nylon, fiberglass and wood. Mussels attach to substrates via proteinaceous byssal threads produced from a gland posterior to the foot. *D. bugensis* typically occur in fresh water but thrive in salinities up to 1‰ and can reproduce in salinities below 3‰. Salinities exceeding 6‰ cause mortality (Ussery & McMahon 1995; Wright *et al*. 1996).

Reproduction
D. bugensis is a prolific breeder. It is dioecious and exhibits external fertilisation. A fully mature female mussel is capable of producing up to one million eggs per season (Richerson 2002; D'Itri 1996).

Nutrition
D. bugensis are filter feeders which use cilia to pull water into their shell cavity from where it passes through an incurrent siphon. Desirable particulate matter is removed in the siphon. Each adult mussel is capable of filtering one or more liters of water each day, removing phytoplankton, zooplankton, algae and even their own veligers (larvae) (Snyder *et al*. 1997). Any undesirable particulate matter is bound with mucus, known as pseudofeces, and ejected out the incurrent siphon. The particle-free water is then discharged out the excurrent siphon (Richerson 2002, D'Itri 1996, Nalepa & Schloesser 1993).

General Impacts
Nutrient loading and species introductions are thought to be two of the major environmental problems currently facing freshwater ecosystems (Richter *et al*. 1997, Hall *et al*. 2003 in Haynes *et al*. 2005), and both of these anthropogenic factors are of concern in the Great Lakes, USA (Haynes *et al*. 2005).\r\n
Reduction in Native Biodiversity:\r\n*D. bugensis* causes changes in the structural characteristics of zooplankton including total abundance, biomass and species composition. Specifically, there is an inverse relationship between zooplankton abundance/biomass and density of *Dreissena* mussels (Grigorovich & Shevtsova, 1995). *Dreissena* infestations have caused upwards of 95% reduction in unionid numbers and extirpated eight species of unionids in some areas of the Great Lakes (Schloesser *et al*. 1998; Schloesser & Masteller 1999). Individuals attach themselves to the shells of other mussels, forming encrusting mats many shells thick (10-30mm). \r\n
Modification of Natural Benthic Communities: *Dreissena* negatively affects benthic invertebrate communities, especially filter-feeding or deep-dwelling invertebrates that rely on detrital rain (Dermott and Munawar 1993, Strayer *et al*. 1998, Johannsson *et al*. 2000, in Haynes *et al*. 2005). Predicting benthic invertebrate community response to a change in nutrient levels is very difficult, and the potential synergistic effects of nutrient alterations and exotics such as *Dreissena* are complex (Haynes *et al*. 2005).\r\n
Economic: Thick encrustations of mussels form on man-made structures or within raw water systems, impacting on operation and efficiency. *D. bugensis* can have major detrimental impacts on recreational and commercial shipping/boating as well as on water-using industries, potable water treatment plants and electric power stations (Ussery & McMahon, 1995).

Management Info
Compared to the zebra mussel (*Dreissena polymorpha*) there has been little research carried out on the biology, ecological requirements and tolerances of quagga mussels (*Dreissena bugensis* (Mackie & Claudi, 2009). Indeed most research on the control of mussels has focused on *D. polymorpha* (McEnnulty *et al*., 2001). However it is thought that most of the control methods would also apply to quagga mussels (G.L. Mackie, pers. comm.; Virginia Department of Game and Inland Fisheries, 2005). \r\n\r\n
Prevention: Studies suggest that humans are responsible for most introductions of zebra and quagga mussels into new areas. The best way to prevent and manage dreissenid invasions in open waters is thought to be prevention through public outreach and education. Examples of this include public signage and wash stations at boat launches and other potential introduction points (Frischer *et al*. 2005).\r\n\r\n
Detection: One of the most important criterions for successful eradication of a species is early detection allowing control measures to take place while the incursion is still relatively small. Detection relies on monitoring and education. In Lake George, NY zebra mussels were detected in 1999 while the population was relatively small. Control efforts between 1999 and 2007, mainly using physical means and SCUBA, were successful in eradicating zebra mussels from the lake (Wimbush *et al*. 2009).\r\n\r\n
Chemical Control:\r\nChemical control is one of the most common methods for control or eradication. Chlorination is often used; *D. bugensis* is more sensitive to chlorination than *D. polymorpha*. Thus chlorination programs currently in use to combat *D. polymorpha* are more than sufficient to simultaneously control *D. bugensis*. Another alternative has been potassium permanganate, especially for drinking water sources, even though chemical controls are not environmentally sound solutions. *D. polymorpha* was recently eradicated from Millbrook Quarry, Virginia using 174,000 gallons of potassium chloride solution over a 3 week period in 2006 (Virginia Department of Game and Inland Fisheries, 2005). Other chemical control options include chlorine dioxide, sodium hypochloride, ozone, mollusicides and polymers (D'Itri, 1996).\r\n\r\n
Physical:\r\nDecreasing water levels of water bodies to cause desiccation of *D. bugensis* is an effective, readily applied and environmentally neutral technique. It would be most effective in raw water systems such as navigation locks and water intake structures, which are designed to be periodically dewatered for maintenance. This is a particularly attractive method of control because it could be utilized to mitigate fouling not just by *D. bugensis* but also mixed populations of this species and D. polymorpha (Brady *et al*., 1996; Ussery & McMahon, 1995). Other physical methods include manual scraping, high-pressure jetting, antifouling coatings and mechanical filtration.\r\n\r\n\r\n
Biological Control: Research is currently underway to test the effectiveness of the CL145A strain of the bacteria *Pseudomonas fluorescens* which produces a toxin that destroys the digestive system of *Dreissena* spp. (Molloy & Mayer 2007).\r\n\r\n
Other: A variety of other control methods in use or being developed are oxygen \r\ndeprivation, thermal treatment, radiation, molluscicides, ozone, antifouling coatings, electric currents, and sonic vibration (D'Itri, 1996; Mackie & Claudi, 2009). Fears and Mackie (1995) investigated the use of low-voltage currents for preventing settlement and attachment by *D. bugensis* by using steel rods and plates with the current running through them placed near the intake of a pulp and paper plant. Complete prevention of settlement was achieved at 8 volts/in with steel rods on both wood and concrete surfaces (Fears & Mackie, 1995).

Pathway
A study conducted by Ricciardi and colleagues (1995) revealed that under temperate summer conditions adult *D. bugensis* may survive on overland transport (e.g. small trailer-boats) for up to 5 days. Veligers can be transported in fish and bait wells as well as in cooling ports of inboard and outboard motors. Most or all the introductions of quagga mussels beyond the 100th Meridian in North America are purported to be via trailered boats (Mackie & Claudi 2009).Its release into Great Lakes waters is linked to discharge of ship ballast water (Mills *et al.*, 1999).

Principal source: Ussery and McMahon, 1995 Comparative study of the desiccation resistance of zebra mussels (*Dreissena pdyzmvpha*) and quagga mussels (*Dreissena bugensis*)
Richerson, 2002. \r\nDREISSENA Species FAQs, A closer look

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ALIEN RANGE

[1] ATLANTIC - NORTHEAST
[1] CASPIAN SEA
[1] GREAT LAKES
[1] LAKE HURON
[1] LAKE ONTARIO
[1] LAKE SUPERIOR
[1] NETHERLANDS
[2] RUSSIAN FEDERATION
[5] UKRAINE
[3] CANADA
[1] GERMANY
[1] LAKE ERIE
[1] LAKE MICHIGAN
[1] LAKE ST. CLAIR
[1] MEDITERRANEAN & BLACK SEA
[2] ROMANIA
[1] ST. LAWRENCE RIVER
[19] UNITED STATES

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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).
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Invasive species - Molluscs is available from:
http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Moluscos[Accessed 30 July 2008]
Spanish:
La lista de especies del Sistema de informaci?n sobre especies invasoras de m?xico cuenta actualmente con informaci?n aceca 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.
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