Alexandrium minutum 简体中文 正體中文

System: Marine

Kingdom	Phylum	Class	Order	Family
Plantae	Pyrrophycophyta	Dinophyceae	Gonyaulacales	Goniodomataceae

Common name red tide phytoplankton (English), red tide dinoflagellate (English)

Synonym
Alexandrium ibericum , E. Balech 1985
Alexandrium lusitanicum , Balech
Pyrodinium minutum , (Halim) Taylor
Alexandrium minutum , Halim, 1960 NIMPIS, 2006

Similar species *Alexandrium andersoni, Alexandrium angustitabulatum, Alexandrium camurascutulum, Alexandrium hiranoi, Alexandrium lusitanicum, Alexandrium tamarense, Alexandrium tamutum*

Summary Alexandrium minutum is a small dinoflagellate that forms algal blooms in many coastal regions around the world. It was originally described from a red tide in the Alexandria harbour. Toxins produced in high concentrations by these single-celled organisms are responsible for many global cases of paralytic shellfish poisoning (PSP) in humans. Toxins may also affect other components of the ecosystem including mammals, birds, fish and zooplankton.

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Species Description
Alexandrium minutum is a toxic single-celled armoured dinoflagellate that is well characterised morphologically in Balech, 1995. Cells are spherical in shape and small-sized, 15 to 29 um in diameter. The cell is green-brown in colour with a theca (clear protective covering). Small details on this theca differentiate *A.minutum* from other *Alexandrium* species. Cysts of *A. minutum* are from spherical to slightly flattened in shape and from circular (25–35 um diameter) when seen from above to oval (28–35 um long, 20–30 um wide) in lateral view. The most common cell content is granular material and a more or less condensed yellow–orange accumulation body. Nevertheless, globular content is also observed in some cysts (Bravo *et al*., 2006).

Habitat Description
Alexandrium minutum is found in warm, temperate, coastal and estuarine waters. It has been reported over a number of geographical areas and in a wide range of coastal hydrographic regimes (i.e. Hallegraeff *et al*., 1988; Yoshida *et al*., 2000; Usup *et al*., 2002; Vila *et al*., 2005). *A. minutum* is the most widespread toxic PSP species in the Mediterranean Sea, and is one of the two main causative organisms responsible for the incidence of PSP in Southeast Asia (Vila *et al*., 2001; Lim *et al*., 2006). It seems to be restricted to coastal enriched sites, particularly harbours, estuaries or lagoons (Giacobbe *et al*., 1996, Vila *et al*., 2005). In the field *A. minutum* has been related to low salinities and nutrient-rich freshwater inputs in such way that the existence of local freshwater outflows seems to be an important factor in the ambient where this species blooms (Cannon 1990, Erard-Le Denn 1993; Vila *et al*., 2005). However, the euryhaline and eurytherm character of this species is well known and has been proved from culture experiments (Grzebyk *et al*., 2003, Cannon 1996). The growth rate of *A. minutum* increases with increasing temperature and irradiance (Lim *et al*., 2006); nevertheless it has shown that it is also possible reach relatively high growth rates (up to 0.5 div day-1) at 12ºC after a period of adaptation (Cannon 1996). Cysts in bloom areas are associated with fine organic estuarine and coastal sediments, e.g. along the Catalan coast (NW Mediterranean Sea) blooms are associated with local accumulation of cysts in confined water areas (Garcés *et al*., 2004, Bravo *et al*., 2006).

Reproduction
Reproduction in *A. minutum* is asexual and sexual. *A. minutum* reproduces asexually by binary fission. In sexual reproduction, gametes fuse to produce resting cysts. Cysts fall into sediment and lie dormant until conditions are favourable. They then germinate to produce vegetative cells (Probet *et al*., 2002). Blooms of *A. minutum* generally occur in spring, when the water column is stable, nutrients availability is high and conditions are suitable for germination of cysts. Growth is influenced by temperature, light and nutrient availability (NIMPIS, 2002).

Nutrition
Trophic status: Primary Producer

General Impacts
Alexandrium minutum produces toxins which are toxic to some zooplankton and fish and can reduce copepod reproduction. The toxins are bioaccumulated in zooplankton, shellfish and crabs, the consumption of which can lead to paralytic shellfish poisoning (PSP) in humans and other mammals. The toxins responsible for this disease are neurotoxins, which in humans may cause muscular paralysis, neurological symptoms and, in extreme cases, death (Hallegraeff, 1993; Van Dolah 2000). Due to the potential for disease outbreak the occurrence of algal blooms near shellfish farms usually results in their closure, which results in economic losses. Prohibition of wild harvesting will also impact on local tribe or populations that rely on shellfish as a food source (Magda Vila., pers.comm., 2007).

Management Info
Preventative measures: The monitoring of coastal waters for the presence of harmful algae normally involves microscopic examinations of phytoplankton populations. These procedures are time consuming and require a great deal of taxonomic experience. A study by Galluzzi and collegues (2004) outlined the use of molecular tools to help detect the presence of target microorganisms in marine field samples. In the study they developed a real-time PCR-based assay for rapid detection and quantification assay of all toxic species of the *Alexandrium* genus in both fixative-preserved environmental samples and cultures. Quantification results were compared with standard microscopy counting methods. The two methods gave comparable results, confirming that real-time PCR could be a valid, fast alternative procedure for the detection and quantification of target phytoplankton species during coastal water monitoring. \r\n
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. *Alexandrium minutum* is identified as one of ten potential domestic target species most likely to be spread to uninfected bioregions by shipping. *A. minutum* 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 *A. minutum* 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.
Following an algal bloom in the Penzé River, France in 1997, *Alexandrium* cells were observed to be infected by sporocysts of the parasite *Parvilucifera* (Apicomplexan) (Erard-Le Denn *et al.,* 2002). The parasite was also reported from Spain infecting *A. catenella* during a bloom in Tarragona harbour (Delgado, 1999) and from scandinavian waters infecting *Dinophysis* (Norén *et al*., 1999). The parasite was found to infect laboratory cultures of several other dinoflagellate species, and estimates of parasite-induced mortality indicate that this parasite is capable of removing a significant fraction of dinoflagellate biomass in a short time, raising the possibility of its use as a biological control agent of toxic dinoflagellate blooms (Delgado, 1999; Erard-Le Denn *et al*., 2002). However, the effect of this parasite on natural population of A. minutum populations did not induce to the bloom decrease at least in two bloom episodes (Probet, 1999; Vila *et al*., 2005).

Pathway
The red-tide dinoflagellate may be accidentally transferred with ballast water (Hallegraeff and Bolch 1992, NIMPIS, 2002).The red-tide dinoflagellate may be accidentally transferred with transfer of rocks, sand and shellfish (Laabir and Gentien, 1999, NIMPIS, 2002). There is a potential risk of infection of new areas by the translation of sediments rich in cysts due to draining of sediments from areas recurrently affected by *A. minutum* blooms (e.g. harbours) (Magda Vila., pers.comm., 2007)

Principal source: NIMPIS 2002. *Alexandrium minutum* 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.)
Vila M, Giacobbe MG,*et al*.., 2005. A comparative study on recurrent blooms of *Alexandrium minutum* in two Mediterranean coastal areas. Harmful Algae 4 673–695

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

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Pubblication date: 2007-03-27

ALIEN RANGE

[1] ATLANTIC - NORTHEAST
[1] DENMARK
[1] IRELAND
[2] MEDITERRANEAN & BLACK SEA
[1] PORTUGAL
[1] SWEDEN
[1] TURKEY
[1] UNITED STATES
[2] AUSTRALIA
[1] EGYPT
[1] MALAYSIA
[1] NEW ZEALAND
[1] SPAIN
[1] TAIWAN
[1] UNITED KINGDOM

BIBLIOGRAPHY

51 references found for **Alexandrium minutum**

Managment information
Delgado, M., 1999. A new diablillo parasite in the toxic dinoflagellate *Alexandrium catenella* as a possibility to control harmful algal blooms. Harmful Algae News 19, 1-3.
Erard-Le Denn, E., Chr�tiennot-Dinet, M.J. and Probert, I. 2000. First Report of Parasitism on the Toxic Dinoflagellate *Alexandrium minutum* Halim, *Estuarine, Coastal and Shelf Science 50*(1): 109-113.g
Furones D, Vila M, Garc�s E, Sampedro N, Arin L, Mas� M, Camp J, Delgado M, Fern�ndez M and Diog�ne J. (In press). The monitoring programme for marine toxins and harmful phytoplankton in the Catalan coastline, North Western Mediterranean, Spain. International Conference on Molluscan Shellfish Safety (ICMSS04). 2004, Galway, Ireland.
Galluzzi, L., Penna, A., Bertozzini, E., Vila, M., Garc�s, E. and Magnani, M. 2004. Development of a Real-Time PCR Assay for Rapid Detection and Quantification of *Alexandrium minutum* (a Dinoflagellate), *Applied and Environmental Microbiology 70*(2): 1199-1206.
HAE-DAT, undated. IOC-ICES-PICES Harmful Algae Event Data Base: HAE-DAT
Summary: HAE-DAT is a meta data base containing records of harmful algal events. HAE-DAT contains records from the ICES area (North Atlantic) since 1985, and from the PICES area (North Pacific) since 2000 (in prep.). IOC Regional networks in South America and North Africa are preparing to start contributing.
Available from: http://ioc.unesco.org/hab/HAEDAT.htm#1 [Accessed 28 March 2997]
Hallegraeff, G.M., 1993. A review of harmful algal blooms and their apparent global increase. Phycologia 32, 79-99.
Hallegraeff G.M and Bolch CJ, 1992. Transport of diatoms and dinoflagellates resting spores in ships� ballast water: implications for plankton biogeography and aquaculture. Journal Plankton Research 14: 1067-1084.
Hayes, K. R., R. Cannon, K. Neil, and G. Inglis. 2005. Sensitivity and cost considerations for the detection and eradication of marine pests in ports. Marine Pollution Bulletin Article in Press, Corrected Proof - Note to users.
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]
Laabir M and Gentien P, 1999. Survival of toxic dinoflagellates after gut passage in the Pacific oyster *Crassostrea gigas* Thunburg. Journal Shellfish Research 18: 217-222.
Mas� M., Garc�s E., Pag�s F. and Camp J. 2003. Drifting plastic debris as a potential vector for dispersing Harmful Algal Blooms (HAB) species. Scientia Marina 67: 107-111
Summary: Available from: http://www.icm.csic.es/scimar/PDFs/sm67n1107.pdf {accessed 28 March 2007]
Moestrup, Ø., Codd, G.A., Elbr�chter, M., Faust, M.A., Fraga, S., Fukuyo, Y., Cronberg, G., Halim, Y., Taylor, F.J.R., Zingone, A., 2002. IOC Taxonomic Reference List of Toxic Plankton Algae.
Summary: Available from: http://ioc.unesco.org/hab/htmltaxlist.htm [Accessed 28 March 2007]
National Introduced Marine Pest Information System (NIMPIS), 2002. *Alexandrium minutum* 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.).
Summary: Available from: http://www.marine.csiro.au/crimp/nimpis/ [Accessed 24 November 2005]
Nor�n, F., Moestrup, O., Rehnstam-Holm, A., 1999. *Parvilucifera infectans* Nor�n et Moestrup gen. et sp. nov. (Perkinsozoa phylum nov.): a parasitic flagellate capable of killing toxic microalgae. European Journal of Protistology 35(3), 233-254.
Smayda TJ and CS Reynolds 2001. Community Assembly in Marine Phytoplankton: Application of Recent Models to Harmful Dinoflagellate Blooms. Journal of Plankton Research Vol.23 no.5 pp.447-461
Van Dolah, F.M. 2000. Marine algal toxins: origins, health effects, and their increased occurrence. Environ. Health Prespect. 108:133-141.
Vila, M., Camp, J., Garc�s, E., Mas�, M., Delgado, M., 2001. High resolution spatio-temporal detection of potentially harmful dinoflagellates in confined waters of the NW Mediterranean. J. Plankton Res. 23(5), 497–514.

General information

Balech, E., 1989. Redescription of *Alexandrium minutum* Halim (Dinophyceae) type species of the genus *Alexandrium*. Phycologia 28(2), 206–211.

Balech, E., 1995. The Genus *Alexandrium* Halim (Dinoflagellata). Sherkin Island Marine Station, Sherkin Island Co., Cork, Ireland.

Bolch, C.J., Blackburn, S.I., Cannon, J.A. and Hallegraeff, G.M.1991. The resting cyst of the red-tide dinoflagellate *Alexandrium minutum* (Dinophyceae), *Phycologia 30*(2): 215-219.

Bravo I, Garc–s E, Diog–ne J, Fraga S, Sampedro N, Figueroa RI., 2006. Resting cysts of the toxigenic dinoflagellate genus *Alexandrium* in recent sediments from the Western Mediterranean coast, including the first description of cysts of *A. kutnerae* and *A. peruvianum*. Eur. J. Phycol. 41:293–302.

Cannon, J.A. 1996. Competition between the dinoflagellates *Alexandrium minutum* and *Prorocentrum micans* in the Port River, South Australia. In: Yasumoto, T., Oshima, T., Fukuyo, Y. (Eds.), Harmful and Toxic Algae. IOC of UNESCO, pp. 381-384.

Chang FH, Anderson DM, Kulis DM, Till DG. 1997. Toxin production of *Alexandrium minutum* (Dinophyceae) from the Bay of Plenty, New Zealand. Toxicon 35(3) 393-409

Delgado M, Estrada M, Camp J, Fern–ndez J.V, Santmart– M, Llet– C., 1990. Development of a toxic *Alexandrium minutum* Halim (Dinophyceae) bloom in the harbour of Sant Carles de la R–pita (Ebro Delta, northwestern Mediterranean). Sci Mar 54: 1-7.

Deng-Fwu Hwang, Research on Marine Toxins in Taiwan, Journal of Toxicology: Toxin Reviews, Volume 22, Issue 4, Dec 2003, Pages 663 - 678

Elbraechter, M 1999. Exotic flagellates of coastal North Sea waters. Helgolaender Meeresuntersuchungen 52 (3-4) 235-242

Erard-Le Denn E 1997. *Alexandrium minutum*. In: Berland B, Lassus P (eds) Efflorescences toxiques dans les eaux c–ti–res fran–aises. Rep–re Oc–an, V 13, p 52-56.

Erard-LeDenn, E., Chretiennot Dinet, M.J., Probert, I., 2002. First report of parasitism on the toxic dinoflagellate *Alexandrium minutum* Halim. Estuar. Coast. Shelf Sci., 50(1), 109-113.

Franco J.M., Fernandez P. & Reguera B. 1994. Toxin profiles of natural population and cultures of *Alexandrium minutum* Halim from Galician (Spain) coastal waters. J. Appl. Phycol. 6: 275-279.

Garc–s, E., Bravo, I., Vila, M., Figueroa, R.I., Mas– , M., Sampedro, N., 2004. Relationship between vegetative cells and cyst production during *Alexandrium minutum* bloom in Arenys de Mar harbour (NW Mediterranean). J. Plankton Res. 26 (6), 1–9.

Giacobbe M.G, Oliva F.D, Maimone G 1996. Environmental factors and seasonal occurrence of the dinoflagellate *Alexandrium minutum*, a PSP potential producer, in a Mediterranean lagoon. Est Coast Shelf Sci 42: 539-549.

Gomez F, & L Boicenco 2004. An annotated checklist of dinoflagellates in the Black Sea. Hydrobiologia 517: 43–50

Grzebyk, D., Bechemin, C., Ward, C.J., Verite, C., Codd, G.A., Maestrini, S.Y., 2003. Effects of salinity and two coastal waters on the growth and toxin content of the dinoflagellate *Alexandrium minutum*. J. Plankton Res. 25(10), 1185-1199.

Guiry, M.D. 2006. Species detail *Alexandrium minutum* Halim AlgaeBase version 4.1. 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; *Alexandrium minutum* information is available from: http://www.algaebase.org/speciesdetail.lasso?species_id=52068&-session=abv3:82D8BFA71695a0654EuWx3A65799 [Accessed 10 November 2006].

Halim Y. 1960. *Alexandrium minutum*, n. gen. n. sp. dinoflagell– provocant des –eaux rouges–. Vie et Milieu 11: 102-105.

Hallegraeff G.M., Steffensen D.A. & Wetherbee R. 1988. Three estuarine Australian dinoflagellates that can produce paralytic shellfish toxins. J. Plankton Res. 10: 533-541.

Hansen, G., Daugbjerg, N., Franco, J.M., 2003. Morphology, toxin composition and LSU rDNA phylogeny of *Alexandrium minutum* (Dinophyceae) from Denmark, with some morphological observations on other European strains. Harmful Algae 2, 317-335.

Hewitt C L, M L Campbell, R E Thresher, R B Martin, S Boyd, B F Cohen, D R Currie, M F Gomon, M J Keough, J A Lewis, M M Lockett, N Mays, M A McArthur, T D O Hara, G C B Poore, D J Ross, M J Storey, J E Watson and R S Wilson., 2004. Introduced and cryptogenic species in Port Phillip Bay, Victoria, Australia. Marine Biology 144 (1) 183 - 202

ITIS (Integrated Taxonomic Information System), 2007. Online Database *Alexandrium minutum*

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=183930 [Accessed 6 February 2007]

Lim, P., Leaw, C., Usup, G., Kobiyama, A., Koike, K. and Ogata, T. 2006. Effects of Light and Temperature on Growth, Nitrate Uptake, and Toxin Production of two Tropical Dinoflagellates: *Alexandrium tamiyavanichii* and *Alexandrium minutum* (Dinophyceae), *Journal of Phycology 42*: 786–799.

Montresor, M., Marino, D., Zingone, A., Dafnis, G., 1990. Three *Alexandrium* species from coastal Tyrrhenian waters (Mediterranean Sea). In: Gran–li, E., Sundstr–m, B., Edler, L., Anderson, D.M. (Eds.), Toxic Marine Phytoplankton. Elsevier, New York, pp. 82–87.

NOBANIS (North European and Baltic Network on Invasive Alien Species) 2005. *Alexandrium minutum* (Goniodomataceae, Phytoplankton)

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 region. By establishing a common portal access to IAS-related data, information and knowledge in the region is facilitated. The NOBANIS network has a national contact in each of the participating countries - Denmark, Estonia, Finland, Faroe Islands, Germany, Greenland, Iceland, Latvia, Lithuania, Norway, Poland, Sweden and the European part of Russia.

NOBANIS is available from http://www.nobanis.org; this page is available from: http://www.nobanis.org/speciesInfo.asp?taxaID=3425 [Accessed 24 September 2006]

Oshima Y., Hirota M., Yasumoto T., Hallegraeff G.M., Blackburn S.I. & Steffensen D.A. 1989. Production of paralytic shellfish toxins by the dinoflagellate *Alexandrium minutum* Halim from Australia. Bull. Jap. Soc. Sci. Fish. 55: 925.

Probert I, Lewis J, Denn E.E.L. 2002. Morphological details of the life history of *Alexandrium minutum* (Dinophyceae). Cryptogamie algologie 23 (4): 343-355.

Probet, I., 1999. Sexual reproduction and ecophysiology of the marine dinoflagellate *Alexandrium minutum* Halim. PhD thesis, University of Westminster, London, pp. 99.
Salas, M. Fde; Emmerik, M. J van; Hallegraeff, G. M; Negri, A. P; Vaillancourt, R. E; Bolch, C. J Toxic., 2000. Australian *Alexandrium* Dinoflagellates: Introduced or indigenous? Harmful Algal Blooms 2000. pp. 477-480. 2001.
Usup, G., Pin, L.C., Ahmad, A., Teen, L.P., 2002. *Alexandrium* (Dinophyceae) species in Malaysian waters. Harmful Algae 1, 265&#65533;275.
Van Lenning, K., Vila, M., Mas&#65533;, M., Garc&#65533;s, E., Angl&#65533;s, S., Sampedro, S., Morales-Blake, A., Camp, J. (In press). Short-term variations in development of a recurrent toxic *Alexandrium minutum* dominated dinoflagellate bloom induced by meteorological conditions. J. Phycol.
Vila M, Giacobbe M. G, Maso M, Gangemi E, Penna A, Sampedro N, Azzaro F, Camp J, Galluzzi L 2005. A comparative study on recurrent blooms of *Alexandrium minutum* in two Mediterranean coastal areas. Harmful Algae 4 673&#65533;695
Vila M, M Grazia Giacobbeb, M Masoa, E Gangemib, A Pennac, N Sampedroa, F Azzarob, J Campa, L Galluzzic 2005. A comparative study on recurrent blooms of *Alexandrium minutum* in two Mediterranean coastal areas. Harmful Algae 4 673&#65533;695
Yoshida, M., Ogata, T., Thuoc, C.V., Matsuoka, K., Fukuyo, Y., Hoi, N.C., Kodama, M., 2000. The first finding of toxic dinoflagellate *Alexandrium minutum* in Vietnam. Fish. Sci. 66, 177&#65533;179.