GLOBAL INVASIVE SPECIES DATABASE

FULL ACCOUNT FOR: ***Gymnodinium catenatum***

Gymnodinium catenatum 简体中文 正體中文

System: Marine

Kingdom	Phylum	Class	Order	Family
Plantae	Pyrrophycophyta	Dinophyceae	Gymnodiniales	Gymnodiniaceae

Common name naked dinoflagellate (English), estuarine dinoflagellate (English), chain-forming dinoflagellate (English)

Synonym

Similar species *Gymnodinium microreticulatum, Gymnodinium nolleri, Gymnodinium uberrium, Diplopsalis spp.*

Summary Gymnodinium catenatum is a toxic, bloom forming species of microalgae. It is usually seen in long, swimming chains of tiny cells, with up to 32 cells in a chain (occasionally 64). It is also seen as solitary cells with a green-brown colour. The size of these cells ranges from 38 - 53 um long and 33 - 45 um wide. The cells are circular to squarish in shape, with many rounded organelles within them. Cysts of *G. catenatum* are brown, spherical and range in size from 45 - 50 um in diameter. *G. catenatum* is the only known unarmoured dinoflagellate that produces toxins responsible for PSP (Paralytic Shellfish Poisoning). This species is widely distributed, from the Mediterranean to the Caribbean, Indian Ocean and Australasian waters.

view this species on IUCN Red List

Species Description
For a detailed description of the vegetative cell, resting cyst, gametes and young planozygotes please see *species description*.

Notes
Once established, blooms are subject to disturbance by turbulence caused by high windstress. In winter months declining water temperatures (<10°C) and increasing windstress are responsible for the termination of seasonal dinoflagellate blooms (NIMPIS, 2002d). Shellfish, copepods, tintinnids and dinoflagellates have all been recorded as consumers of *G. catenatum* (NIMPIS, 2002a).

Lifecycle Stages
Soil extracts are essential for growth (NIMPIS, 2002d). One division every 3-4 days is the optimal growth rate (NIMPIS, 2002d).

Habitat Description
A nektonic species (capable of independently moving about the water column and currents) *G. catenatum* is found in bays and estuaries throughout the world. Vegetative cells can be distributed throughout the whole water column during a bloom, with cysts being found in sediments (NIMPIS, 2002a). Minimum temperature is 4°C, maximum is 30°C. Growth poor at 4°C and 12°C (Tasmanian strains). No growth at 11°C. Growth in laboratory ar 12-17°C. Blooms when water temperatures range from 12-18°C. Ambient temperature <10°C terminates blooms. Growth poor at 25°C and 30°C (Tasmanian strains). Rapid growth at 17-28°C, optimal 18-22°C. Killed at temperatures of 35°C for 30 minutes to several hours. Minimum salinity is 15 ppt, maximum is 35.5 ppt. Survives 15-34 psu (Tasmanian strains). No survival after 35 days at 15-20 psu, no growth at 20 psu. *G. catenatum* described from the Gulf of California with salinity 35.07-35.50 ppt. Survives 15-34 psu, optimum 23-34 psu (Tasmanian strains). Chain-forming at 23-26 ppt. (NIMPIS, 2002b).

Reproduction
Both sexual and asexual reproduction occurs in *G. catenatum*. Vegetative cells reproduce primarily asexually *via* oblique binary fission, dividing into new cells. Certain environmental conditions (primarily a deficiency in nutrients) are thought to trigger the switch to sexual reproduction. Sexual reproduction results in the formation of cysts, which lie dormant in the sediments until conditions are suitable for them to germinate and produce new cells (NIMPIS, 2002a). Reproductive temperature range is 12-18°C, while the reproductive salinity range is 23-34 ppt. Temperature and organic nutrients are the cues for reproduction. In Tasmania blooms can only develop if temperatures are >14°C at the time of bloom initiation, a rainfall event occurs as a trigger, and there is a calm, stable water column for sustained development (NIMPIS, 2002d).

Nutrition
G. catenatum produces its own food through the process of photosynthesis. It is able to acquire nutrients through the cell wall, and has also been noted as a grazer on other phytoplankton (NIMPIS, 2002a). The physico-chemical variables that correspond with the presence of *G. catenatum* are, in descending order of importance: temperature, phosphates, dissolved oxygen, silicate, nitrite, and nitrate (Morquecho & Lechuga-Devéze, 2004).

General Impacts
Toxins (saxitoxins and gonyautoxins) produced by *Gymnodinium catenatum* can cause Paralytic Shellfish Poisoning (PSP). Studies show that most outbreaks are produced at temperatures lower than 25°C (Garate-Lizarraga *et al.*, 2004). The toxins are released when *G. catenatum* cells are eaten by shellfish, such as oysters, mussels and scallops, making them poisonous to consume (NZFSA, 2004). In extreme cases, PSP causes muscular paralysis, respiratory difficulties, and can lead to death. In Mexico, three separate outbreaks of PSP, in Mazatlán, Guerrero, and Oaxaca, resulted in 460 individuals being poisoned, with 32 deaths (Band-Schmidt *et. al*, 2004).
G. catenatum also poses threats to wild and aquaculture shellfish industries, due to economic losses resulting from farm closures (NIMPIS, 2002a).
Commercial shellfish farming has been impacted through the denial of access to traditional sources of spat supply. This is due to the risk of introducing *G. catenatum* into important unaffected populations. There has also been widespread contamination of shellfish with PSP toxins in New Zealand, and 500 individuals were hospitalised and at least 20 people died due to PSP along the Pacific coasts of Mexico. Mussels, oysters and scallops from areas affected by *G. catenatum* blooms have been highly contaminated with paralytic shellfish toxins, resulting in human poisonings (NIMPIS, 2002c).
Mass mortality has occurred at shrimp farms that have been affected by blooms of *G. catenatum* (Alonso-Rodríguez & Páez-Osuna, 2003).

Management Info
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. *Gymnodinium catenatum* is identified as one of ten potential domestic target species most likely to be spread to uninfected bioregions by shipping. *G. catenatum* 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 *G. catenatum* as a 'high priority species' - these species have a reasonably high invasion potential and their impact potential is the highest of all the potential domestic target species.
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.
For details on management of this species, please see *management information*

Pathway
Ballast water can transport this organism long distances to new environments.Cysts of *G. catenatum* can be accidentally translocated through aquaculture and fisheries activities, such as in oyster cages or on mussel ropes.

Principal source: NIMPIS, 2002a. *Gymnodinium catenatum* species summary. National Introduced Marine Pest Information System (Eds: Hewitt C.L., Martin R.B., Sliwa C., McEnnulty, F.R., Murphy, N.E., Jones T. & Cooper, S.).

Compiler: IUCN/SSC Invasive Species Specialist Group (ISSG)

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ALIEN RANGE

[1] ARGENTINA
[1] BAHA DE LA PAZ
[1] CHINA
[1] CUBA
[1] IBERIAN COASTAL
[1] JAPAN
[1] KOREA, REPUBLIC OF
[4] MEXICO
[1] PACIFIC - EASTERN CENTRAL
[1] PORTUGAL
[2] SPAIN
[1] VENEZUELA
[1] AUSTRALIA
[1] BRAZIL
[1] COSTA RICA
[1] HONG KONG
[1] ITALY
[1] KOREA, DEMOCRATIC PEOPLE'S REPUBLIC OF
[1] MEDITERRANEAN & BLACK SEA
[1] NEW ZEALAND
[1] PHILIPPINES
[1] SINGAPORE
[1] URUGUAY

BIBLIOGRAPHY
36 references found for **Gymnodinium catenatum**

Managment information
Commonwealth Scientific and Industrial Research Organisation (CSIRO) 2004. New test to detect aquatic pests.
Summary: Reports on a new DNA test to detect *G. catenatum* in ballast water.
Available from: http://www.marine.csiro.au/media/04releases/21apr04.html. [Accessed 11 Jan, 2005]

Garate-Lizarraga, I., and Bustillos-Guzman, J.J., Alonso-Rodriguez, R., and Luckas, B. 2004. Comparative paralytic shellfish toxin profiles in two marine bivalves during outbreaks of *Gymnodinium catenatum* (Dinophyceae) in the Gulf of California. *Marine Pollution Bulletin*. 48 (3-4): 397-402.

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]

McEnnulty, F.R., Jones, T.E. and Bax, N.J. (2001), The Wed-Based Rapid Response Toolbox. Web publication: . Date of release: June 2001, Date of access: 19/10/2004

Summary: Contains management information.

Yoo, J.S. and Shin, H.W. 2004. Effects of basic oxygen furnace slag and inorganic nutrients on the germination of resting cysts of two toxic dinoflagellates. *Journal of Environmental Biology*. 25 (2): 147-150.

General information

Alonso-Rodr&#65533;guez, R., and P&#65533;ez-Osuna F. 2003. Nutrients, phytoplankton and harmful algal blooms in shrimp ponds: a review with special reference to the situation in the Gulf of California. *Aquaculture* 219: 317-336.

Summary: Outlines the effects of *G. catenatum* blooms on commercial shrimp farms.

Band-Schmidt, C. J., Morquecho, L., Lechuga-Dev&#65533;ze, C. H., and Anderson, D. M. 2004. Effects of growth medium, temperature, salinity and seawater source on the growth of *Gymnodinium catenatum* (Dinophyceae) from Bah&#65533;a Concepci&#65533;n, Gulf of California, Mexico. *Journal of Plankton Research* 26(12): 1459-1470.

Summary: Has information on salinity and temperature preferences.

Barbara-Sanchez, A. L. and Gamboa-Maruez, J. F. 2001. Distribution of *Gymnodinium catenatum* Graham and shellfish toxicity on the coast of Sucre State, Venezuela, from 1989 to 1998. *Journal of Shellfish Research* 20(3): 1257-1261.

Summary: Has distribution information for Venezuela.

CONABIO. 2008. Sistema de informaci&#65533;n sobre especies invasoras en M&#65533;xico. Especies invasoras - Algas. 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 - Algae is available from: http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Algas [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 - Algas is available from: http://www.conabio.gob.mx/invasoras/index.php/Especies_invasoras_-_Algas [Accessed 30 July 2008]

de Oliveira-Proen&#65533;a, L.A., Tamanaha, and M. S., de Souza, N. P. 2001. The toxic dinoflagellate *Gymnodinium catenatum* Graham in Southern Brazilian Waters: occurrence, pigments and toxins. *Revista Atl&#65533;ntica, Rio grande* 23: 59-65.

Summary: This paper records the first known occurrence of *G. catenatum* in Brazilian waters. PSP toxins were detected in mussels (*Perna perna*), which are cultured in this area.

Garate-Lizarraga Ismael , Jose Jesus Bustillos-Guzman , David Javier Lopez-Cortes, Francisco Hernandez-Sandoval, Katrin Erler, Bernd Luckas., 2006. Paralytic shellfish toxin profiles in net phytoplankton samples from Bahia Concepcion, Gulf of California, Mexico Baseline / Marine Pollution Bulletin 52 800&#65533;815

Garate-Liza&#65533;rraga I., J.J. Bustillos-Guzma&#65533;n., L. Morquecho., C.J. Band-Schmidt., R. Alonso-Rodri&#65533;guez., K. Erler., B. Luckas., A. Reyes-Salinas and D.T. Go&#65533;ngora-Gonza&#65533;lez., 2005. Comparative paralytic shellfish toxin profiles in the strains of *Gymnodinium catenatum* Graham from the Gulf of California, Mexico. Marine Pollution Bulletin 50 208&#65533;236.

Garate-Liz&#65533;rraga, I., Bustillos-Guzman, J. J., Erler, K., Mu&#65533;et&#65533;n-G&#65533;mez, M. S., Luckas, B., and Tripp-Quezada, A. 2004. Paralytic shellfish toxins in the chocolata clam , *Megapitaria squalida* (Bivavlvia: Veneridae), in Bah&#65533;a de la Paz, Gulf of California. *Revista de Biolog&#65533;a Tropical* 52 (Suppl. 1): 133-140.

Summary: Contains the first known occurrence of *G. catenatum* in Bah&#65533;a de la Paz, as well as the first known occurrence of PSP in this location and in chocolata clams.

Garate-Liz&#65533;rraga, I., Siqueiros-Beltrones, D. A. 2003. Infection of *Ceratium furca* by the parasitic dinoflagellate *Amoebophrya* (Amoebophyridae) in the Mexican Pacific. *Acta Botanica Mexicana* 65: 1-9.

Summary: Reports the first record of *G. catenatum* from the west coast of the Baja peninsula.

Gomez, F. 2003. The toxic dinoflagellate *Gymnodinium catenatum*: An invader in the Mediterranean Sea. *Acta Botanica Croatica*. 62 (2): 65-72.

Graham, H. 1943. *Gymnodinium catenatum*, a new dinoflagellate from the Gulf of California. *Transactions of the American Microscopical Society*62 (3): 259-261.

Summary: The original paper describing *G. catenatum* for the first time.

Green, D.H., Llewellyn, L.E., Negri, A.P., Blackburn, S.I., and Bolch, C.J.S. 2004. Phylogenetic and functional diversity of the cultivable bacterial community associated with the paralytic shellfish poisoning dinoflagellate *Gymnodinium catenatum*. *FEMS Microbiology Ecology*. 47 (3): 345-357.

Guiry, M.D. & Nic Dhonncha, E., 2005. *Gymnodinium catenatum* AlgaeBase version 3.0. World-wide electronic publication, National University of Ireland, Galway.

Summary: AlgaeBase is a database of information on algae that includes terrestrial, marine and freshwater organisms. AlgaeBase is available from: http://www.algaebase.org; *Gymnodinium catenatum* information is available from: http://www.algaebase.org/speciesdetail.lasso?species_id=52337&sk=0&from=results&-session=abv3:82D8C9F5076c500931kSpSC20074 [Accessed 04 March 2005].

ITIS (Integrated Taxonomic Information System), 2005. Online Database *Gymnodinium catenatum*

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/itisca/taxastep?king=every&p_action=containing&taxa=Gymnodinium+catenatum&p_format=&p_ifx=plglt&p_lang= [Accessed March 2005]

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Summary: Note: paper is in Spanish. This paper records the first known occurrence of *G. catenatum* in Cuban waters.

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Summary: Reports on the algal bloom of *G. catenatum* that resulted in the closure of many commercial shellfish-growing areas in New Zealand.

Mee, L.D., Espinosa, M., and Diaz, G. 1986. Paralytic shellfish poisoning with a *Gymnodinium catenatum* red tide on the Pacific Coast of Mexico. *Marine Environmental Research* 19: 77-92.

Summary: Has some information on the effects of *G. catenatum* in Mexico.

Morquecho, L. and Lechuga-Deveze, C.H. 2003. Dinoflagellate cysts in recent sediments from Bahia Concepcion, Gulf of California. *Botanica Marina*. 46 (2): 132-141.

Morquecho, L., and Lechuga-Dev&#65533;ze, C. H. 2004. Seasonal occurrence of planktonic dinoflagellates and cyst production in relationship to environmental variables in subtropical Bah&#65533;a Concepci&#65533;n, Gulf of California. *Botanica Marina* 47: 313-322.

Summary: States some of the environmental variables that correlate with the presence of *G. catenatum*.

National Introduced Marine Pest Information System (NIMPIS), 2002a. *Gymnodinium catenatum* species summary. National Introduced Marine Pest Information System (Eds: Hewitt C.L., Martin R.B., Sliwa C., McEnnulty, F.R., Murphy, N.E., Jones T. & Cooper, S.). Web publication , Date of access: 10/19/2004

Summary: Contains a species summary.

National Introduced Marine Pest Information System (NIMPIS), 2002b. *Gymnodinium catenatum* habitat & survival. National Introduced Marine Pest Information System (Eds: Hewitt C.L., Martin R.B., Sliwa C., McEnnulty, F.R., Murphy, N.E., Jones T. & Cooper, S.). Web publication , Date of access: 10/19/2004

Summary: Summarises the habitat and environmental tolerances for this organism.

National Introduced Marine Pest Information System (NIMPIS), 2002c. *Gymnodinium catenatum* impact details. National Introduced Marine Pest Information System (Eds: Hewitt C.L., Martin R.B., Sliwa C., McEnnulty, F.R., Murphy, N.E., Jones T. & Cooper, S.). Web publication , Date of access: 10/19/2004

Summary: Summarises the impacts of this organism.

National Introduced Marine Pest Information System (NIMPIS), 2002d. *Gymnodinium catenatum* reproduction & life cycle. National Introduced Marine Pest Information System (Eds: Hewitt C.L., Martin R.B., Sliwa C., McEnnulty, F.R., Murphy, N.E., Jones T. & Cooper, S.). Web publication , Date of access: 10/19/2004

Summary: Contains information on life-cycle and reproduction.

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Summary: Contains the results of a survey to determine the locations in which *G. catenatum* occurs in New Zealand.

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Summary: Has information on *G. catenatum* in Costa Rica. Written in Spanish.

Yuri B. Okolodkovi & Ismael Garate-Lizarraga., 2006. An Annotated Checklist Of Dinoflagellates (Dinophyceae) from the Mexican Pacific. Acta Botanica Mexicana 74: 1-154