HARMFUL ALGAE NEWS

An IOC Newsletter on toxic algae and algal blooms No. 23

• Mexico

Distribution of *Gymnodinium catenatum* Graham, in coastal waters of México

Gymnodinium catenatum Graham 1943 (Fig. 1) is a PSP toxin producer, originally described for the Gulf of California, México. Recent reports show a wider distribution of this species, with occurrences in Argentina, Australia, Italy, Japan, Portugal, and Spain. Along the Mexican Pacific coast, *G. catenatum* is distributed from Oaxaca northward to the central part of the Gulf of California (29°N) (Fig. 2). In the first report of this species in the central part of the Gulf of California, densities reached concentrations up to 1 million cells/L [1]. The first documented PSP outbreak due to *G. catenatum* occurred almost thirty years later (1979) in Bahía Mazatlán near its entrance to the Gulf of California. During that episode, three human deaths and an extensive fish kill occurred. PSP ranged from < 20 to 7640 µg/STX eq/100g in oysters, clams, and lobsters, and cell densities were as high of 6.6 x 10^6 cells/L [2]. Thereafter, important blooms have been reported for Bahía Mazatlán and Manzanillo, and Acapulco harbors [3, 4, 5, 6]. In the Acapulco blooms, PSP concentrations ranged from 120 to 250 µg/STX eq/100g in oysters, and *G. catenatum* abundance varied from 7.6 to 37.6 x 10^3 cells/L. However, no human fatalities have occurred. This fact may result from the relatively low toxin content of the local strains [7].

Since the 1980s, our group has carried out several phytoplankton studies in Bahía Concepción and Mazatlán; two important water bodies located near the middle and mouth of the Gulf of California,

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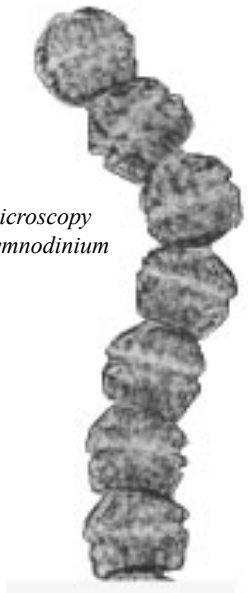

Figure 1. Light microscopy photograph of Gymnodinium catenatum

• China

Prorocentrum donghaiense - a high biomass bloom-forming species in the East China Sea

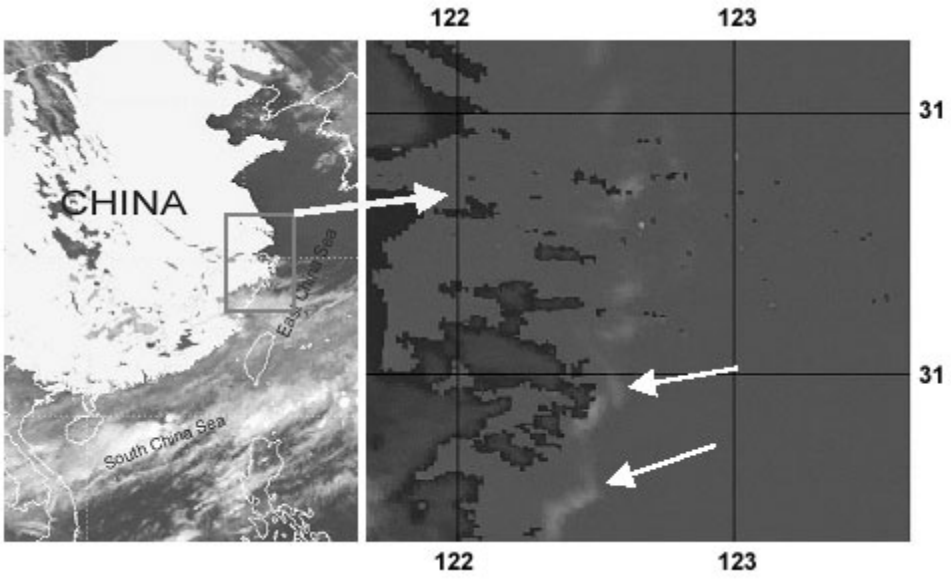

Fig. 1. Prorocentrum donghaiense bloom detected by FY satellite

Bloom occurrence

Since 1995, *Prorocentrum donghaiense* Lu 2001, a recurrent and high biomass bloom-forming species, has been observed in the plume front between coastal water of Zhejiang and Taiwan warm current [1]. It forms massive blooms in the convergence zone of the Yangtze (Changjiang) River Estuary and the coastal waters of Zhejiang province (Fig. 1). The bloom mainly appears in the surface layer of the water column but in some case the thickness of this kind of bloom can reach 10 meters. The coverage of discolouration (looks like diluted soy-sauce) can be several hundred, sometimes even a few thousand km^2. The bloom appears in April and May almost every year. The maximum recorded cell concentrations were up to 36 x 10^7 dm^{-3} and the corresponding value of chl a was

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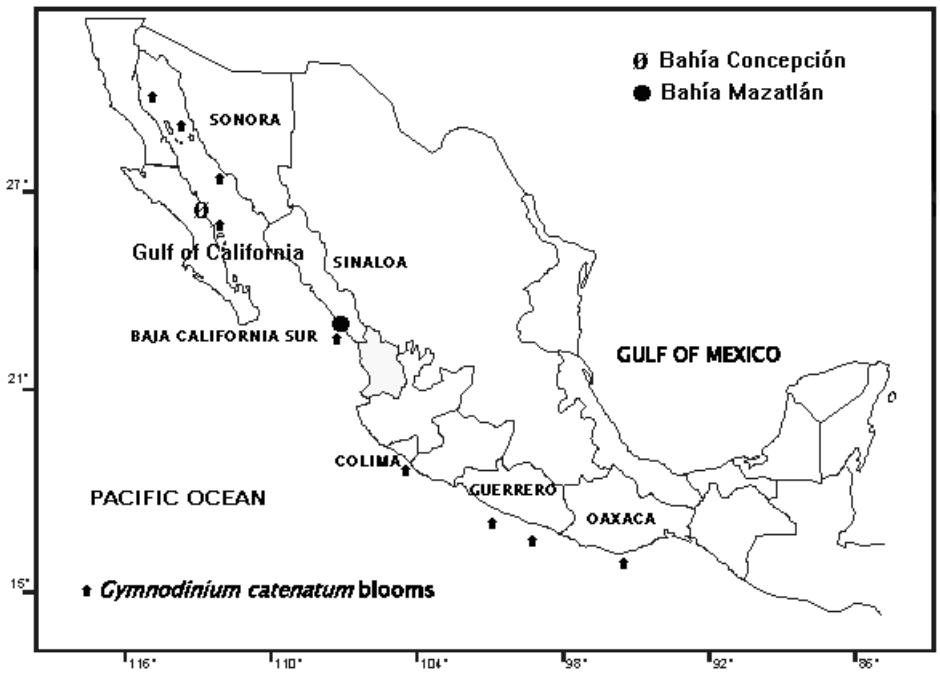

Figure 2. Distribution of G. catenatum blooms in Pacific coastal waters of México.

respectively. In the Gulf of California, several PSP-toxin producing species, such as *Alexandrium catenella, A. molinatum*, and, *A. minutum*, have been identified [3, 8, 9], but *G. catenatum* has been the most common bloom-forming species in the last four years. Therefore, special attention has been focussed on this species. Most *G. catenatum* blooms occur between February and May in the water temperature range 17 to 25 °C [3, 5, 8, 9]. Preliminary results of PSP toxin analyses from Bahía Concepción showed that neoSTX, dcSTX, dcGTX2, B1-2, and C1-2-3 were quantitatively the most important in phytoplankton and scallop flesh samples from areas with moderate and high abundances of *G. catenatum* [10]. Toxin profiles of a bloom of *G. catenatum* samples from Mazatlán were composed of C2, dcGTX2, and dcGTX3 toxins. As previously suggested, if saxitoxin analogue composition is a distinctive feature of different *G. catenatum* populations [7, 11], then our results suggest that the presence of neoSTX in plankton and scallop samples could be used as a distinctive characteristic of *G. catenatum* from Bahía Concepción. The characterization of toxin profiles of *G. catenatum* from different localities of the Mexican Pacific coast, as well as long term monitoring programs, are needed if prevention of harmful red tide effects are to be avoided in the future.

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IOC Taxonomic Reference List of Toxic Plankton Algae

Problems pertaining to toxic microalgae are being worked on and discussed by many categories of researchers: ecologists, taxonomists, toxicologists, by persons involved in monitoring the environments for harmful effect of toxic algae, by politicians, journalists, etc. It is a source of confusion that the scientific ('Latin') names of the algae sometimes change when the organisms become available for more detailed studies due to improved methodology or after establishment of the organisms in pure cultures, and such changes may give rise to misunderstandings.

At the Fourth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Vigo, Spain, 30 June-2 July 1997, it was decided to establish a Task Team on Algal Taxonomy with the aim of providing an agreed reference list of harmful algal species, including correct citation of the author(s), date of valid publication, and a list of synonyms.

The Committee comprised Ø. Moestrup (Copenhagen) as Chair, G.A. Codd (Dundee), M. Elbrächter (Sylt), M.A. Faust (Washington D.C.), S. Fraga (Vigo), Y. Fukuyo (Tokyo), G. Cronberg (Lund), Y. Halim (Alexandria), F.J.R. Taylor (Vancouver), and A. Zingone (Naples).

During the HAB 2000 Conference in Hobart, Tasmania, February 2000, the Committee met and discussed the contents and the format of the list. Following additional discussions over the e-mail, it was decided to prepare all entries in the list as follows:

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• Norway

A new bloom of *Chattonella* in Norwegian waters.

Since the first observations of *Chattonella* in 1991 outside the Netherlands [1], there have been several observations of the genus in northern Europe. The first large bloom was in 1998, covering an area from the west coast of Denmark, along the west coast of Sweden to the southern coast of Norway [2]. A second bloom occurred two year later in the southern North Sea [3]. In spring 2001, the raphidophytes *Chattonella marina* and *Heterosigma akashiwo* formed a massive bloom in the northeast part of Skagerrak. At its maximum, the bloom cover an area from the Kattegat, along the West Coast of Sweden and along the southern coastline of Norway up to Farsund. The first observations in Norwegian water were made in routine sampling in the Bay of Flødevigen at the beginning of March. The annual diatom spring bloom had started and was approaching maximum density of 2 x 10^6 cell l^{-1}, mainly dominated by *Chaetoceros* spp. During this period *Chattonella marina* was only observed in low numbers. As water masses with lower salinity from the east arrived in the bay, resulting in stronger stratification, the density of *Chattonella* started to increase from 16th March (Fig. 1). In the early phase of the bloom, large elongated cells was most common, reaching maximum concentration of 2 x 10^6 cell l^{-1} on 23rd March. This phase was partly overlapped by an increase in small cells of *Chattonella* and *Heterosigma akashiwo* that reached a maximum density of 9.5 x 10^6 cell l^{-1} at the end of March. On 26th March, the research vessel "G.M. Dannevig" set out to monitor and collect environmental data in the bloom area between Arendal and Langesund.

There was strong stratification in the whole area, with a pycnocline between 5-10 m depth. Above the pycnocline the salinity was 22-28 psu. The water temperature was 1 and 3°C down to 5 meter, and was rather uniform over the whole area. Above the pycnocline nitrate and phosphate concentrations were low at most stations. Silica, however, was relatively high throughout the water column, with a minimum around the pycnocline.

The cell counts showed that *Chattonella* and *Heterosigma* were mainly distributed above the pycnocline, and were absent at most stations below it. The maximum density of *Chattonella* was observed in the upper 2 meter. The picture that emerges from cell counts was verified by the chlorophyll *a* measurements, which showed high levels in the upper meters, 4 to 11 µg l^{-1}. The density of *Chattonella* was relatively high at most stations, where 10 out of 19 stations had > 5 x 10^6 cell l^{-1}, with a maximum concentration of 12.5 x 10^6 cell l^{-1}. Only one stations showed concentrations < 1x10^6 cell l^{-1}. *Heterosigma* was present at all stations, with a maximum density of 13.5 x 10^6 cell l^{-1}, but only four stations had concentrations ≥ 5 x 10^6 cell l^{-1}. In addition to the two dominating species, representatives of *Apedinella*, *Pseudopedinella*, and *Chrysochromulina* were present at all stations, along with several species of unidentified flagellates (<10 µm). Diatoms were observed above the pycnocline at a few stations, but were more common in deeper water masses. By the end of the cruise, an unidentified flagellate appeared and became rather common. This flagellate matches the description of the unidentified flagellate which appeared during the *Chattonella* bloom in 2000 [3].

Blooms of *Chattonella* have resulted in fish mortality in Japanese waters and other area in the past [4, 5, 6]. During the bloom in 1998, approximately 350 ton of salmon died in farms along the southern coast of Norway [2]. It has been estimated that this year's bloom killed approximately 1100 ton of Atlantic salmon. The precise mechanism behind the fish killing remains unclear, but studies indicate that interactions with the gills resulting in suffocation could be the cause [7]. It has been reported that *Chattonella* may produce a neurotoxin that could lead to fish mortality [8]. Investigations at the National Veterinary Institute and National Veterinary School, Norway, found no sign of toxins in the algae, fish or mussel meat during the bloom this year (C. Miles and T. Aune, personal communications).

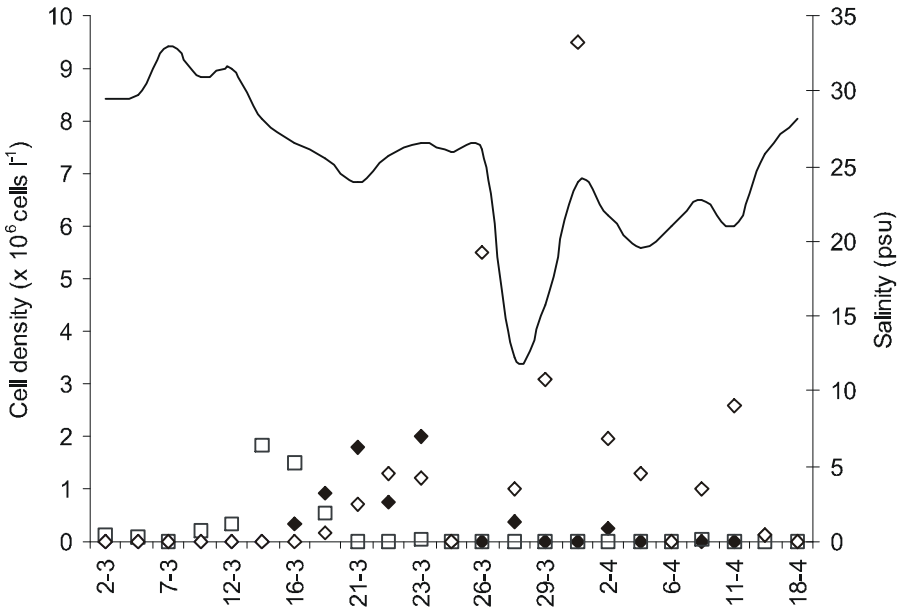

Figure 1. Routine sampling in the Bay of Flødevigen from the 2nd March to 19th April. Cell density (10^6 cells l^{-1}, left-hand axis) of diatoms (□), large Chattonella marina (♦), and small C. marina and Heterosigma akashiwo (◊). Line indicates the salinity (psu, right-hand axis) at 1 meter depth.

Acknowledgment

Thanks to the technical staff at Flødevigen Marine Research station, Lena Omli, Terje Jåvold, & Anita Reisvaag, and the crew at "G.M. Dannevig" for their contributions to this work. The Norwegian Research Council (Project No. 146052/120) and the Institute of Marine Research funded the investigation.

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more than 200 µg/ dm^3. During blooming, water temperature was 17-20ºC and salinity range was about 20-28 PSU. The discolouration of the surface water caused by blooms of this species is so extensive that it has been observed by several different satellite sensors during cloud free weather in the last a few years.

Morphological Observation of the species

This species usually occurs as single cells but sometimes also as two or four cell chains (Fig. 2). Cells are asymmetric and elongated with slightly indented anterior end and rounded posterior end, 16-22 µm long, 9.5-14 µm wide and 7-9 µm thick. The periflagellar area on the right valve is v-shaped and has one flagellar pore and more than one smaller auxiliary pore surrounded by apical collars. The spines on the thecal plates are dense and knob-like. There are 3 spines per µm. Valve pores are round with a distinct wall. Trichocyst pores are distributed mainly around the margin of the valves (Fig. 3). The megacytic zones of old cells are broad with dense tiny knobs. This species is morphologically different from *Prorocentrum dentatum* and *Prorocentrum obtusidens* (see table 1) [2, 3, 4, 5, 6].

Environmental aspects

The bloom-forming tendency of *P. donghaiense* is very similar to that of *P. minimum*, which is one of the most important potentially toxic bloom-forming species in the Oslofjord, Kiel Fiord (Baltic Sea), and other coastal areas around the world, especially in estuaries. The blooms of both species, typically occur in the surface layer of the water column of stratified water masses, where there is a large supply of mineral nutrients above the pycnocline.

The species was recorded at the beginning of the 1990s but originally confused with other *Prorocentrum* species in the East China Sea. Massive blooms of *P. donghaiense* were not recorded until 1995. This may indicate some kind of environmental change has taken place here.

The dynamic processes of this typical high biomass bloom species need to be elucidated in the future. This is one of the major tasks of the new national research project (CEOHAB)– the Chinese Ecology and Oceanography on Harmful Algal Blooms programme. CEOHAB also much concerned with how to link and co-ordinate

Table 1. Diagnostic characteristics of relevant Prorocentrum species

Species	*P. donghaiense*	*P. dentatum* Stein	*P. obtusidens* Schiller
Type locality	Yangtze Estuary (ECS)	Atlantic Ocean	Mediterranean Sea
Cell shape			
	cell asymmetric and elongated, ovular posterior end	with pointed anterior extension at one side and tapered posterior end	anterior contours of the cell almost parallel, with a distinct blunt extension at one side
Cell size (Original description)	16-22 µm L 9.5-14 µm W 7-9 µm T	50-60 µm L	36 µm L 16-22 µm W
Index = L:W	1.5 - 1.7	2.12	1.6 - 2.3
Index (different authors)		1.9-2.5 (Dodge) 1.5 (Yoo & Lee) 2.52 and 2.9-3.2 (Horiguchi)	2.3 (Throndsen) 2.4 - 2.6 (Schiller)
Anterior spine visible in LM ?	not distinct, appears as apical collar	no	no
Valve pores	yes, surrounded by wall, grouped	yes	yes
visible in LM ?	no	yes	yes
Valve spines	yes	yes	?
visible in LM ?	no	yes	
Shape (SEM)	short and knob like	pointed	
Spine density	3 spines/µm		
Trichocyst pores	mainly near margin of the plates	mainly around margin	?
Structure of megacytic zone (old cell)	5 rows of knobs/µm 8 knobs/µm on each row		
visible in LM ?	yes	yes	yes
Social behavior /harmful events	Single cell, sometimes two or four cell chain. bloom-forming in coastal water, discoloration of water (like diluted soy-sauce).	Single cell	sparse, solitary

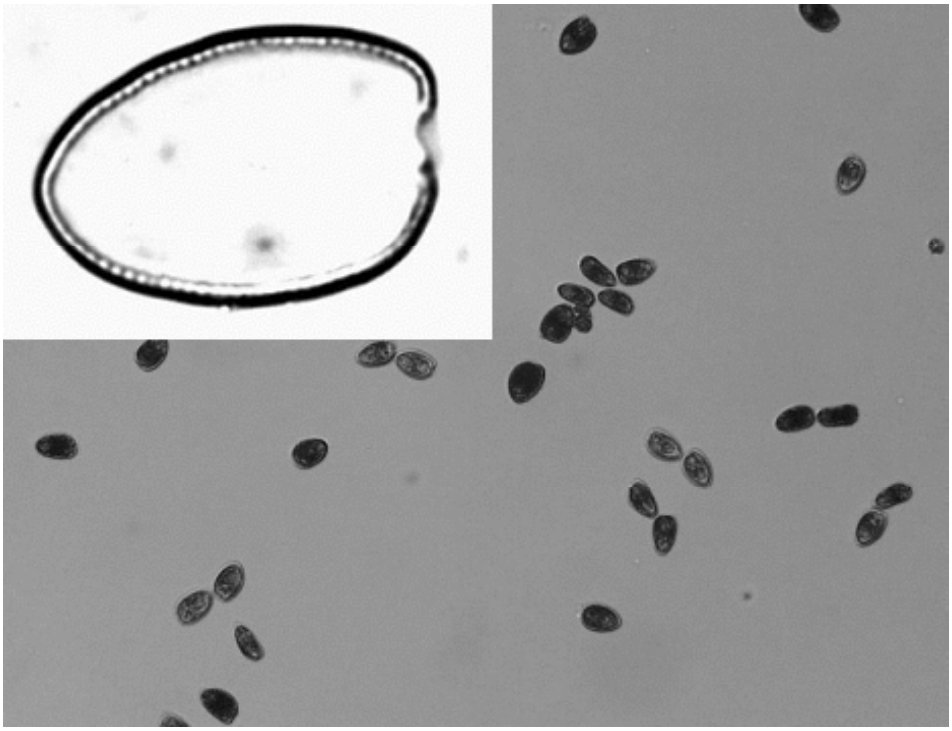

Fig.2. The Prorocentrum image under light microscope

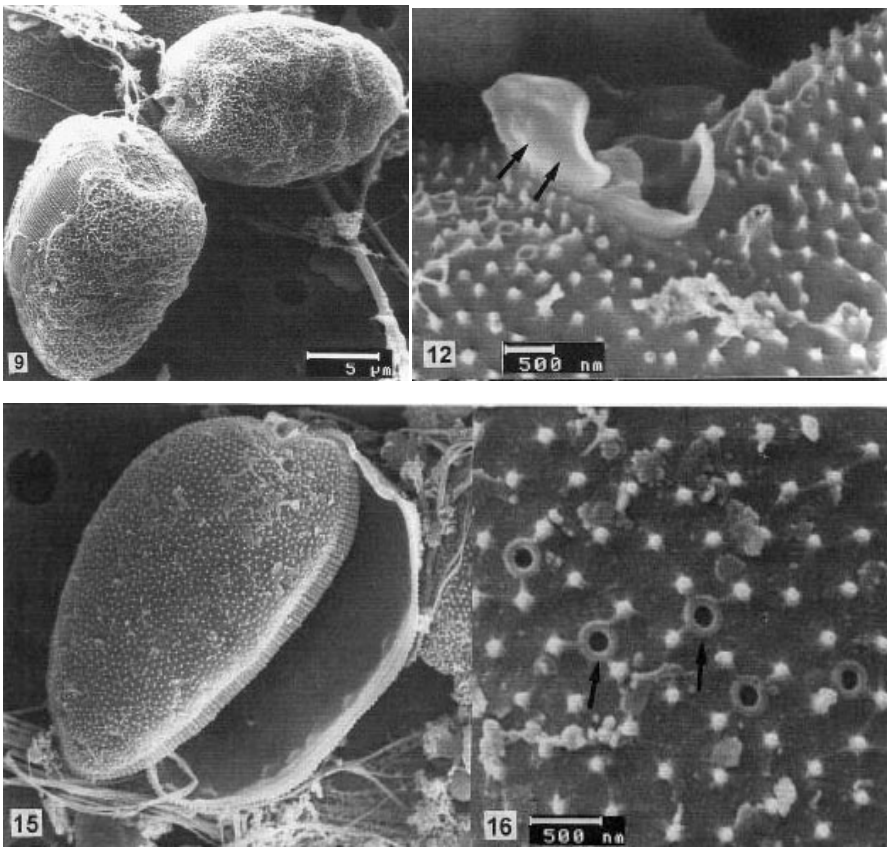

Fig.3. SEM image of Prorocentrum donghaiense

CEOHAB with GEOHAB in the near future and to obtain more support from the international HAB community.

Acknowledgements

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1. Correct name according to the International Botanical Code of Nomenclature, followed by author(s) and year it was given its present name
2. Basionym (the first name applied to the species, including year)
3. Reference to the article in which the species was first described
4. Reference to the article in which the species was given its present name
5. Type locality
6. Synonyms, including year
7. Main harmful effects
8. Up to (usually) 3 references with information on toxicity, toxins or toxic effects
9. Notes (if applicable)

The list of eukaryotic algae was completed in early 2002. The cyanobacteria (blue-green algae) will be added when the list of freshwater algae has been completed (mainly blue-green algae). In addition to a

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• Brazil

First report of *Microcystis* toxicity in Goiás (Central Brazil). Evidence of hepatic damage in mice.

Abstract

The presence of *Microcystis* genus in several water supplies of Goiânia city (State of Goiás, Central Brazil) was monitored. Extracts for mouse bioassay were prepared from both concentrated *Microcystis*, using a 20 mm mesh net and from colonies cultivated in ASM-1 liquid culture medium. Extracts from just one of the sampling stations studied were found to be toxic. Cultivated colonies showed very slight signs of toxicity in mice, but extract from concentrated ones induced 100% lethality in tested animals. Damage on liver tissue such as hepatocyte degeneration, coagulation areas and lymphocyte infiltration was also observed.

Introduction

Since a severe microcystin poisoning occurred in Caruaru (North Eastern Brazil) in 1996, when 69 persons died after an hemodialysis session, toxic *Microcystis* strains have been reported and studied in several Brazilian regions [1, 2, 3, 4]. In the State of Goiás, such studies about identification of toxic cyanobacteria had not been developed yet, even though most of surface water supplies for human consumption are lagoons, dams or similar reservoirs of still water, mainly in rural zones. Moreover, no monitoring neither educational programs exist in order to prevent such intoxication events.

The results presented here belong to a project that is being developed in the Catholic University of Goiás, aimed to the identification of toxic cyanobacteria in our State and to study environmental, seasonal and culture conditions of toxin production.

Methods

Sampling: Samples were collected monthly in four water supplies from Goiânia city intended for human consumption (Water Treatment Station and Agronomy Faculty Lagoon) or recreation (Buritis lake and Rosas lake, both located in urban parks). Sampling was conducted according to previously published recommendations [5, 6, 7].

Cyanobacteria were concentrated with a 20 mm mesh nylon net or isolated with Pasteur pipettes and cultivated in ASM-1 culture medium [8, 9] with a nitrogen/ phosphorus ratio of 4, under 12 hours light period and constant shaking.

Toxic extracts: Freshly obtained biomass was filtered through Whatman No.1 paper and then extracted with 0,5% ammonium acetate in methanol, concentrated in vacuum rotation evaporator to totally remove methanol and resuspended in 0,9% sodium chloride.

Mouse bioassay: Extracts equivalent to 1 g of cells per ml were injected intraperitoneally in male adult *Swiss* mice, three animals per sample. Volume injected represented 1% of body weight for each animal (1 ml/100 g). In order to observe chronic effects on liver, animals were injected daily during a whole week. Control mice were treated with 0,9% NaCl solution.

Toxic effects on liver: Livers from both control and treated animals were removed and weighed in analytical balance to calculate relative weight as the percent value to total body weight. The material was fixed in formaldehide/phosphate buffer. After paraffin inclusion, liver slices for microscopic observation were prepared using a microtome cutter Leica RM-2123-RT and stained with hematoxiline-eosine. Images were made using an optic microscope Olympus CX-40 coupled to a digital camera Olympus C-3000.

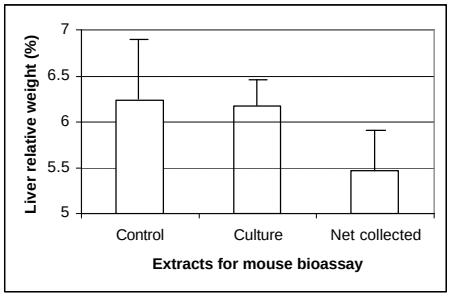

Figure 1: Effect of extracts from cultivated and net collected Microcystis on livers relative weight.

Results

Extracts from cultivated *Microcystis* strains isolated from all sampling stations showed no lethality in mice, although those from Buritis lake induced signs of neurological intoxication (dorsal hair standing on end, closed eyes and stretched out extremities) during the first 2 – 3 hours after the injection, and then quickly recovered.

Extracts prepared from *Microcystis* populations directly collected from water surface of Buritis lake were lethal in mice, as shown in tables 1 and 2.

As shown in figure 1, relative weight of treated animals liver was slightly lower as compared to those from control animals, though differences were statistically not significant. Moreover, no visible alterations were observed on liver surface, which was apparently undamaged.

Microscopic analysis of tissues stained with hematoxiline-eosine dye revealed hepatocyte degeneration, coagulation areas due to local haemorrhage and severe lymphocyte infiltration in the liver of mice treated with extracts prepared from net collected *Microcystis* (Fig. 2).

Discussion

Cultivated *Microcystis* from Buritis lake did not induced lethality in mice but just signs of slight intoxication, while colonies collected *in situ* were hepatotoxic in 100% of tested animals. This difference might be due to different nutrient concentration, expressed as nitrogen/

Table 1: Mouse bioassay response to Microcystis *extracts from different sampling stations.*

Sampling station	N/P ratio	Net concentrated colonies	Cultivated colonies
Water Treatment Station (running water)	19	No colonies found	---
Agronomy Faculty lagoon (still water)	6,5	Non toxic	Non toxic
Buritis lake (still water)	10,5	TOXIC (see table 2)	Slightly toxic
Rosas lake (still water)	14	Slightly toxic	Non toxic

Table 2: Lethality in mice of Microcystis *collected in Buritis lake.*

Time (h)	24	48	72	96	120
Mortality (%)	33,3	-	66,6	-	100

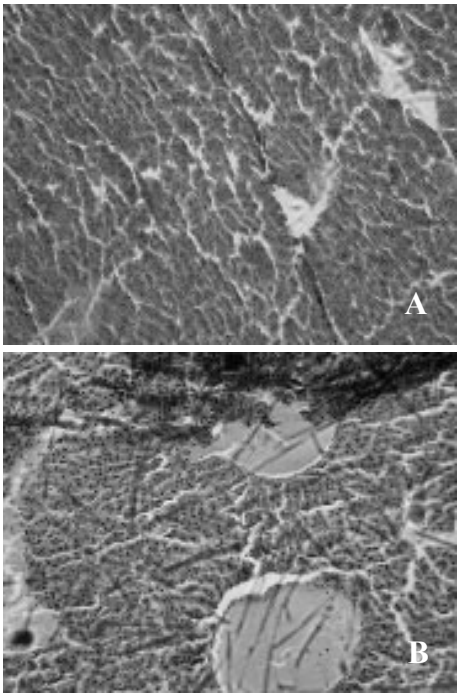

Figure 2: Effect of Microcystis *extract on mouse liver. A) Control. B) Treated with* Microcystis *extract from Buritis lake, showing lymphocyte infiltation (black arrow) and coagulation areas (white arrow).*

phosphorus ratio (N/P) in culture medium (N/P = 4) and in Buritis lake natural water (N/P = 10,5), and suggests the need of further studies on nutrient composition of culture medium, in order to increase toxin yield and to define optimum production conditions.

The fact that relative weight of treated mice liver was lower (though not significantly) then in control animals, was surprising, for most authors have described an increase of the liver weight in animals treated with hepatotoxins [9,10], even one day after the first injection. Hepatocyte degradation and haemorrhage have been probably responsible for our results. Hepatocyte injury and coagulation zones in liver tissue might be an evidence to the presence of microcystin in the tested extract. Lymphocyte infiltration reveals a severe infection, which is not necessarily due to microcystin, but it might be a consequence of using raw non sterile extract.

Buritis lake is not intended for human consumption but just for recreational purposes and toxic *Microcystis* colonies were present in concentrations not enough to form scums. Nevertheless, their presence is a fact that evidences the need of more complete environmental studies and monitoring programmes, in order to prevent future intoxication events. Such a surveillance would be extended to other regions of the State, where still surface waters are being used for human consumption.

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(Cont'd from p. 5)

printed edition, the list will be made generally available on the internet and updated at regular intervals. Suggestions for changes and additions to the list should be forwarded to the IOC Centre on Harmful Algae in Copenhagen Jacob Larsen: jacobl@bot.ku.dk with a copy (cc) to the Chairman of the Committee (moestrup@bot.ku.dk). The latter will evaluate the suggested changes, if needed after consultation with members of the Committee.

The Committee hopes to extend the list during the coming years, and to include additional information, including illustrations.

http://ioc.unesco.org/hab/data4taxlist.htm

New bibliographic database on HAB

The IOC/ASFA Bibliographic Database on HAB, HAB-BIB, contains more than 6000 references on potentially harmful algae, primarily from marine and brackish waters. It is based on an extract from the FAO-IOC-UNDOALOS-UNEP Aquatic Sciences and Fisheries Abstracts (ASFA) bibliographic database.

HAB-BIB covers the time period 1978 to 1999 (we are working on 99-02), as well as selected references from 1927-1971. The pre-1971 references and supplementary references 1971-99 have been entered electronically into the ASFA database by the IOC Science & Communication Centre on Harmful Algae at University of Copenhagen. Literature from the period 1971-1977 are at present not available on-line from ASFA, but only in the ASFA printed journals. In the near future all records will be electronically available through ASFA.

The search results may be exported either as a text file or by the use of RIS Auto Export Plug-In, directly into Reference Manager or Procite software (can be downloaded for free)

An attractive feature of HAB-BIB is that you may search by the ASFA geographical codes.

http://ioc.unesco.org/hab/HAB-BIB.htm

• Greece

Intense DSP outbreak associated with a *Dinophysis* bloom in Thermaikos Gulf (N.W. Aegean Sea, Greece)

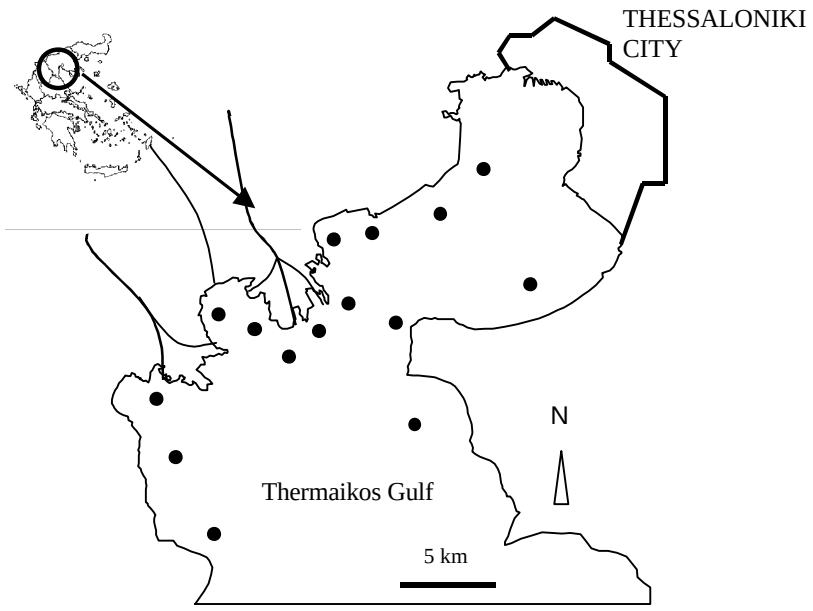

Figure 1. Map of Thermaikos Gulf, showing the sampling stations.

Several species of *Dinophysis* were observed in the past in low cell numbers in Thermaikos Gulf [1] (Fig. 1), which is the major shellfish cultivation area in Greece (95% of total production). During the harmful algal bloom monitoring programme in Thermaikos Gulf, a few *Dinophysis* (< 200 cells l^{-1}) were observed at the end of December 1999. At the beginning of samplings in 2000, high numbers, 3 x 10^4 cells l^{-1}, of *Dinophysis* (Fig. 2) were observed. The highest abundance reached, 5.4 x 10^4 cells l^{-1}, in the northeast part of the gulf in early February. The main part of the *Dinophysis* population was observed in the mid-depths (5 – 7 m) and occasionally near the bottom (13 – 16 m). The outbreak lasted until March 2000.

Among the *Dinophysis* cells, some individuals were morphologically similar to *D. acuminata* and others to *D. sacculus.* Since the identification between *D. sacculus* and *D. acuminata* is problematic [2], we cannot yet say whether these individuals belong to *D. acuminata* or *D. sacculus*.

Two size classes of *Dinophysis* were observed during the outbreak, large cells (44 –52 µm L; 32 – 38 µm W) and small cells (32 – 36 µm L, 22 – 28 µm W). In the initial stages of the outbreak, the *Dinophysis* population consisted of 50% small and 50 % large cells. During the outbreak, the decrease in the population was followed by the reduction in the percentage of small size cells.

Dinophysis was observed in water ranging in temperature from 9.5 to 11.5 °C, in salinity from 35.5 to 37.5 ‰, in PO_4-P from 6.5 to 390 µg l^{-1}, in SiO_2-Si from 12 to 140 µg l^{-1} and total inorganic nitrogen from 20 to 120 µg l^{-1}.

During this period the water column (maximum depth 16m) was homogeneous both in temperature and salinity. No relationships were found between numbers of *Dinophysis* and temperature, salinity and inorganic nutrients concentrations

The National Reference Laboratory for Biotoxins found DSP toxins in mussels with the mouse bioassay method, during the period of the *Dinophysis* outbreak. The closing of production zones (four months) caused damage to 40% of the total bivalve mollusc production of Thermaikos Gulf.

The same organism was also observed in the period March – May 2001 in Thermaikos Gulf. This outbreak was of shorter duration and lower abundance but also toxic.

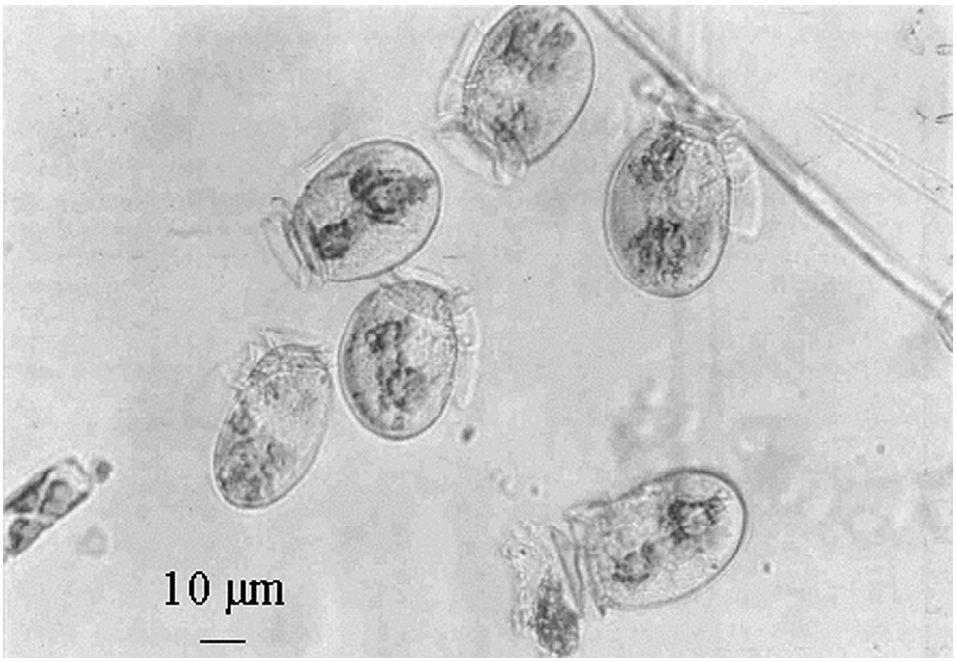

Fig. 2. Living Dinophysis cells in LM.

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• Chile

Application of remote sensing of ocean colour to forecast HAB events in Chile

A very intense event of HAB was detected at the beginning of the austral summer of 2002 in the south of Chile, due to the presence in high concentrations of the species *Alexandrium catenella* [1].

More than 30 people were intoxicated and one dead was registered in the X region of the country, in the last March.

There were strong economic impact in the area around the Archipelago of Chiloé, were the main population resource is the extraction of shellfish.

The region was declared as a catastrophic area by the president of the country in April.

This was the first event registered in this area, and the Northern limit of distribution of the species, which has expanded to north. Until this year the species was registered to affected the Southern regions (XI and XII) of this country.

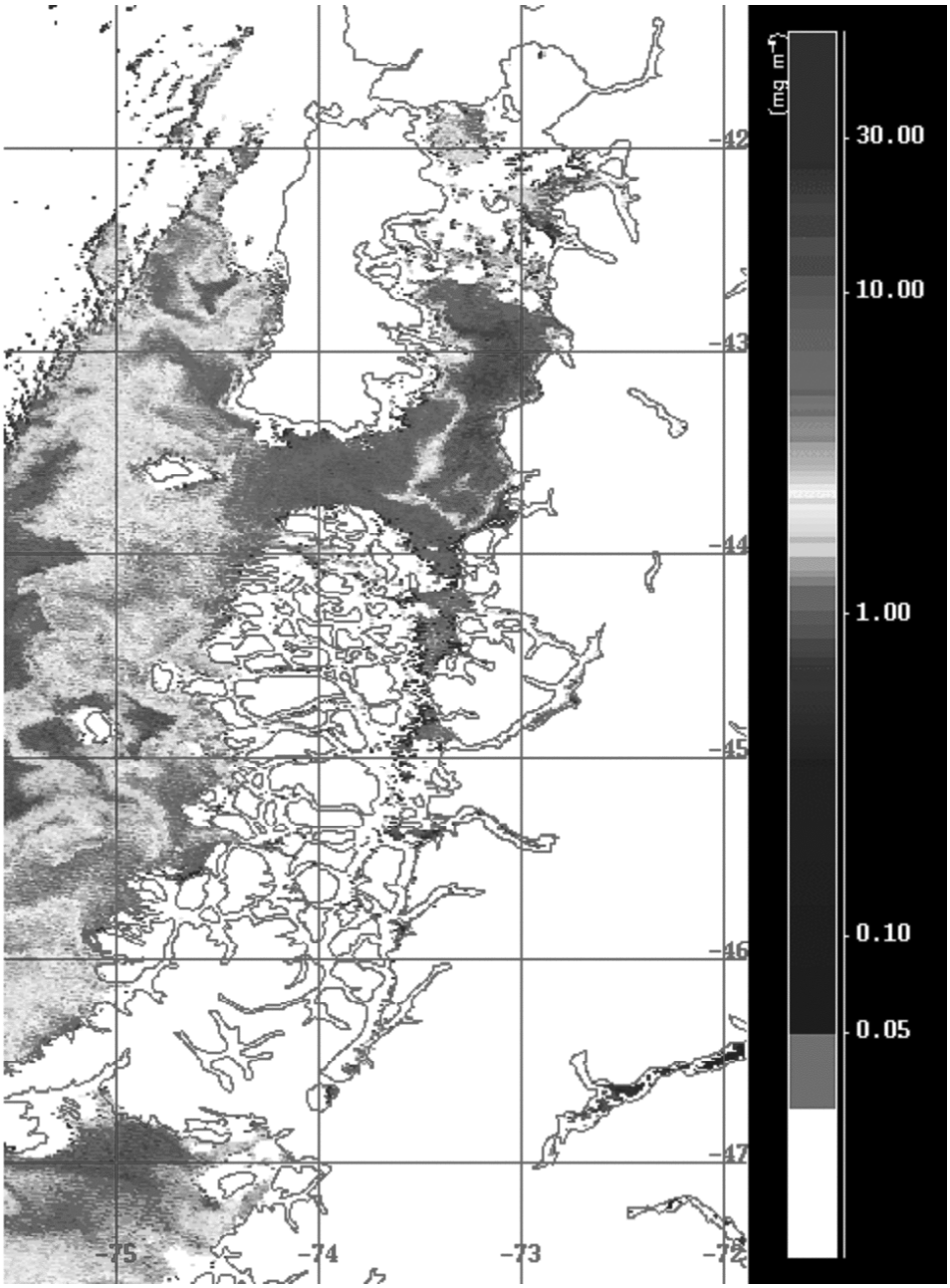
Remote sensing data has not been exploited for the moment for this application, in Chile. The method has been generally recognised as useful to identify high-risk blooms, and target in situ sampling [2].

During the beginning of this year new cooperations between Institutions and companies were established to promote remote sensing in Chile, as a contribution to monitor HAB.

This technology, supported by additional local knowledge and ancillary data was presented was presented by Dr. C. Rodriguez, for this application during the IV Spatial Conference of Latin America (Cartagena, Colombia, May 2002) to support this field of research. The proposal was accepted in the workgroup 3, in the session of prevention and mitigation of natural disasters.

The region affected by the high toxicity bloom is shown in the following image. This SeaWiFS data corresponds to 16th February 2002. The image was obtained and process at the Centre for Space Studies under agreement with Orbimage/NASA.

Image: Chlorophyll concentration ($mg \cdot m^{-3}$) around Chiloe Island. The high concentrations correspond to the algal bloom development during the last austral summer in this Chilean region. SeaWiFS Image from 16th February 2002.



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• Tyrrhenian Sea

Blooms of *Alexandrium taylori* in the Tyrrhenian Sea (Vulcano, Aeolian Islands)

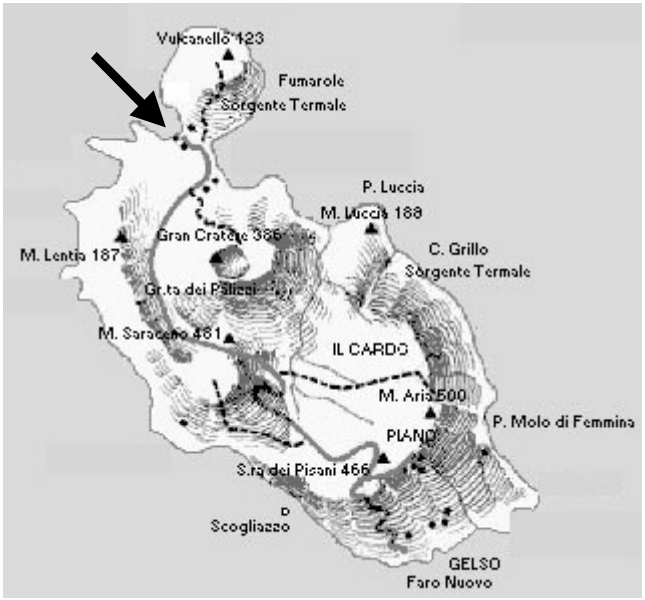

Fig. 1. Location of the West Bay of Vulcano (arrow), Tyrrhenian Sea, where the A. taylori *blooms take place in the summer.*

Since summer 1999 recurrent blooms of the dinoflagellate *Alexandrium taylori* Balech have been recorded off Vulcano Island [1]. *A. taylori* was first described in 1994 from the Atlantic, but in recent years (1997-2001) an increasing number of coastal areas in the Western Mediterranean Sea have been affected by blooms of this species [2]. During the summer periods 1999-2001, high-density blooms of *A. taylori* took place also off Vulcano Island (SW Mediterranean), where the beach of the West Bay (Fig. 1) is regularly affected by these events involving a greenish-yellow discolouration of the surface waters. The *A. taylori* densities and chlorophyll *a* concentrations ranged between 10^6-10^7 cells×L^{-1} and 0.2-120 µg×L^{-1}, respectively. In summer 2000, the population of *A. taylori* (Fig. 2) often represented the highest percentage of the total phytoplankton, constituting up to a 97% of the whole community. The remaining 3% of the phytoplankton community was composed of small diatoms. In summer 2001, phytoplankton blooms were entirely represented by *A. taylori* (100%), forming large patches mainly nearshore, in shallow waters of the West Bay (0.5-5 m depth). Water temperatures ranged from 28 to 30°C.

The location and extension of the yellowish patches were wind-driven, being confined to the beach under SE winds. Unlike other observations from the northern part of the Mediterranean basin [3], nutrient concentrations in the waters of the West Bay seemed to play a relevant role in the development of the *A. taylori* blooms, as well as in their maintenance in time. In the summer 2000, the seawater samples contained high concentrations of nutrients, above all ammonia and total phosphorus, with values up to 14.0 µM of NH_3-N and 3.2 µM of TOT-P. These concentrations were apparently connected with the hotel sewage during periods of increased anthropogenic pressure, as well as with the partial treatment of the wastes discharged into the sea, resulting in an enrichment of the waters. In contrast, the presence of riverine outputs or water contamination by bacteria were never observed in the West Bay during the study periods.

The nutrient load, together with the confinement of the West Bay of Vulcano - a semi-closed beach with calm waters and high summer temperatures – could have been responsible for the growth of *A. taylori* during most of the summer. As a final result, events of water discolouration due to persistent blooms of this dinoflagellate are more and more causing damage to the tourist industry on the island during the summer season.

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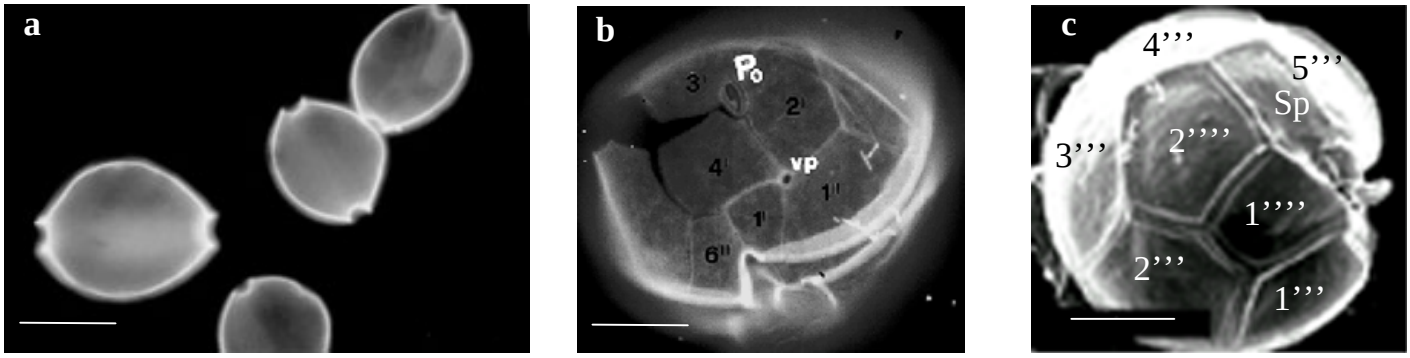

Fig. 2. A. taylori micrographs. a) General cell shape. LM, fluorescence. b) Epithecal details under epifluorescence, LM. c) Antapical view showing the hypothecal plates, SEM. Scale bars = 10 µm.

• International

LIFEHAB workshop held in Calvià, Majorca

The LIFEHAB workshop was conceived as a forum for discussion among specialists in taxonomy, life history strategies, cellular and molecular biology, geology and modelling of microalgal species. It was sponsored by the Marine Science and Technology Programme of the European Commission.

The workshop was held in Calvià, Majorca, Spain, October 24-27, 2001. Organised by the Institut de Ciències del Mar, CMIMA-CSIC (Barcelona) and the Calvià Town Council (Majorca, Balearic Islands).

The main goals were to: 1) review current knowledge of the life-cycles of phytoplanktonic organisms, focusing on HAB species; 2) identify the role of heteromorphic life cycles in population dynamics; 3) define future HAB research directions to fill existing gaps in knowledge; 4) discuss the most appropriate approaches and methods; and 5) promote the development of co-operative scientific initiatives.

The workshop included 25 presentations covering relevant aspects of life cycle studies in phytoplankton, ranging from updated reviews of the information available for the major algal groups, the role played by different life history stages in population dynamics, and the new tools available for addressing research questions. Discussion sessions focussed on the main gaps of knowledge and research needs.

The meeting allowed the updating of the available but frequently scattered knowledge on the topic, and created a scientific forum for discussion and clarification of different points. Discussions dealt with up-to-date methodologies and current knowledge to propose research recommendations (priority topics, methodology, modelling) on the life history of HABs.

The extensive discussion which took place during the Workshop highlighted a number of research needs which are common to all algal groups, as well as specific requirements related to life-cycle modalities peculiar to distinct algal divisions. The main gaps identified in our knowledge and priority research lines were:

Characterization of species. Knowledge of the morphological and functional complexity of life cycles, and of the modes of sexual reproduction, is needed in order to provide a more comprehensive framework for the definition of distinct taxa.

Elucidation of life cycles. Basic information on life histories should be gathered for a wide range of species to gain information on general life-cycle patterns within the different algal groups.

Life histories and toxicity. It is crucial to unravel the mechanisms and effects of toxin production in different life-cycle stages, which requires more sensitive methods for the quantification and detection of toxin profiles at the single-cell level.

Coupling of life histories and *in situ* population dynamics? The main challenge is to understand how distinct stages of life cycles interact with environmental and biological variables so as to produce harmful blooms, contribute to the persistence and expansion of harmful species, and to the make-up of their genetic diversity.

Kinds of methodological and technological developments needed. One of the major needs and challenges is the development and validation of molecular probes for rapid and reliable identification of HAB species and their different life history stages in the natural environment. Intraspecific genetic variability, as well as different physiological-related responses of the target organisms, should be investigated in order to design and validate molecular probes. Technological advances are required for improving *in situ* detection methods and instrumentation.

How can different disciplines contribute to the development of knowledge on HAB life cycles? The mechanisms underlying life cycles of harmful algae and their negative effects encompass a wide range of biological, physical and ecological scales, from genes to populations, from the interstitial environment in the sediment to large-scale movements of water masses, from cell-to-cell relationships to ecosystem interactions.

Cooperation among different research disciplines, coupled with the application of new technologies and the development of new models, represent special challenges for future research.

The proceedings of the workshop are available on the web: http:// www.icm.csic.es/bio/projects/lifehab/

For more information please contact: Esther Garcés, Departament de Biologia Marina i Oceanografia, Institut de Ciències del Mar, CMIMA, Passeig Marítim de la Barceloneta, 37-49,

COURSE ANNOUNCEMENT

Taxonomy of Harmful Microalgae

The Intergovernmental Oceanographic Commission (IOC) of UNESCO announces a regional training course in Taxonomy of Harmful Microalgae in collaboration with University of the Philippines, University of Tokyo, University of Tasmania, the IOC Science and Communication Centre on Harmful Algae, University of Copenhagen, and the Virtual University of the International Ocean Institute.

The training course is a pilot-project within a project to establish an Internet portal on harmful algae for South East Asia, the HABSEA Portal. The course consists of 2 parts: the first part is a 3-months Internet distant learning course and second part is a 10-days practical microscope course in species identification.

The course is open for participants from South East Asia, and 16 persons will be accepted for this course. The IOC of UNESCO will cover all direct costs such as travel, accommodation, and allowances, but not Internet connections and fees for working hours in connection with the distant learning part of the course.

Schedule and venue: The distant learning part of the course will include a 3-day introductory workshop on 3-5 February 2003, held in South East Asia, followed by 3 months work at your home laboratory. The estimated workload is one day per week. The microscope course will take place at the University of the Philippines, Manila, ultimo May 2003.

Applications. Application forms are available from http://ioc.unesco.org/hab/train.htm. Applications should be send to Rhodora Azanza, IMS, the University of the Philippines by 15 November 2002. The selected participants will be contacted directly by the organizers, and have you not been contacted by 15 December, you should not expect to participate in the course.

All applications must be endorsed by an appropriate authority including an approval that the applicant is permitted to use working time equivalent to one day per week for 3 months to follow the distant learning part of the course and to participate in the microscope course. It should also be approved that appropriate computer facilities are at the disposal of the applicant. Internet browser and CD drive is required. Full details will appear in due time at http//:portal.unesco.org/seahab.

Contact: Prof. Rhodora V. AZANZA, Marine Science Institute, University of the Philippines, Diliman, Quezon City 1101, PHILIPPINES, Tel: (63) 2 98 96 76 to 79, local 7414, Fax: (63) 2 921 59 67, E-mail: rhod@upmsi.ph

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NEW HAB SOURCE BOOK FOR SOUTH AMERICA

The Spanish Institute of Oceanography (IEO) and the Intergovernmental Oceanographic Commission of UNESCO (IOC) are pleased to announce the publication of the book:

"Floraciones Algales Nocivas en el Cono Sur Americano" by E.A. Sar, M.E. Ferrario & B. Reguera. *Instituto Español de Oceanografía*, 2002, 312 pp. (ISBN: 84-95877-01-5; NIPO: 406-02-001-9). (Spanish only)

The preparation of this book was planned following the second meeting of the IOC Working Group on Harmful Algal Blooms in South America (FANSA, Mar del Plata 1995). The IOC-IEO Science and Communication Centre on Harmful Algae (IEO, Vigo) supported the editing and production of it.

The book is divided into four parts. The first part provides information and discussion on how to implement a monitoring programme of phytoplankton and phycotoxins, and on analytical and updated assay methods according to the EU Directives, for the detection, identification and quantification of phycotoxins. The second part deals with taxonomic aspects of different groups of harmful algae; the third part, Regional Reports, gives a thorough description on harmful events that have occurred in the different countries of the region , and their ongoing monitoring and research projects. The authors are mainly South American scientists, including the national focal points of the FANSA WG, and a few foreign scientists. The book will be distributed and mailed free to Iberoamerican institutions. Experts from other countries can get a free copy provided they accept to pay the mailing costs on arrival.

Orders should be placed with:

IOC-IEO Science and Communication Centre on Harmful Algae, Instituto Español de Oceanografia, Centro Oceanografico de Vigo, Apdo. 1552, 36200 Vigo, Pontevedra, SPAIN, Phone: 34 986 492111, Fax: 34 986 492003, e-mail: vigohab@vi.ieo.es. A PDF version of the whole book is available at http://ioc.unesco.org/hab

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MONITORING AND MANAGEMENT STRATEGIES FOR HARMFUL ALGAL BLOOMS IN COASTAL WATERS

APEC and IOC are pleased to announce the availability of the technical report: *Monitoring and Management Strategies for Harmful Algal Blooms in Coastal Waters*, by D. M. Anderson, P. Andersen, V. M. Bricelj, J. J. Cullen, and J. E. Rensel. APEC Report # 201-MR-01.1, Asia Pacific Economic Programme, and Intergovernmental Oceanographic Commission of UNESCO, Technical Series No. 59, Paris, France.

The APEC HAB project supported the editing and printing of this report, and the IOC is assisting in distribution and mailing.

This 268-page report provides a broad review of the many programs, technologies, and policies used worldwide in the monitoring and management of harmful algal blooms in coastal waters.

To order a hardcopy or to download the PDF: http://ioc.unesco.org/hab

HARMFUL ALGAE NEWS

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