Bugula neritina **System:** Marine

Kingdom	Phylum	Class	Order	Family
Animalia	Ectoprocta	Gymnolaemata	Cheilostomata	Bugulidae

Common name bryozoan (English), common bugula (English), brown bryozoan (English)

Synonym *Sertularia neritina*
Anamarchis neritina

Similar species *Bugula turrita, Bugula stolonifera, Bugula spp.*

Summary Bugula neritina (brown bryozoan) is an erect, bushy bryozoan. It is an abundant fouling organism that colonises any freely available substratum, including artificial underwater structures and vessel hulls.

view this species on IUCN Red List

Species Description
Bugula neritina forms flexible bushy colonies, branching biserial, to about 10cm high and is purplish-brown in colour. Zooids white and globular, with the outer corner pointed (Bishop Museum 2002, in Gordon and Mawatari, 1992). Zooids are large and measure an average of 0.97 X 0.28mm. *B. neritina* differs from other species in this genus in that it possesses no avicularia and no spines. The lophophore measures an average of 0.764mm in diameter and bears 23 tentacles (SMSFP 2001). Embryos brooded in ovicells are dark brown in colour and measure approximately 0.25mm in diameter (SMSFP 2001 in Winston 1982).

Notes
Nudibranchs have been recorded as consumers of *Bugula neritina* (NIMPIS 2002). Southern California studies have shown a high mortality rate for bryozoans during red tides (algal blooms). Bryozoans are preyed upon by grazing organisms such as sea urchins and fish. They are also subject to competition and overgrowth from sponges, algae, and tunicates (PWSRCAC 2004).
Bryozoans provide habitat for many species of juvenile fish and their invertebrate prey such as polychaete worms, amphipods and copepods (SMSFP 2001 in Winston 1995). Bryozoans are also found in association with other species that act as support structures: mangrove roots, oyster beds, mussels, *etc.* (SMSFP 2001).
The feeding activities of bryozoans and other filter feeding animals strain out excess food and debris particles to help keep the water clean (VMNH 2005). Bryozoan colonies located in 1m2 of seagrass bed could potentially filter and recirculate an average of 48,000 gallons of seawater per day (SMSFP 2001 in Winston 1995).

Lifecycle Stages
Bryozoans have swimming, lecithotrophic larvae that attach and metamorphose within 1 or 2 days following release from the colony. Larvae are initially photopositive but soon become photonegative/Geopositive, settling usually within a few hours of release (Lynch, 1947). Larvae may have gregarious settlement (Keough, 1984). *Bugula* larvae generally settle throughout the year except during midwinter (Sutherland and Karlson 1977). Field studies in Australia and North America show considerable variation in life history in *B. neritina* from different habitats, apparently due to genetic or early environmental effects (Keough, 1989; NEMESIS 2006). *B. neritina*'s life history may include an annual period of dormancy, in which colonies recede to a regenerative holdfast (Dyrynda and Ryland 1982). This senescence occurs at differing times of year and appears dependent upon water temperature, with populations in cool-temperate areas receding during winter and populations in warm areas receding over summer months (Keough and Chernoff, 1987).

Uses
Bugula neritina colonies are the source of a novel chemical compound (bryostatin) which has been shown to be effective against leukaemia and a number of other kinds of cancer. A newly described species of bacterium, which is symbiotic to *B. neritina* cryptic species 'type D', appears to be the source of bryostatins (Davidson and Haygood, 1999; Davidson *et al*. 2001).

Habitat Description
Bugula neritina colonies are typically found in harbours and embayments, intertidal to 5m, attached to any available hard substrate (Bishop Museum 2002). Larvae colonise a variety of artificial substrata including hulls (Mackie *et al.* 2006). Studies have shown *B. neritina* larvae prefer to attach to rougher surfaces and prefer to attach to organic material. For example, in nature they frequently affix themselves to algae and to established bryozoan colonies (Lynch 1947). *B. neritina* is found in euhaline and polyhaline regions (water salinity around 30-18‰) (Winston 1977).
In North America *B. neritina* occurs on rocky reefs and seagrass leaves (Hayes *et al.* 2005).

Reproduction
Each bryozoan colony begins from a single, sexually produced, primary zooid. This zooid undergoes asexual budding to produce a group of daughter cells, which themselves form buds, and so on. Most bryozoans are hermaphroditic, each zooid capable of producing sperm and eggs. Sperm is released into the coelom and the fertilised eggs are retained and brooded for a time before being released (Bishop Museum 2002).

Nutrition
The bryozoan is a suspension feeder. It has a retractable U-shaped crown of tentacles (lophophore) which bear cilia that create a current, bringing microscopic plankton and organic particles toward the animal. Particles are then guided into the mouth by action of the tentacles and cilia (Bishop Museum 2002).

General Impacts
Bryozoans are one of the main organisms to encrust and foul ships, piers, buoys and other man-made marine surfaces and structures (VMNH 2005). *B. neritina* populations may tolerate high levels of pollution (including copper) which increases its potential to be a fouling pest. A tolerance to toxicants could provide a competitive advantage in polluted areas (Piola and Johnston 2006). Verification of the chemical tolerances of invasive and non-invasive lineages of *B. neritina*, and other fouling organisms in general, is needed to test this hypothesis (Josh Mackie., pers.comm., 2007).

Management Info
Preventative measures: A two year study was undertaken for the Department of Environment and Heritage (Australia) by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to identify and rank introduced marine species found within Australian waters, and those not found within Australian waters. All of the non-native potential target species identified in this report are ranked as high, medium and low priority, based on their invasion potential and impact potential. *Bugula neritina* is identified as one of ten potential domestic target species most likely to be spread to uninfected bioregions by shipping. *B. neritina* is also identified as one of ten most damaging potential domestic target species, based on overall impact potential (economic and environmental). A hazard ranking of potential domestic target species based on invasion potential from infected to uninfected bioregions identifies *B. neritina* as a 'medium priority species' - these species have a reasonably high impact/or invasion potential.
For more details, please see Hayes *et al.* 2005.
The rankings determined in Hayes *et al.* 2005 will be used by the National Introduced Marine Pest Coordinating Group in Australia to assist in the development of national control plans which could include options for control, eradication and/or long term management.
It has been suggested that ballast water control measures be implemented to control the spread of *B. nertina via* the oyster aquaculture industry (PWSRCAC 2004).
Chemical: Copper-based treatments have been used to control many pest species. The attachment of *B. neritina* larvae to copper, mercury and control paint was investigated by Wisely (1962) who found that the numbers attaching to the control paint strips was seven times greater than the numbers attaching to copper, and twenty times greater than the numbers attaching to mercury (NIMPIS 2001). Introduction of *B. neritina* by\r\ncopper-painted vessels may be aided by a potential tolerance to toxicants (Piola and Johnston 2006).

Pathway
Bugula neritina attaches to oyster shells and be transferred along with oyster shippings (Cohen 2005).*Bugula neritina* can be transported *via* tiny colonies attached to the sides of ballast tanks or on floating material inside the ballast tanks (Cohen 2005).Ship/boat hull fouling is a common means of movement of *Bugula neritina* colonies and a likely source of ongoing introductions.

Principal source: Bishop Museum 2002. *Bugula neritina* (Linnaeus, 1758). Guidebook of introduced marine species of Hawaii.
SMSFP 2001. *Bugula neritina* (Linnaeus, 1758). Smithsonian Marine Station at Fort Pierce.

Compiler: IUCN/SSC Invasive Species Specialist Group (ISSG) with support from La Fondation d'entreprise Total

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ALIEN RANGE

[1] ARGENTINA
[7] AUSTRALIA
[1] BERMUDA
[1] CHILE
[1] ECUADOR
[1] FRANCE
[2] INDIA
[3] ITALY
[1] KOREA, DEMOCRATIC PEOPLE'S REPUBLIC OF
[1] LIBYAN ARAB JAMAHIRIYA
[1] ATLANTIC - WESTERN CENTRAL
[1] BELGIUM
[1] BRAZIL
[1] CHINA
[1] EGYPT
[1] GERMANY
[1] ISRAEL
[3] JAPAN
[1] KOREA, REPUBLIC OF
[1] MEDITERRANEAN & BLACK SEA

[1] MEXICO
[2] NEW ZEALAND
[1] PHILIPPINES
[1] SPAIN
[1] UNITED KINGDOM
[1] NETHERLANDS
[1] PANAMA
[1] PUERTO RICO
[1] TURKEY
[24] UNITED STATES

BIBLIOGRAPHY

32 references found for **Bugula neritina**

Managment information

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 [Accessed 13 January 2009].

Hayes, K., Sliwa, C., Migus, S., McEnnulty, F., Dunstan, P. 2005. National priority pests: Part II Ranking of Australian marine pests. An independent report undertaken for the Department of Environment and Heritage by CSIRO Marine Research.

Summary: This report is the final report of a two year study designed to identify and rank introduced marine species found within Australian waters (potential domestic target species) and those that are not found within Australian waters (potential international target species).
Available from: http://www.marine.csiro.au/crimp/reports/PrioritypestsFinalreport.pdf [Accessed 25 May 2005]

Keough, M. J. and Ross, J. 1999. Introduced fouling species in Port Phillip Bay. In Marine Biological Invasions of Port Phillip Bay Victoria: 9-11. L., H. C., Campbell, M. L., Thresher, R. E. and Martin, R. B. (Eds.). Hobart: CSIRO Marine Research.

Mackie, J. A., Keough, M. J. and Christidis, L. 2006. Invasion patterns inferred from cytochrome oxidase I sequences in three bryozoans, *Bugula neritina*, *Watersipora subtorquata*, and *Watersipora arcuata*. Marine Biology 149: 285-295.

McEnnulty, F.R., Jones, T.E. and Bax, N.J. 2001. *The Web-Based Rapid Response Toolbox*. Retrieved 7 December 2006, from NIMPIS database.

Summary: NIMPIS is a database of information on introduced and potentially invasive marine species for Australia.
Available from: http://crimp.marine.csiro.au/NIMPIS/controls.htm [Accessed 7 December 2006]

General information

Bishop Museum. 2002. *Bugula neritina* (Waters, 1878), *Guidebook of introduced marine species of Hawaii*. Hawaii Biological Survey, Bishop Museum.

Cohen, A.N. 2005. *Guide to the Exotic Species of San Francisco Bay*. San Francisco Estuary Institute: Oakland, USA.

Summary: This source provides biological, introduction and distributional information of *B. neritina*.
Available from: http://www.exoticsguide.org/species_pages/b_neritina.html [Accessed 27 December 2006]

CONABIO. 2008. Sistema de informaci&#65533;n sobre especies invasoras en M&#65533;xico. Especies invasoras - Otros invertebrados. Comisi&#65533;n 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 - Aquatic invertebrates is available from:
http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Otros_invertebrados [Accessed 30 July 2008]
Spanish:
La lista de especies del Sistema de informaci&#65533;n sobre especies invasoras de m&#65533;xico cuenta actualmente con informaci&#65533;n aceca de nombre cient&#65533;fico, familia, grupo y nombre com&#65533;n, as&#65533; como h&#65533;bitat, estado de la invasi&#65533;n en M&#65533;xico, rutas de introducci&#65533;n y ligas a otros sitios especializados. Algunas de las especies de mayor riesgo ya tienen una liga directa a la p&#65533;gina de alertas. Es importante resaltar que estas listas se encuentran en constante proceso de actualizaci&#65533;n, por favor consulte la portada (http://www.conabio.gob.mx/invasoras/index.php/Portada), en la secci&#65533;n novedades, para conocer los cambios.
Especies invasoras - Otros invertebrados is available from:
http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Otros_invertebrados [Accessed 30 July 2008]

Davidson, S. K., Allen, S. W., Lim, G. E., Anderson, C. M. and Haygood, M. G. 2001. Evidence for the biosynthesis of bryostatins by the bacterial symbiont *Candidatus Endobugula sertula* of the bryozoan *Bugula neritina*. Applied Environmental Microbiology 67(10): 4531-4537.

Davidson, S. K. and Haygood, M. G. 1999. Identification of sibling species of the bryozoan *Bugula neritina* that produce different anticancer bryostatins and harbour distinct strains of the bacterial symbiont *Candidatus Endobugula sertula* . Biological Bulletin 196: 273-280.
Ghobashy, A.F.A. and El Komy, M.M. 1980. Fouling in the southern region of the Suez Canal, *Aquatic Ecology 14*(3): 179-185.
Summary: This paper investigates fouling organisms and ecological conditions in the Suez Canal.
Hill, K., 2001. *Bugula neritina*. Smithsonian Marine Station at Fort Pierce.
Summary: A species inventory of east central Florida s Indian River Lagoon (IRL) system including taxonomic, ecological and life history information.
Available from: http://www.sms.si.edu/IRLSpec/Bugula_neriti.htm [Accessed 27 December 2006]
ITIS (Integrated Taxonomic Information System), 2005. Online Database *Bugula neritina*
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.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=156056 [Accessed 4 December 2006]
Keough, M. J. and Chernoff, H. 1987. Dispersal and population variation in the bryozoan *Bugula neritina* Ecology 68(1): 199-210.
Lynch, W. F. 1947. The behavior and metamorphosis of the larva of *Bugula neritina* (Linnaeus): experimental modification of the length of the free-swimming period and the responses of the larvae to light and gravity. Biological Bulletin 92: 115-150.
Lynch, W.L. 1947. The behavior and metamorphosis of the larva of *Bugula neritina* (Linnaeus): experimental modification of the length of the free-swimming period and the responses of the larvae to light and gravity, *Biological Bulletin 92*: 115-150
Summary: The distribution, external morphology, swimming movements and metamorphosis of the larvae of *B. neritina* are discussed in this paper.
Available from: http://www.biolbull.org/cgi/reprint/92/2/115 [Accessed 27 December 2006]
Mackie, J.A., Keough, M.J. and Christidis, L. 2006. Invasion patterns inferred from cytochrome oxidase I sequences in three bryozoans, *Bugula neritina*, *Watersipora subtorquata*, and *Watersipora arcuata*, *Marine Biology 149*: 285–295
Summary: This paper studies population structure in invasive bryozoans using genetic analysis. There is evidence of widespread, rather than genetically independent introductions of bryozoans.
McGovern, T. and Hellberg, M. E. 2003. Cryptic species, cryptic endosymbionts, and geographic variation in chemical defenses in the bryozoan *Bugula neritina*. Molecular Ecology 12: 1207-1215.
National Introduced Marine Pest Information System (NIMPIS), 2002. *Bugula neritina species summary*. In: Hewitt, C.L., Martin, R.B., Sliwa, C., McEnnulty, F.R., Murphy, N.E., Jones, T. and Cooper, S. (eds). NIMPIS. Retrieved 7 December 2006, from NIMPIS database.
Summary: NIMPIS is a database of information on introduced and potentially invasive marine species for Australia. The species summary page for *B. neritina* outlines the ecology, biology of this fouling bryozoan.
Available from: http://www.marine.csiro.au/crimp/nimpis/spSummary.asp?txa=6929 [Accessed 14 February]
NEMESIS (National Exotic Marine and Estuarine Species Information System). 2004. *Bugula neritina - Ecology*. The Smithsonian Environmental Research Center. Retrieved 7 December 2006, from Chesapeake Bay Introduced Species Database.
Summary: NEMESIS is a resource for information on non-native marine species that occur in the coastal waters of the United States. This page outlines some biological and ecological information for *B. neritina*.
Available from: http://invasions.si.edu/nemesis/CH-ECO.jsp?Species_name=Bugula+neritina [Accessed 7 December 2006]
NEMESIS (National Exotic Marine and Estuarine Species Information System). 2005. *Bugula neritina -Invasion History*. The Smithsonian Environmental Research Center. Retrieved 7 December 2006, from Chesapeake Bay Introduced Species Database.
Summary: NEMESIS is a resource for information on non-native marine species that occur in the coastal waters of the United States. This page gives a history of spread and invasion comments for *B. neritina*.
Available from: http://invasions.si.edu/nemesis/CH-INV.jsp?Species_name=Bugula+neritina [Accessed 7 December 2006]
NEMESIS (National Exotic Marine and Estuarine Species Information System). 2006. *Bugula neritina*. The Smithsonian Environmental Research Center. Retrieved 7 December 2006, from Chesapeake Bay Introduced Species Database
Summary: Available from: http://invasions.si.edu/nemesis/CH-TAX.jsp?Species_name=Bugula%20neritina [Accessed 12 March 2010]
NOBANIS (North European and Baltic Network on Invasive Alien Species) 2005. *Bugula neritina*. Retrieved 19 December 2006, from NOBANIS database.
Summary: The North European and Baltic Network on Invasive Alien Species (NOBANIS) has developed a network of common databases on alien and invasive species of the North European and Baltic Sea region. NOBANIS is a common portal for access to IAS-related data, information and knowledge. This page is a record of *B. neritina* in Germany.
Available from: http://www.nobanis.org/NationalInfo.asp?countryID=DE&taxaID=5818 [Accessed 19 December 2006]
Perkol-Finkel, S. and Benayahu, Y. 2004. *Recruitment of benthic organisms onto a planned artificial reef: shifts in community structure one decade post-deployment*. Article in press.
Summary: Available from: http://www.tau.ac.il/lifesci/departments/zoology/members/benayahu/documents/3aip.pdf [Accessed 19 December 2006]
Piola, R.F. and Johnston, E.L. 2006. Differential resistance to extended copper exposure in four introduced bryozoans, *Marine Ecology Progress Series 311*: 103-114.
Summary: This study compares the toxicity of copper to four cosmopolitan bryozoan species, *Bugula neritina*, *Watersipora subtorquata*, *Schizoporella errata* and *Tricellaria occidentalis*.
Available from: http://www.int-res.com/articles/meps2006/311/m311p103.pdf [Accessed 12 December 2006]
Prince William Sound Regional Citizens Advisory Council. 2004. *Non-indigenous Aquatic Species of Concern for Alaska. Fact Sheet 9. Single Horn Bryozoan.*
Summary: This source provides biology, distribution, impact and control information about the single horn bryozoan (*Schizoporella unicornis*).
Available from: http://www.pwsrcac.org/docs/d0015800.pdf [Accessed 19 December 2006]

Sutherland, J.P. and Karlson, R.H. 1977. Development and Stability of the Fouling Community at Beaufort, North Carolina, *Ecological Monographs 47*(4): 425-446.
Summary: This study looks at larval recruitment patterns of fouling species at Beaufort (North Carolina, USA).
USGS (United States Geological Survey). 2005. *Bugula neritina*.
Summary: Distributional records for *B. neritina* in the USA.
Available from:
http://nas.er.usgs.gov/queries/collectioninfo.asp?NoCache=12%2F5%2F2006+4%3A59%3A44+PM&SpeciesID=266&State=&HUCNumber=
[Accessed 6 December 2006]
Virginia Museum of Natural History (VMNH), 2005. More Bryozoan Information. VMNH Virginia, USA.
Summary: An overview of the biology and problems caused by bryozoans.
Walters, L.J. 1992. Field Settlement Locations on Subtidal Marine Hard Substrata: Is Active Larval Exploration Involved?, *Limnology and Oceanography 37*(5): 1101-1107.
Summary: The role of larval exploration of surfaces in determining spatial patterns of settlement was examined in the field in a low-energy environment by comparing locations where larvae first contacted complex surfaces to locations where larvae metamorphosed. Two species were studied: the barnacle *Balanus amphitrite* and the bryozoan *Bugula neritina*.
Available from: http://aslo.org/lo/toc/vol_37/issue_5/1101.pdf [Accessed 12 December 2006]
Winston, J.E. 1977. Distribution and Ecology of Estuarine Ectoprocts: A Critical Review, *Chesapeake Science18*(1): 34-57.
Summary: This article reviews the special ecological and physiological features of brackish-water ectoprocts (bryozoans) and their global distributions.
Wyatt, A.S.J., Hewitt, C.L., Walker, D.I. and Ward, T.J. 2005. Marine introductions in the Shark Bay World Heritage Property, Western Australia: a preliminary assessment, *Diversity and Distributions 11*(1): 33&#65533;44
Summary: This paper discusses the management of introduced marine species in the Shark Bay World Heritage Property (Australia).