Behavourial trait of *Ostreopsis ovata* (Dinophyceae) in Mediterranean rock pools: the spider’s strategy

*Ostreopsis* (Ostreopsidaceae, Gonyaulacales, Dinophyceae) is a thecate dinoflagellate occasionally planktonic but generally benthic, opportunistically attaching to different substrates (e.g. macroalgae, rocks, sediment or detritus aggregates) by forming a mucilaginous matrix within which the solitary cells can move [1].

The morphology of the genus is well known [2], yet the taxonomy is still ill-defined. Cells have a biconvex, drop-shaped theca, antero-posteriorly compressed and dorso-ventrally twisted as compared to typical dinokont cells. The life cycle includes the formation of a resting stage (cyst), probably a hypnozygote. From a nutritional standpoint *Ostreopsis* is a mixotroph, though its trophic behaviour is still poorly known. A peculiar protruding structure, the ventral pore, is thought to be involved both in prey capture in phagotrophic conditions and in mucilaginous fibril extrusion [3]. The genus is cosmopolitan in coastal or estuarine marine waters in temperate, subtropical and tropical areas, where species generally thrive in summer in environments characterised by low energy hydrodynamic conditions and high nutrient availability.

Over the last decade, people swimming or exposed to marine aerosols along the Tyrrhenian and Adriatic Coasts of the Mediterranean Sea have reported a series of symptoms (rhinorrhoea, bronchoconstriction, coughing, fever, dermatitis). These symptoms have been

*Scotland*  
A prolonged *Karenia mikimotoi* bloom in Scottish waters in 2006

*Karenia mikimotoi* (Fig. 1) was first recorded in European waters in Norwegian fjords [1], and has subsequently been identified as a member of the phytoplankton community in various parts of North West Europe [2]. Most recently, in 2005, a major *K. mikimotoi* event occurred to the west of Ireland, with pelagic and benthic mortalities reported by Silke et al. [3].

*Karenia mikimotoi* has regularly been identified in Scottish waters, but with few major environmental consequences. However, a red tide in a number of sea lochs of the Firth of Clyde in 1980 was associated with fish deaths in Loch Fyne [4, 5]. Subsequently, *K. mikimotoi* assumed reduced

(Cont’d on p. 2)
associated with high densities of benthic microalgae belonging to the genus *Ostreopsis* (Dinophyceae), and mainly to the species *O. ovata* Fukuyo. Toxin analyses of the two species identified in the Mediterranean area, *Ostreopsis ovata* and *Ostreopsis cf. siamensis*, have shown the presence of putative palytoxin \[4, 5\]. Toxins could accumulate in the trophic web, thus representing a potential although so far undefined sanitary risk. Given the relevance of these phenomena, the network BenTox-net (BENthic potentially TOXic microalgae NETwork) has been established among scientists from various Italian laboratories [6].

Along the north-western coasts of Sicily (Italy), similar symptoms were reported in summer 2005 and 2006. These cases were more widespread and intense in July and August 2006, when they had a significant impact on economic activities related to tourism. Cases were registered along the littoral of Palermo and Trapani. On those occasions, the Regional Agency for Environmental Protection (ARPA-Sicilia) recorded high densities of *Ostreopsis ovata* both on macroalgae and in the water column. Records of the presence of *Ostreopsis* spp. in Sicily date back to 2001 along the eastern coast (*Ostreopsis cf. siamensis Schmidt*) [7] and to 2003 (*Ostreopsis* sp.) along the western coasts (unpublished results).

Research on the seasonal dynamics of *Ostreopsis ovata* started in autumn 2006 at a sampling station (38° 06’ 23.3” N, 13° 29’ 58.9” E) on the coast of Sicily (Fig. 1), where respiratory problems were reported in summer 2005 and 2006. The coastline is characterized by many shallow (5-10 cm) rock pools with a pebbly bottoms. Macroalgae dominating the pools were Chlorophytes (*Ulva rigida, Chaetomorpha linum*) and Rhodophytes (*Corallina elongata, Pterocladia capillacea*). A number of potentially toxic dinoflagellates were identified on the macroalgal surfaces, including *Amphidinium carterae, Amphidinium operculatum, Coolia monotis, Ostreopsis ovata* and *Prorocentrum lima* [8].

During this study, *in situ* and laboratory observations on live samples led to the detection of a peculiar behavioural strategy of *Ostreopsis ovata* cells in relation with the production of the mucilaginous matrix [9]. *In situ*, in low turbulence conditions, an extended network of reddish mucilaginous strings bridging all the different kinds of available substrate floated in the morning probably due to oxygen bubbles trapped in it (Fig. 2). Microscopical analyses of the network showed a dense population of *Ostreopsis ovata* freely swimming in this mucilaginous matrix. Samples of living macroalgae collected during this event and placed in a large tank showed within a few minutes many reddish mucilaginous threads bridging drifting algae and the tank’s walls. Light microscope observations showed *Ostreopsis* cells extruding exopolymers from the ventral pore (Fig. 3) and cooperating in the rapid formation of the strings (Fig. 4). Small
organisms were seen trapped in the newly formed networks, including potential predators of Ostreopsis (e.g. nematodes). At once and amazingly, hundreds of Ostreopsis cells jumped on the partially immobilised organisms (Fig. 5). Two available videos reveal the useless efforts of attacked organisms (nematode and copepod) to rid themselves of Ostreopsis. This is the first record of the aggressive behaviour of Ostreopsis ovata. Similar actions are detected in many dinoflagellates, such as the heterotroph Pfiesteria [10]. A ventral “peduncle-like” sticky structure was observed in some specimens of Ostreopsis (Fig. 6) and could play a role in the complex role of the mucilaginous matrix produced by Ostreopsis. However, Ostreopsis can also produce high toxin concentrations with allelopathic effects like the haptophyte Prymnesium [11]. Is the observed attack strategy of Ostreopsis a predation or a defence mechanism? Further studies are needed to answer this question. Grazing impact reduction and/or feeding strategy are therefore possible hypotheses to consider in addition to other suggestions (e.g. anchoring to the substrate, intercellular communication) on the complex role of the mucilaginous matrix produced by Ostreopsis.

References


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Cylindrospermopsis Algal Toxin Immunoassay Test Kit

Environmental Assurance Monitoring, LLC (EAM) is pleased to announce availability of a new Cylindrospermopsis ELISA kit, manufactured by Abraxis LLC. The kit is the second innovative product offered by EAM for rapid, near real-time cyanobacterial testing, and complements the advanced generation Microcystins/Nodularins (ADDA) ELISA kit for protein phosphate blockers.

User’s guide, flow chart, product data sheet and programming guides for the StatFax plate and strip readers are available upon request. The list price of the kit is US $500.00. This is the first of several innovative or improved products for cyanobacterial testing anticipated for release in the first half of this year.

This past testing season saw a verification of our value added Microcystins/Nodularins (ADDA) ELISA kit results over prior generation kits. A sample from a monitoring program using our kits was identified as positive and sent to a lab for confirmation and identification. The lab used a prior generation ELISA kit and obtained a negative result. Upon analysis by traditional laboratory methods, the positive was confirmed and identified as a congener.

For more information, please contact us at +1 913 825 9000 or info@eamonitor.com or visit our website at www.eamonitor.com

G.D. Hinshaw, Environmental Assurance Monitoring, LLC, 10336 Long St, Overland Park, KS 66215, USA.
Table 1. Mortalities of marine organisms reported to SEPA and thought to be related to the K. mikimotoi bloom.

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Organisms Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>17/07/06</td>
<td>Lochaber</td>
<td>Crabs</td>
</tr>
<tr>
<td>04/08/06</td>
<td>South Uist</td>
<td>Heart urchins (Arinicola marina)</td>
</tr>
<tr>
<td>05/08/06</td>
<td>South Uist, North Uist</td>
<td>Lugworms (Arinicola marina)</td>
</tr>
<tr>
<td>12/08/06</td>
<td>Orkney</td>
<td>Cockles and lugworms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diver reported mortalities of sea scorpions and conger eels in Scapa Flow</td>
</tr>
<tr>
<td>12/08/06</td>
<td>Orkney</td>
<td>Crabs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mussels, cockles</td>
</tr>
<tr>
<td>12/08/06</td>
<td>Lewis/Harris</td>
<td>Fish, crustaceans and invertebrates</td>
</tr>
<tr>
<td>12/08/06</td>
<td>Wester Ross</td>
<td>Wings fish and lugworms</td>
</tr>
<tr>
<td>12/08/06</td>
<td>NW Skye</td>
<td>Starfish and lugworms</td>
</tr>
<tr>
<td>18/08/06</td>
<td>Orkney</td>
<td>Flatfish, lugworm, cockles, Echinocardium sp., Echinus sp.</td>
</tr>
<tr>
<td>21/08/06</td>
<td>Orkney</td>
<td>Sea scorpions, conger eels, Echinus sp., sunstar, crabs, scallops</td>
</tr>
<tr>
<td>23/08/06</td>
<td>Golspie, E Sutherland</td>
<td>Lugworms and polychaetes</td>
</tr>
<tr>
<td>24/08/06</td>
<td>NW Sutherland</td>
<td>Divers report mortalities offish and scallops</td>
</tr>
</tbody>
</table>

(significance in Scottish waters for nearly two decades, with the next recorded blooms of red tide proportions being in 1999 in Orkney and in 2003 in the Orkney and Shetland Islands. However, somewhat prophetically, Smayda [6] noted that K. mikimotoi must be recognised as posing a major threat to aquaculture in Scotland, despite its insignificant adverse impact to date.

Phytoplankton samples are currently collected on a regular basis from 31 sites around the Scottish coast as part of the monitoring programme for the presence of toxin-producing phytoplankton, funded by the Food Standards Agency Scotland, and operated by the Scottish Association for Marine Science (SAMS). The programme monitors species or genera of possible concern to shellfish safety. However, the operation of this programme also allows enumeration of other potentially harmful phytoplankton, including K. mikimotoi. Phytoplankton samples are also collected from six sites by Fisheries Research Services (FRS), Aberdeen, as part of their coastal ecosystem monitoring programme, where full community phytoplankton analysis is performed, generating long-term time series in order to examine the effects of climate change on the phytoplankton community. In both programmes, Lugol’s iodine-fixed samples were enumerated using the Utermöhl technique.

In 2006, these monitoring programmes indicated the presence of a dense bloom of K. mikimotoi around the Scottish coast. The organism was identified at most of the SAMS biotoxin monitoring and FRS coastal ecosystem monitoring sites regularly surveyed. However, it was not recorded from the Firth of Clyde area in Loch Fyne or in Loch Ryan in the south west, and was present on only one occasion in Loch Striven (Clyde area). Densities markedly exceeded normal “background levels” for a prolonged period at many sites; the distribution is outlined in Fig 2. The peak bloom density was $3.7 \times 10^6$ cells L$^{-1}$ in Scapa Flow (Orkneys) on the 14th August.

Elevated K. mikimotoi densities in nearshore waters were first evident in the north in Orkney in the first week of July (Fig 3). However, this early bloom remained relatively modest in density (peaking at $3 \times 10^5$ cells L$^{-1}$) and declined to low concentrations by mid July. A second and more prolonged increase in K. mikimotoi was evident in the Scottish west coast in mid July, with densities of $5.3 \times 10^5$ cells L$^{-1}$ in Loch Scridain, Mull, and $7.6 \times 10^5$cells L$^{-1}$ in Loch Roag, Lewis on 17th July (Fig. 3). These observations coincided with elevated chlorophyll concentrations that had previously been evident offshore from satellite remote sensing (Fig. 4a), reaching the coast at these locations (Fig. 4b). These satellite data strongly suggest that the K. mikimotoi bloom developed offshore and was advected...
towards the coast. Such a method of development and transport is consistent with a study of *K. mikimotoi* in Irish waters by Raine et al. [7].

*K. mikimotoi* densities showed only modest further increase in Mull but rapidly reached worryingly high densities in the Western Isles, with a value of $1.7 \times 10^6$ cells L$^{-1}$ on 31st July. As the cell density declined in early August in the Western Isles, increases occurred in the Orkneys and Shetlands, and also on the north east coast at Golspie (Dornoch Forth) and Stonehaven during mid August. While the advective transport of phytoplankton in Scottish waters is relatively poorly understood in comparison with other areas [6], the progression of the bloom is consistent with cells being transported in the Scottish coastal current [8]. However, the rate of increase of cell numbers and the peak cell density at particular sampling sites (generally within sea lochs) will be related to the particular hydrological and chemical status of the site and are hence quite variable between locations.

The somewhat delayed development of the bloom at sites within the Minch, at sites in Wester Ross and Skye (Fig. 2), is at first glance somewhat at odds with this latitude based pattern. However, these observations can be related to the fact that much of the water of the coastal current fails to enter the Minch, but flows to the west of the Western Isles [9], suggesting that the seed population would have been reduced within the Minch.

The major impacts of the 2006 *K. mikimotoi* bloom were mortalities of benthic organisms due to anoxic conditions that followed the bloom. Table 1 details the faunal mortalities reported to the Scottish Environment Protection Agency (SEPA) and FRS during August 2006 and thought to be related to the *K. mikimotoi* bloom. The first report of mass mortalities of crustaceans was from Loch Shiel on 17th July 2006. No water sample was received and so no causative organism was identified. Public reports of mortalities of benthic organisms such as the lugworm (*Arenicola marina*), common cockle (*Cerastoderma edule*), blue mussel (*Mytilus edulis*), heart urchin (*Echinocardium* sp.), edible sea urchin (*Echinus esculentus*), common starfish (*Asterias rubens*), sun starfish (*Solaster papposus*) and king scallop (*Pecten maximus*) were common throughout August. Additionally, fishermen and divers reported mortalities of fish such as the sea scorpion (*Myoxecephalus scorpius*), conger eel (*Conger conger*) and flatfish (Pleuronectiformes) as well as mortalities of crab and lobster. Mortalities were reported from the west coast, the Western Isles of Lewis and Harris, the north coast, the Orkneys and Shetlands, and the Scottish east coast as far south as Golspie.
Karenia mikimotoi also has the potential to negatively affect farmed fish through both the production of haemolytic cytotoxins [10, 11] and, if in sufficient density, hypoxia [12]. For some reason, the 2006 K. mikimotoi bloom was not associated with the same level of farmed fish mortalities as in 2003, where extensive fish mortalities (53,000 farmed fish) were reported from four sites in the Shetlands. However, aquaculture production is of great economic and social importance in Scottish waters with a value of £340 million, directly supporting 2,300 full-time equivalent jobs in the fragile rural economy of the Highlands and Islands. It is therefore important both environmentally and economically to better understand the dynamics of the 2006 bloom and thus allow early warning and mitigation of any future occurrences.

Presently, the reasons for the development of the 2006 bloom remain unclear. However, it is possible that remnants of the 2005 Irish K. mikimotoi bloom were able to over winter on the shelf in the manner suggested by Raine et al. [13] to provide the seed population. The unusually warm summer and resultant elevated sea temperatures and favourable winds may then have provided suitable conditions for bloom development and subsequent advection to the Scottish coast.

References

* Corresponding author.

Mexico

Bloom of Pseudo-nitzschia fraudulenta in Bahía de La Paz, Gulf of California (June-July 2006)

Records of harmful algae blooms (HABs) have increased in the past 15 years in the Gulf of California [1, 2]. Natural events, as well as human activities have contributed to this increase; however, some of the increase could be related to an increase of articles on this subject. The ciliate Myrionecta rubra and dinoflagellate Gymnodinium catenatum are the main blooming species in the Gulf of California. Bahía de La Paz is located on the southwestern coast of the Gulf of California, one of the most important bays to the local economy because of shellfish extraction and fisheries. HABs are frequent and periodic in Bahía de La Paz. More than 25 species are involved [2]. Recently, some diatoms and raphidophytes have been included in the list of blooming species in this area [2, 3].

From 10 June to 28 July 2006, green and green-brown patches appeared on beaches along Bahía de La Paz (24°062’-24°112’ N, 110°192’-110°262’ W). Water samples were collected in plastic bottles for testing nutrients (NH₄, NO₃, NO₂, PO₄, and SiO₂), pigments, and identifying and measuring abundance of phytoplankton species. Phytoplankton samples from the bloom areas were fixed and preserved with Lugol’s solution for identification and cell counts. Cell counts were made in 5-ml settling chambers under an inverted phase contrast microscope. Net phytoplankton samples were taken using a net 20 µm mesh. A sub-sample of 30 ml was filtered (filters Whatman GF/F) to determine the presence of domoic acid. Pseudo-nitzschia species were identified to species level using scanning electron microscopy (SEM). Analyses of toxins were carried out with an HPLC-MS API 165 PE SCIEX according to the procedure in Hummert.
et al. [4]. The detection limit of the method is 3 ng DA absolute.

This bloom was observed along the Bahía de La Paz shore where temperature ranged from 18.5 to 26.5°C (Fig. 1). Nutrient concentrations during the bloom were (in μM): NH₄ (<0.5), NO₂ (0.1-2.71), NO₃ (0.1-0.183), PO₄ (0.073-1.44), SiO₂ (2.94-35.5). Dissolved oxygen varied from 6.60-8.42 mg/L. Phytoplankton biomass (in mg/m³) and pigment composition was composed mainly of chlorophyll a (1.03 to 23.03) and fucoxanthin (0.36 to 0.68). During the first week of this bloom, we measured the highest densities of *Thalassiosira* sp. (1.24–1110×10⁴ cells L⁻¹). Fish mortality occurred from obstruction of gills. Several tons of dead fish were removed from the beaches during the first and the second week. Simultaneous with the *Thalassiosira* bloom, *Pseudo-nitzschia* became abundant forming a new bloom. *Pseudo-nitzschia fraudulenta* was by far the most abundant species (Fig. 2A). Average valve measurements were (μm): length (87.2), width (5.02), striae/10μm (2.46), fibulae/10μm (1.38), poroids/1μm (5.26). *P. pungens* (Fig. 2B) and a *P. pseudodelicatissima* complex were also present, but were scarce. Highest abundances of *Pseudo-nitzschia* spp. varied from 5 to 13×10⁶ cells L⁻¹. *Pseudo-nitzschia fraudulenta* is considered an uncommon form in the Gulf of California [5]. The bloom occurred under upwelling conditions characteristic of this season [6], accompanied by low temperature (18.5 to 19°C) at the start of the bloom. These temperatures are low, compared with typical seasonal water temperatures of 26 to 28°C in June, which were measured at the end of the bloom. Chain-forming diatoms of medium and large size, such as *Pseudo-nitzschia* spp., and *Thalassiosira* spp. dominate spring and summer upwelling events in coastal waters [7]. This suggests that *P. fraudulenta* could be considered as a blooming-species characteristic of upwelling systems.

Other bloom-forming species collected during sampling were *Gymnodinium catenatum*, *Cocchlidium polykrikoides*, *Polykrikos kofoidii*, *Ceratium furca*, and *Peridinium quinguecornes*. Domoic acid was detected in net phytoplankton samples (24 to 52 ng/filter). *P. fraudulenta* has recently been demonstrated to produce domoic acid [8]. Domoic acid, the agent causing amnesic shellfish poisoning (ASP), occurs in at least eight species in this genus [8, 9]. Because of the high densities of *P. fraudulenta* in samples we believe this species was the main source of domoic acid in net phytoplankton samples. However toxicity of *P. fraudulenta* must be confirmed in laboratory strains because no domoic acid was detected in cultures of this species from the Gulf of Naples [10]. The highest concentration of DA in the chokolata clams (*Megapitaria chocolata*) was only 0.55 mg kg⁻¹. *P. fraudulenta*, *P. pungens* and *P. pseudodelicatissima* have been reported to produce low levels of domoic acid [8, 9]. The action limit for the amount of DA allowed in molluscan shellfish is established at 20 mg kg⁻¹. During this *Pseudo-nitzschia* bloom, many schools of sardine were feeding on this diatom, and in turn, hundreds of brown pelicans were feeding on sardine. However, no die-offs of sardines or pelicans were observed. This is the first bloom of *P. fraudulenta* containing domoic acid recorded in this region. We continue to monitor *Pseudo-nitzschia* species in Bahía de La Paz and other embayments from the Gulf of California and collect different strains to determine their levels of toxicity.

We would like to thank Irena Kaczmarca and James M. Ehrman at Mount Allison University in Sackville, NB, Canada for their invaluable help identifying species using scanning electron microscopy; F. Hernández-Sandoval for pigment analysis.

**References**


K. Erler, Friedrich-Schiller Univ., Faculty of Biology and Pharmacy, Dornburgerstraße 25, 07743 Jena, Germany.
Pseudo-nitzschia spp. and Prorocentrum micans blooms in Luanda Bay, Angola

In May-June 2006, two red tides with mass mortalities of fish, cephalopods, crabs and lobsters occurred in Luanda Bay. In the first bloom on 24 June, with sea temperature around 22°C and salinity 27, Pseudo-nitzschia spp dominated, with maximum concentrations of the 670 x 10^3 cell L^-1. The second event was dominated by Prorocentrum micans with maximum concentrations of 5 x 10^6 cell L^-1. The latter bloom with brown color water, extended throughout the Bay and for 2 days caused mortalities of pelagic and demersal fish, a cephalopod, crabs, and lobsters (Table 1).

Surface samples were collected at 11 stations in Luanda Bay on 24 May and 13 June 2006 (Fig. 1), fixed immediately in 2% formol, or kept alive for some hours to help species identification. The Utermöhl technique was followed, using an inverted microscope with phase contrast “Axiovert 200”. Cells counts are shown in Table 2.

Some species of Pseudo-nitzschia produce domoic acid, an amino acid with high neurotoxic activity in humans [1-3]. In the Benguela current, Pseudo-nitzschia species occur, but the presence of domoic acid has not been observed [4]. On 13 and 14 June 2006, water temperature was about 25°C and salinity 33. At this time, the dinoflagellate Prorocentrum micans dominated the bloom with mean concentrations of 2.8 x 10^6 cell L^-1 and 0.57 x 10^6 cell L^-1 on 13 and 14 June respectively (Fig. 2).

In this second event, the first dead organisms were detected on the morning of 13 June; the mortality intensified during the day in the whole Bay, and decreased on 14 June in the coastal areas (Fig. 3). This event caused panic amongst the

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Table 1. Species identified in the mortality (13-14 June 2006).

<table>
<thead>
<tr>
<th>Species</th>
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<tbody>
<tr>
<td>Hemiramphus brasiliensis</td>
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<tr>
<td>Citharichthys stampfli</td>
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<td>Muraena melanotis</td>
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<td>Dentex barnardi</td>
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<tr>
<td>Brachydeuterus auritus</td>
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<td>Lygodontis marei</td>
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<td>Acanthus monroviae</td>
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<tr>
<td>Cephalopholis sp.</td>
</tr>
<tr>
<td>Epinephelus sp.</td>
</tr>
<tr>
<td>Bodianus speciosus</td>
</tr>
<tr>
<td>Pomadasyis incisus</td>
</tr>
<tr>
<td>Bothus podas</td>
</tr>
<tr>
<td>Neoniphon sp.</td>
</tr>
<tr>
<td>Stegastes sp.</td>
</tr>
<tr>
<td>Balistes capriscus</td>
</tr>
<tr>
<td>Conger conger</td>
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<td>Scarus hoefleri</td>
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**Demersal fish**

<table>
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<tbody>
<tr>
<td>Sardinella maderensis</td>
</tr>
<tr>
<td>Trachurus trecae</td>
</tr>
<tr>
<td>Liza falcipinnis</td>
</tr>
<tr>
<td>Laeops sp.</td>
</tr>
<tr>
<td>Spicara nigricauda</td>
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</tbody>
</table>

**Cephalopods**

<table>
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<tbody>
<tr>
<td>Sepia officinalis</td>
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</table>

**Crustaceans**

<table>
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<tbody>
<tr>
<td>Panulirius regius</td>
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<tr>
<td>Callinete marginatus</td>
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<tr>
<td>Callinete amnicola</td>
</tr>
<tr>
<td>Callinete pallidus</td>
</tr>
</tbody>
</table>

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Table 2. Densities cell L^-1 in different stations in Luanda Bay.

<table>
<thead>
<tr>
<th>Station</th>
<th>Pseudo-nitzschia spp 10^3 cell L^-1</th>
<th>Prorocentrum micans 10^6 cell L^-1</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>0</td>
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<tr>
<td>2</td>
<td>1.1</td>
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<tr>
<td>3</td>
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<td>4</td>
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<td>10</td>
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<td>0.10</td>
</tr>
<tr>
<td>11</td>
<td>317</td>
<td>0.04</td>
</tr>
</tbody>
</table>

![Fig. 1. Map of sampling location in Luanda Bay](image1)

![Fig. 2. Abundance of Prorocentrum micans on 13 and 14 June, 2006](image2)
fishermen as more species became involved (Table 1). *Prorocentrum* has previously been identified as a cause of fish mortalities in Angola [5]. *Prorocentrum micans* is not regarded as toxic, but in high concentrations can cause anoxia as bloom material decays. A similar event was recorded in St. Helena Bay, South Africa, in 1994, in which *Prorocentrum micans* associated with others species was associated with mortality of several fish species [6]. In this event the death of marine fauna was caused by anoxia or poisoning by hydrogen sulphide generated by anaerobic bacteria.

On 24 May and 13-14 June, *Prorocentrum micans* was widely distributed in the Bay, with a maximum concentration of 5x10^6 cell L^-1 at St. 9, followed by Stations 8, 5, 1, and 4. The lowest concentration was at St. 11 with 38.9 x 10^3 cell L^-1 (Table 2).

**References**


**Sri Lanka**

**Microcystin producing *Microcystis aeruginosa* in Lake Beira, Sri Lanka**

Cyanobacteria or blue green algae are aquatic and photosynthetic prokaryotes which form harmful algal blooms (HAB) under optimal conditions. Of the more than 50 genera of freshwater cyanobacteria identified, 12 are capable of producing toxins [1]. Mass presence of these organisms in freshwaters is of increasing concern worldwide due to their production of a range of hepatotoxins and neurotoxins. *Microcystis* is the most common of these toxic cyanobacteria. *Microcystis* occasionally forms dense aggregations of cells that float on the surface of the water forming a thick layer or ‘mat’. These blooms potentially affect water quality as well as the health of human and natural resources. Decomposition of large blooms can lower the concentration of dissolved oxygen in the water resulting in death of fish in the water bodies.

Sri Lanka has thousands of man made ‘tanks’ or reservoirs. One of these, Lake Beira (6° 56’ N & 79° 51’E), is a unique landmarks of Colombo and a historic relic from its colonial past. Today it covers 65 hectares with a catchment area of 448 hectares. Previous reports on water blooms have revealed the occurrence of toxic cyanobacteria in fresh water bodies of Sri Lanka, including Lake Beira [2].

In May 2006, heavy growth of algae and large numbers of fish deaths were recorded in Lake Beira. According to the National Aquatic Resources Agency (NARA), Sri Lanka, no epidemic was found among the fish, and oxygen deficiency, especially in the early hours of the day, caused the deaths.
Therefore, a study was carried out to determine whether any toxic cyanobacteria were present in the algal bloom. A molecular technique was used to identify cyanobacteria present in the Lake waters. Water samples were collected aseptically in sterile brown glass containers on 24th May 2006. These samples were collected from different sites and cultures originated from the bloom analyzed. Presence of the gene tested (the mcyE gene, which encodes the glutamate activating adenyltransferase domain of the microcystin synthetase gene cluster) in the samples indicated that the algal strains isolated have the potential to produce microcystins, and the species present was identified as *Microcystis aeruginosa* (EF051238 and EF051239). Thus, the cause of the fish deaths could have been either cyanophyte toxins or oxygen depletion. By combining microscopy with molecular techniques, the presence of toxigenic cyanobacterial in raw water sources and recreational waters can easily be monitored.

**References**


**Spain**

**Mucilage event associated with Gonyaulax fragilis in NW Mediterranean Sea**

Table 1. Environmental parameters observed in surface water of some stations located in the area affected by mucilage (for beaches n=10 and offshore stations n=4).

<table>
<thead>
<tr>
<th></th>
<th>Beaches</th>
<th>500 m offshore</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min-Max (Avg)</td>
<td>Min-Max (Avg)</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>19 and 26/07/06</td>
<td>12 and 13/07/06</td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>28-30.5 (29.02)</td>
<td>20.07-21.7 (20.99)</td>
</tr>
<tr>
<td><strong>Salinity</strong></td>
<td>37.6-38.2 (37.87)</td>
<td>37.32-37.99 (37.76)</td>
</tr>
<tr>
<td>PO4 (µM)</td>
<td>0.05-0.51 (0.13)</td>
<td>0.02-0.08 (0.05)</td>
</tr>
<tr>
<td>NH4 (µM)</td>
<td>0.06-1.48 (0.85)</td>
<td>0.51-0.79 (0.62)</td>
</tr>
<tr>
<td>NO2 (µM)</td>
<td>0.05-0.63 (0.15)</td>
<td>0.07-0.08 (0.08)</td>
</tr>
<tr>
<td>NO3 (µM)</td>
<td>0.54-17.55 (3.19)</td>
<td>0.24-0.25 (0.24)</td>
</tr>
<tr>
<td>H4SiO4 (µM)</td>
<td>0.41-0.86 (0.67)</td>
<td>0.67-1.2 (0.6)</td>
</tr>
<tr>
<td>Mean daily wind speed*</td>
<td>0.3-1.2 (0.6)</td>
<td>0.3-1.2 (0.6)</td>
</tr>
<tr>
<td>Max. wind speed*</td>
<td>10.4</td>
<td>10.4</td>
</tr>
</tbody>
</table>

* Data set from two meteorological stations located near the affected area.

The accumulation of mucilage in coastal waters may have important consequences for local fishing and tourist industries. Sporadic episodes of mucilage production have been observed for many coastal waters worldwide, and at some locations, like the Adriatic basin (Mediterranean Sea) and Tasman Bay (New Zealand), such events have been recorded as recurrent. In the Adriatic Sea, the formation of mucilage has been historically attributed to extracellular organic matter produced mainly by diatoms [1, 2]. However, some studies suggested that the appearance of mucilage might also be related to the dinoflagellate *Gonyaulax fragilis* (Schütt) [3, 4]. Pompei et al. [4] observed the constant concomitant presence of *G. fragilis* and mucilage formation, and detected the capacity of this organism to produce large amounts of extracellular carbohydrates in culture. In addition, Pistocchi et al. [5] found similarities in the composition of monomeric carbohydrates of *G. fragilis* exudates in culture (especially when grown in f/2 medium) and those analyzed in mucilage derived from natural waters. In Tasman Bay, mucilage accumulation was attributed to the polysaccharide exudates of *Gonyaulax hyaline* (Ostenfeld et Schmidt) [6], which is very similar to *G. fragilis*. In the Western Mediterranean Sea, mucilage events associated with *G. hyaline* were reported for coastal waters of Andalusia (South Spain) during autumn 2002 [7]. Along the Catalan coast (NE Spain), the presence of mucilage was observed in many occasions, but its detection was never associated with a specific phytoplankton species.

Between 10 July and 4 August 2006 (performed on a daily base during summer months) revealed several aggregates of mucilage along a 65 km section (Fig. 1). In general, this mucilage presented a green-brownish colour (Fig. 2) and its formation occurred after a long period of calm weather conditions associated with high atmospheric pressure. The environmental variables considered during this event are presented in Table 1.

In the context of the Harmful Algae Monitoring Programme (initiated in 1995), mucilage was collected from two
aggregates, separated by a distance of 25 Km, on 27 July. One of them was located near the coast (Arenal beach), whereas the other was located 500 m offshore of the Pineda beach (Fig. 1). Samples were fixed with Lugol’s solution and examined under an inverted microscope equipped with epifluorescence detection. *G. fragilis* was identified using the epifluorescence mode after the addition of Calcofluor [8] directly into the sedimentation chamber (Fig. 3).

Microscopic analysis revealed that *G. fragilis* and *Pseudo-nitzschia calliantha* (identified using the SEM technique) were the two most abundant species in both mucilage samples collected (with maximum abundances of $2.27 \times 10^6$ and $23 \times 10^6$ cells L$^{-1}$, respectively). Other organisms were also abundant, including *Chaetoceros* spp. in the Arenal sample and *P. caciantha*, *Ostreopsis* sp. and some species of gymnodinioiids in the Pineda sample. In the latter, many additional species were detected at low concentrations. Several of the *G. fragilis* cells present in the mucilage showed sticky material leaving from their apical part (Fig. 3).

High abundances of *Pseudo-nitzschia* spp. are commonly observed along the Catalan coast [9]. In contrast, *G. fragilis* has only been recorded in a few cases, and always at very low densities [10, 11]. However, during the above mentioned mucilage event, *G. fragilis* occurred along 60% of the beaches monitored in the area (Fig. 1), with a maximum abundance of 2160 cells L$^{-1}$.

This is the first study reporting exceptionally high *G. fragilis* cell numbers along the Catalan coast. Moreover, it is the first record indicating a wide distribution of this species in the area. Based on these two observations, the formation of mucilage was most likely associated with *G. fragilis*. Additional studies are, however, needed to confirm this association and to evaluate possible contributions by species from other taxonomic classes simultaneously detected.

Acknowledgements

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References


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Bloom of *Ostreopsis ovata* on the Conero Riviera (NW Adriatic Sea)

At the end of September 2006, an unusual bloom of the benthic dinoflagellate *Ostreopsis ovata*, occurred on the Conero Riviera, a rocky promontory along the sandy coast of the NW Adriatic Sea. The bloom was observed as a brown, velvet-like mat, covering natural and artificial rocks, seaweed thalli, and mollusc shells. Due to the weak association of microalgal cells with the substrate, the mat was easily resuspended in the water column by waves and mechanical action. The bloom persisted for 30-40 days and by mid-November, only a sporadic presence of *O. ovata* was observed.

The occurrence of *O. ovata* in microalgal communities of western Italian coasts is known since the 1980s, when it was reported in the Tyrrhenian Sea [1, 2]. In the last decade, bloom events became more frequent, and their occurrence in summer in the Tyrrhenian and Ligurian Seas was associated with death of benthic organisms and/or human health problems such as respiratory difficulties and skin irritation [3-6]. *O. ovata* has been reported also on the Sicily coast (Giacobbe pers. comm.), [13] and in the southern Adriatic Sea, where it has been observed since 2001 [7]. This is the first report for the northern Adriatic basin. Moreover, in the same period, *O. ovata* has also been observed on the rocky coast of the Gulf of Trieste, NE Adriatic Sea (Cabrini & Monti, pers comm.).

*O. ovata* is a producer of palytoxin-like compounds [8]. Due to its appearance at the end of summer, when tourist affluence was decreasing, the bloom was apparently not associated with health problems, although unknown toxicity, not due to other common toxins of this area, such as YTX and DSP, was detected in mussels in the same period (Poletti, pers. comm.).

In the northern Adriatic Sea, microphytobenthic communities are commonly represented by diatoms and filamentous cyanobacteria, which exhibit typical seasonal behaviour. Benthic dinoflagellates such as *Prorocentrum lima* are rarely observed, always in summer, at low abundance, and only associated with soft sediments [9, 10].

The appearance of this bloom lead to intense sampling, from the sandy coast of Palombina to Numana harbour (Fig. 1): sampling was carried out in different areas and on different substrates and in the water column, to estimate microalgal abundance. Results show that *O. ovata* cells colonized a variety of substrates, such as macroalgae, rocks, mussel shells, and also benthic invertebrates (Fig. 2). *O. ovata* was not observed in samples collected on sandy beaches. Densities reached 6500 cells cm\(^{-2}\) on rocks and 20,000 cells g\(^{-1}\) fresh wt (corresponding to 124,000 cells g\(^{-1}\) dry wt) on seaweed samples. These values were lower than those observed in the Ligurian [5], Catalan [11], or Aegean Seas [12], but at the time of sampling the bloom was declining. Higher numbers were found on ramified filamentous (e.g. *Chondria*) and parenchymatic (e.g. *Dictyota*) algae than on laminar thalli (e.g. *Ulva*). The abundances of *O. ovata* in the water column amounted to about 2000 cells L\(^{-1}\).

The identification and counting of *O. ovata* in the samples was carried out with an inverted microscope (Fig. 3) under epifluorescence using Calcofluor. However, due to the taxonomical uncertainties with *O. siamensis*, the diagnosis was confirmed by the molecular PCR based analysis. *Ostreopsis* cells were isolated using a micropipette, and monospecific cultures were maintained in F/2 and F/4 media at 21 ± 1°C and a 14:10 h (light:dark) photoperiod. Illumination was provided by fluorescent tubes with a photon irradiance of 100 µmol photons m\(^{-2}\) s\(^{-1}\).

Samples *O. ovata* from scraped mats and macroalgal thalli were processed for molecular analysis using the PCR based method. Genomic DNA and genus and species specific PCR assays were carried out as described by [13,14]. Genomic DNA was promptly amplified by PCR assay using genus and species-specific primers. Designed primers for the high variable
and conserved ITS-5.8S rDNA regions for the genus Ostreopsis and species O. ovata and O. cf. siamensis gave PCR amplified products of appropriate size for the genus and species O. ovata: 92 bp and 210 bp, respectively. No amplified products specific for O. cf. siamensis (223 bp) were obtained. The primers showed high specificity with no other detectable bands observed, and did not amplify non-target genomic DNAs. The PCR based method applied to different kind of environmental samples proved to be a rapid and sensitive way to confirm the taxonomic identity of O. ovata at the species level.

Ostreopsis ovata is a common species in tropical areas. Its occurrence in Mediterranean microalgal assemblages, may be a result of a recent introduction to the Mediterranean from ciguatera areas [2]; alternatively, its presence in microphytobenthic communities may have been neglected in the past. This species seems to be expanding its range rapidly, even in colder northern areas. Its occurrence in coastal areas of the northern Adriatic Sea (Conero Riviera and Gulf of Trieste) has probably been favoured by the increased water temperatures of the last decade [15]. It clearly poses increasing risks for human health, and effects on benthic communities.

References


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Fig. 2. SEM micrographs of Ostreopsis ovata on different substrates: (A) Cells of O. ovata on brown alga Dictyopteris polyiodioide. (B) O. ovata from a rocky substrate. (C) Cell of O. ovata on brown alga Cystoseira compressa, covered by filamentous cyanobacteria.

Fig. 3. Light micrographs of Ostreopsis ovata: (A) formaldehyde fixed cell. (B) Empty cell showing thecal plates.
• Egypt

Toxic phytoplankton species link to invertebrate and fish mortality in the Eastern Harbour of Alexandria (Egypt) during July-August 2004-2005

The coastal area of Alexandria is subjected to direct discharge of wastewater, mainly from two land-based sources, estimated as about 7 x 10^6 m^3 d^-1 of agricultural drainage water mixed with the overflow from Lake Mariout (main basin outfalls: about 500 x 10^3 m^3 d^-1 primary treated and 300 x 10^3 m^3 d^-1 untreated municipal waste water) into Mex Bay, west of Alexandria, and about 2 x 10^6 m^3 d^-1 of industrial and agricultural waste water into Abu Qir Bay, east, which renders the sea water highly eutrophic.

The Eastern Harbour (E.H.) of Alexandria is located in the central part of the city. It is a sheltered, relatively shallow semi-enclosed marine basin. It was a recipient of huge amounts of municipal wastewater during the last three decades. Yet, there is an encouraging fact in that remedial actions have been taken by the Alexandria Governorate to close the E.H. outfalls, as well as the main sewer of Alexandria (Kayet Bey) at its western vicinity, and their share of waste water had been diverted to the Lake after primary treatment. However, due to water circulation, the harbour is still affected by the water discharge, mainly from Mex Bay (8 Km long).

During August 2004 and July-August 2005 incidents of fish and invertebrate mortality occurred accompanying long duration of visible water discoloration. According to information received from marine protection and diving organizations, the Alexandria Governorate and the environmental authority, that “marine life on the bottom of the E.H. were severely destroyed. Dead fish and stunned demersal and pelagic fishes losing their equilibrium, gasping at the surface, swimming either on their sides or upside down, suffering from disorientation and unresponsiveness to human presence, and the presence of hundreds of small crabs found dead on the sand beach or seeing migrating towards the beach at dawn or found dead in fishermen nets indicating signs of toxicity”. Symptoms of anoxic condition were also observed in dead fish include yellowish coloration of the body and gills. The last cases of massive invertebrate and fish mortality occurred invertebrate and fish mortality occurred in the neritic waters of Alexandria, and during 2004-2005.

The present red tides maintained surface water temperature above 27.5°C to >30°C, and low salinity (34.6-37.5 psu), affected by discharged water from the west. Reduced salinity seems contributing a part to explain the development of C. antiqua and G. mikimotoi in the harbour [4]. Water column stability is a permanent feature. Generally, nutrient concentrations were relatively low, while the reverse was true for organic matter.

G. catenatum Graham became noticeable on 3 August 2004 (0.15 x 10^6 cell L^-1), under relatively high nutrient concentrations (1.68 µM PO_4, 3.65 µM NO_3, 3.8 µM NH_4), and low organic matter (1.46 mg L^-1), followed by its major peak on 7 August, declining the next day. Phosphate and nitrate concentration were reduced to a third on 8 August (0.18 µM PO_4, and 0.55 µM NO_3), ammonia was almost unchanged (3.81 µM and 3.47 µM, for the two days, respectively). These two peaks accompanied high levels of organic matter (7.5 and 8 mg L^-1). G. catenatum was first found in Alexandria waters in 1992 [5, 6].

Table 1. Species linked to invertebrate and fish mortality in the Eastern Harbour of Alexandria during 2004-2005.

<table>
<thead>
<tr>
<th>Species</th>
<th>Year/Maximum Density (MD, cells L^-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2004</td>
</tr>
<tr>
<td>Alexandrium ostenfeldii</td>
<td>9 Aug</td>
</tr>
<tr>
<td></td>
<td>14-15 Aug</td>
</tr>
<tr>
<td>Chattonella antiqua</td>
<td>21 Aug</td>
</tr>
<tr>
<td></td>
<td>13-14 Aug</td>
</tr>
<tr>
<td>Gymnodinium catenatum</td>
<td>7-8 Aug</td>
</tr>
<tr>
<td></td>
<td>1 Aug</td>
</tr>
<tr>
<td></td>
<td>15 Aug</td>
</tr>
<tr>
<td></td>
<td>17 Aug</td>
</tr>
<tr>
<td></td>
<td>21 Aug</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Gymnodinium mikimotoi</td>
<td>13 August</td>
</tr>
<tr>
<td></td>
<td>10-11 July</td>
</tr>
<tr>
<td></td>
<td>14 Aug</td>
</tr>
</tbody>
</table>
Cochlodinium catenatum (Paulsen) Balech et Tangen was first found west of Alexandria (Mex Bay) during 1992 [7], and in the Eastern Harbour during 1998 [2]. Its maximum density on 25 July 2005, in combination with other species raised Chl. a content to 59.5 µg L⁻¹. Phosphate was at 0.62 µM, nitrate 1.62 µM and ammonia 4.18 µM.

Gymnodinium mikimotoi Miya et Kominami ex Oda was previously recorded in the E.H. of Alexandria in September 1998 at 22.5-27.2°C and salinity of 34-36.5 psu [2]. Densities between 0.13 x 10⁶ and 1.66 x 10⁶ cell L⁻¹ were found from late September–early October 2000 [8].

Chattonella antiqua (Hada) Ono attained increased density on 19 August, reaching a peak two days later, accompanied Chl. a at 65 µg L⁻¹. Its densities during 2005 were significantly lower than that recorded in the same period during 2004. C. antiqua was first described and recently found in the Eastern Harbour to be most frequently at 24.5-26°C and 34.5-35 psu, and it shared a role in blooms causing mortality during 2001 [4].

It is concluded that:
1. The water characteristics were deeply affected by water discharge from the west. A reduction in the discharge rate is urgently needed to improve the situation, not only in the harbour, but also along the whole coast of Alexandria.
2. The sever damage of marine life in the Eastern Harbour of Alexandria during August 2004 and July-August 2005 was a direct impact of the occurrence of 6 toxic phytoplankton species.
3. The present blooms originated from the E.H.
4. The long duration of the bloom during all August could help this dramatic event.
5. Increased water temperature could be a crucial triggering factor for the rapid occurrence and development of G. catenatum.
6. Water stabilization was a constant ecological factor.
7. Nutrient concentrations were always low, yet nitrate and ammonia showed moderate values at times. The reverse was true for those of dissolved organic matter.
8. The consumption of inorganic nutrients signals their importance. However, high organic matter concentrations could help to maintain the blooms.
9. The species succession and degree of dominance varied with time.
10. Toxic red tide species are on the rise in Alexandria, A. ostenfeldii became a red tide bloom species in The Eastern Harbour. The phenomenon has become of regular occurrence in the warm season (April - October).
11. Recurrent blooms are expected in the future.
12. The rare occurrence of undesirable species such as Alexandrium minutum, Pseudo-nitzschia pungens and Heterosigma sp. could inflict more damage in the near future.
13. A monitoring program must be carried out along the Egyptian Mediterranean coast to evaluate the real situation. Human health is placed at risk, ecosystems are altered, fishing and aquaculture suffer from economic losses.

References:


• Guatemala

Cochlodinium catenatum on Guatemala coast (2004 & 2007)

Cochlodinium catenatum (Kofoid & Swezy 1921) was first detected May 28th 2004 in Guatemala coastal waters. Satellite images from June 5, 2004 (Fig. 1A), show southern waters partially occupied by high density patches of chlorophyll (＞20 mg/m³). Although there is an area of lower density, the whole coastline of Honduras, El Salvador and the Golfo de Fonseca was completely invaded by high densities of chlorophyll (10-30 mg/m³). This event lasted for approximately 32 days, until June 27. To confirm the presence of the species, phytoplankton samples were taken from 4 sites on June 23 (Fig. 2). Those samples confirmed dominance of C. catenatum with a maximum of 964,000 cells L⁻¹, and forming chains of 2-4 cells (Figs. 3 A, B). The hydrological characteristics are summarized in Table 1 and reveal high nutrient concentrations in the continental waters that flow into the Pacific.

From January 8 until January 29, 2007, there was also a red tide event caused by the same species. Unfortunately, communication of the event was late and no hydrological data could be taken. A sample of water from the dock contained 6,970,000 cells L⁻¹. The dominating chains were formed by 4-8 cells (Fig. 3 C, D). Temperature was 28°C. The satellite image showed a bloom in the Guatemalan Pacific Region (Fig. 1B). It is pertinent to clarify that C. catenatum has frequently been mistaken with C. polykrikoides. According to Chinese and Japanese studies [1], three morphotypes are recognized: C. convolutum, C. polykrikoides and C. sp. (=C. catenatum). Those morphotypes are
recognized by the type of chloroplasts they possess. While *C. convolutum* has reticulated chloroplasts, *C. polykrikoides* has rod-like longitudinally aligned chloroplasts. *C. catenatum*, the one found in these episodes, has granulated chloroplasts (Fig. 2A). It is possible however, that both species coexist on the Pacific coast of Central America and Mexico, as they do in China and Japan. This coincides with the descriptions of *C. catenatum* from Bahia Banderas, Mexico [2]. It also coincides with the descriptions of *C. polykrikoides* found in La Paz, Baja California Sur, Mexico [3], because the photographs show granulated chloroplasts and a truncated epicone, not round as in the case of *C. polykrikoides* [4]. Additionally the densities found in La Paz are very similar to the ones reported in this case. There was a fish mortality, but it was not possible to determine its extent nor the species affected.

The satellite images indicate that the blooms are typically coastal, linked to upwelling that starts in January and with
time move along the entire Central American coast, until mid-year when they reach the Golfo de Fonseca. That was the cause of the large fish mortality of in the southern part of the Golfo de Nicoya, Costa Rica, caused by the same species of alga (personal communication, M. Vargas-Montero). The dominant species may vary according to the intensity of the currents that move the din cysts towards the surface, as well as the prevailing environmental conditions.

**Acknowledgements**

Carlos Suarez Gutierrez, for composing the figures; OBIMAR, Puerto San Jose, for their collaboration in the red tide sampling program.

**References**


**Table 1. Hydrological characteristics and cell concentrations of Cochlodinium catenatum (cells mL⁻¹).**

<table>
<thead>
<tr>
<th>Sampling sites</th>
<th><em>Cells mL⁻¹</em> (surface)</th>
<th><em>Cells mL⁻¹</em> (5 m)</th>
<th>Temp. (°C)</th>
<th>Salinity (ppt)</th>
<th>pH</th>
<th>P (mg L⁻¹)</th>
<th>PO₄ (mg L⁻¹)</th>
<th>NO₃ (mg L⁻¹)</th>
<th>Sechii disk (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>964</td>
<td>120</td>
<td>30.3</td>
<td>32.8</td>
<td>7.8</td>
<td>0.54</td>
<td>1.64</td>
<td>5.3</td>
<td>1</td>
</tr>
<tr>
<td>Site 2</td>
<td>848</td>
<td>60</td>
<td>32.7</td>
<td>32.7</td>
<td>8.1</td>
<td>0.04</td>
<td>0.11</td>
<td>4.2</td>
<td>9</td>
</tr>
<tr>
<td>Site 3</td>
<td>132</td>
<td>40</td>
<td>31.2</td>
<td>32.2</td>
<td>8.3</td>
<td>0.04</td>
<td>0.14</td>
<td>5.2</td>
<td>11</td>
</tr>
<tr>
<td>Site 4</td>
<td>68</td>
<td>36</td>
<td>31</td>
<td>32.1</td>
<td>8.2</td>
<td>0.07</td>
<td>0.2</td>
<td>3.6</td>
<td>5</td>
</tr>
</tbody>
</table>


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**Eighth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB)**

The IPHAB is a mechanism to focus and cooperate on research, capacity enhancement and networks on harmful algae and their effects. The Panel has existed since 1991 and has initiated this newsletter, GEOHAB, manuals and guides, training courses etc.

At its meeting held at UNESCO Headquarters, Paris, from 17 to 20 April 2007, the Panel reviewed the actions completed during 2005-2006. The Panel noted that Denmark, Spain, Japan and the USA had maintained their significant financial support for the IOC HAB Programme. However, the Panel stressed that the IOC HAB Programme will only be able to develop and implement at the present rate in 2008-2009 if there is such financial support from Member States to fund programme staff and activities. The major achievements reported and discussed included: (i) development of the regional activities ANCA, FANSA, HANA and WESTPAC/HAB; (ii) the developments within GEOHAB including an Open Science Meeting on HABs in Stratified Systems, and publication with SCOR of the GEOHAB Research Plans for the Core Research Projects in Upwelling and Eutrophic Systems; (iii) the continued development of the IOC-ICES-PICES Harmful Algal Event Database; (iv) the implementation of eight training courses and several training-through-research projects; (v) the continued publication of the IOC Harmful Algae News; (vi) the results of the ICES-IOC WGHABD; (vii) the IOC co-sponsorship of several international HAB conferences; and (viii) provision of HAB literature to developing countries. The Session included a thorough self assessment of IPHAB mandate and impact. Dr. Leonardo Guzman (Chile) was elected new Chair and Dr. Phil Busby (New Zealand) was re-elected as Vice-Chair. The major decisions of the Panel concern (i) the formulation and communication of an IPHAB strategy for assisting Member States in the mitigation of harmful algal events; (ii) the implementation of HAB monitoring within the Global Ocean Observing System GOOS; (iii) strengthened biotoxin monitoring, management and regulations in cooperation with FAO and WHO, (iv) a strengthened regional HAB Programme development; (v) development of a Harmful Algal Information System within IOC’ International Ocean Data Exchange Programme IODE; (vi) the continuation of providing a taxonomic reference list of HAB species. The planned activities were summarized into a Work Plan and budget for the IOC HAB Programme 2008-2009.

At www.ioc.unesco.org/hab/IPHABVIII.htm you will find detailed background documents on IPHAB, its Work Plan, and its membership.

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**IOC UNESCO**

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France

First record of diatom *Pseudo-nitzschia americana* in French waters

Since 2004, the *Pseudo-nitzschia americana* complex has been recorded along French coasts of the North Sea, Channel and Atlantic Ocean. It has been observed either epiphytic on setae of *Chaetoceros* or planktonic in stepped chains (Fig. 1). Samples have been analysed with light microscopy (LM). The apical axis was 21-45 µm long and the transapical axis was 2.2-3.8 µm wide (n=12). Cell overlap in chains was 7-10% of the length. But these measurements were not enough to identify specimens of this complex at the species level.

In late October 2006, a short chain of 4 cells was isolated for cultivation from a seawater sample collected in Bay of Douarnenez (Fig. 2). After the culture was established, a subsample was studied using scanning electronic microscopy (SEM) to supplement the morphological characteristics (Fig. 3). Cells had no larger interspace between the two central fibulae and the raphe was not interrupted by a central nodule. There were 18-20 fibulae per 10 µm and 25-31 interstriae in 10 µm. The structure of the striae, parallel to the transapical

Fig. 1. Light micrographs showing an epiphytic cell on a setae of *Chaetoceros* (a), a short stepped chain of 4 cells (b).

Fig. 2. Map of Bay of Douarnenez and the sampling site.

Fig. 3. *Pseudo-nitzschia americana*, SEM micrographs of valve views showing an outline of the valve (a), an internal view of the middle portion (b); note the absence of the central interspace and the stria pattern, an external view (c); note the tendency for three rows of poroids (arrows) and an inside view of the apex (d); note the arrangement of the striae.
axis except at the poles, comprised mainly two rows of poroids, but a rudimentary third one was occasionally observed. The number of poroids per 1 µm was 8 or 9.

Compared with data on the 3 species of this complex, our cells were too wide to correspond to *P. linea* [1] and the number of interstriae per 10 µm, intermediate between that described for *P. brasiliana* (20-26) and *P. linea* (38-42), falls in the range mentioned for *P. americana* [1-5] (Table 1). Although *P. americana* is considered a cosmopolitan species, it has not been previously reported in France. Because of its low abundance in field samples, this species could not be identified without isolation followed by an examination using electronic microscopy.

Our results are in agreement with a recent Canadian publication [5] and corroborate the ability of *P. americana* to occur not only as single cells but also in short stepped colonies, as reported for its sister taxa from warmer waters, *P. brasiliana* and *P. linea*.

**Acknowledgements**

Our thanks to Philippe Crassous for his skilled technical assistance using SEM.

**Table 1. Comparative data on the morphology of species within Pseudo-nitzschia americana complex.**

<table>
<thead>
<tr>
<th>Species</th>
<th>Length (µm)</th>
<th>Width (µm)</th>
<th>Cell overlap (%)</th>
<th>Central interspace</th>
<th>Intersstriae (/10 µm)</th>
<th>Rows of poroids</th>
<th>Poroids (/1 µm)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>P. linea</em></td>
<td>13.4-26.6</td>
<td>1.8-2.2</td>
<td>Unknown</td>
<td>No</td>
<td>18-22</td>
<td>2-3</td>
<td>8-10</td>
<td>Lundholm, 2002</td>
</tr>
<tr>
<td><em>P. brasiliana</em></td>
<td>12-65</td>
<td>1.8-3</td>
<td>Unknown</td>
<td>No</td>
<td>20-26</td>
<td>2-3</td>
<td>7-10</td>
<td>Lundholm, 2002</td>
</tr>
<tr>
<td><em>P. americana</em></td>
<td>16-42</td>
<td>2.5-4</td>
<td>Unknown</td>
<td>No</td>
<td>18-24</td>
<td>2-3</td>
<td>8-10</td>
<td>Lundholm, 2002</td>
</tr>
<tr>
<td><em>P. americana</em></td>
<td>16-40</td>
<td>2.5-3</td>
<td>Unknown</td>
<td>No</td>
<td>18-20</td>
<td>2-3</td>
<td>8-9</td>
<td>Hallegraeff, 1994</td>
</tr>
<tr>
<td><em>P. americana</em></td>
<td>18-26</td>
<td>3.5-4</td>
<td>Unknown</td>
<td>No</td>
<td>20-21</td>
<td>2-3</td>
<td>Unknown</td>
<td>Hernandez-Becerril, 1998</td>
</tr>
<tr>
<td><em>P. americana</em></td>
<td>24-32</td>
<td>4</td>
<td>Unknown</td>
<td>No</td>
<td>20-21</td>
<td>2-3</td>
<td>6-7</td>
<td>Orlova, 2002</td>
</tr>
<tr>
<td><em>P. americana</em></td>
<td>12-39</td>
<td>2.5-3.7</td>
<td>10</td>
<td>No</td>
<td>18-23</td>
<td>2</td>
<td>7-10</td>
<td>Kaczmarska, 2005</td>
</tr>
<tr>
<td><em>P. americana</em></td>
<td>21-45</td>
<td>2.2-3.8</td>
<td>7-10</td>
<td>No</td>
<td>18-20</td>
<td>2-3</td>
<td>8-9</td>
<td>Our data</td>
</tr>
</tbody>
</table>

*Brazil*

**Diarrhoetic shellfish poisoning (DSP) outbreak in Subtropical Southwest Atlantic**

*Dinophysis cf. acuminata* is currently found in samples from the southern coast of Brazil and has been identified as a possible threat to the flourishing mussel culture in this part of the country [1]. The production of okadaic acid, a cause of DSP, by *D. cf. acuminata* in the region was earlier characterized, and cultured mussel samples tested positive by mouse bioassay [2].

In January 17th, 2007, during monitoring by mussel and oyster producers in association with our laboratory, alert counts for *D. cf. acuminata* (i.e. 400 cell L-1) were found at Cedro’s beach at Palhoça, South Bay of Florianópolis, Santa Catarina. The following day, a sample from the other side of the bight, at Ribeirão da Ilha, was collected. The counts were higher, and a sample from a *Perna perna* tested positive with the mouse assay (acetone extract of digestive glands).

These results were communicated to the recently formed National Committee for Mussel Sanitation Control - CNCMB. The committee closed the North and South Bays of Florianópolis for mussel collecting and commercialization. The closure was then followed by a more extensive sampling programme to cover a larger region to include other mussel culture areas.

Given the absence of previous epidemiological data and the need to protect consumers, the ban was extended to oysters, clams and scallops, all regularly consumed by the population either from aquaculture or extracted from natural beds.

As the causes and characteristics of the ban started to be fully covered by the media, cases of human intoxication started to be reported, including former cases.

In Florianópolis, positive mouse bioassays persisted for 10 days. The ban was suspended on January 27 when cell counts reached lower values (i.e. 150 cell L-1). During this episode, only *Perna perna* was contaminated, considering 2 out of 3 mice deaths in 24 hours. No contamination of other species was observed.
On January 30th, a few days after the first positive in the South Bay of Florianópolis, 130 people were attended at the health clinic in Bombinhas city, about 70 km to the north with gastrointestinal distress. Due to media exposition, these cases were quickly related to DSP by local health authorities and later confirmed by mouse bioassay. A second ban was set throughout Tijucas Bay. In this area, counting of *D. cf. acuminata* reached the highest value, $5.2 \times 10^4$ cell L$^{-1}$, recorded for Brazilian waters.

The bloom at Tijucas Bay persisted for a longer time, but in contrast to Florianópolis, oysters were also positive by mouse bioassays. The area was free from DSP only after 23 days, when the ban was suspended and mussels again collected and commercialized.

During this episode, the health authorities recorded more than 150 cases of DSP. But the number of cases not notified was also high, indicating that this was a large scale event. This human intoxication scenario might have been even worse if prompt action had not been taken. Santa Catarina is a summer tourist destination. Tourists mainly from Brazil and Latin America, come to enjoy the beaches, but also to consume the nationally famous seafood. The ban was imposed during the high season. While consumers were protected, producers and restaurant owners suffered economic losses. The economic consequences have not been fully assessed, but apart from larger producers, small artisanal growers who depend on mussel culture were also affected.

The data has still being processed to provide guidelines to set up a full HAB monitoring programme. This programme will by more comprehensive as apart from DSP toxins, we have already characterized PSP caused by *Gymnodium catenatum* [3, 4] and ASP by *Pseudo-nizschia* spp. (data not published).

This was the first fully characterized outbreak of mussel contamination with human intoxication in Brazil. It was also the first time a contingency plan was put into practice. The action involved the collaboration of mussel producers and municipal and federal government agents.

**References**


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# A Europe – Chile cooperation on *Alexandrium* blooms

**Puerto Montt 19th December 2006**

Chilean scientists from the 10th region (Los Lagos) and French scientists from Finistère (Western Brittany) met for ten days for a workshop organised and financially supported by the “French department of Finistère”, in Puerto Montt and in Chiloé Island, Chile.

The goal of these meetings was to initiate scientific cooperation between scientists from both areas belonging to various organisations: the Austral University of Chile, University los Lagos (I-mar Research Center), University of Chile (Marine toxins laboratory), IFOP los Lagos, the French National Research Council (phytoplankton laboratory CNRS), University of Western Brittany (LUMAQ), and the French marine research institute (IFREMER).

Discussions focused on the identification of key points for the improvement of HAB management. One of the main HAB problems experienced by both countries in recent years was caused by recurrent blooms of *Alexandrium* spp. first detected in the Magellan Straits in 1972, *A. catenella* now regularly affects the 3 most southern regions of Chile, from 52°S to 42°S (a bloom was expanding from the South of Chiloé Island during this meeting in December 2006). The massive occurrence of *Alexandrium* along French coasts is also recent. *A. minutum* has bloomed regularly since 1988 in several estuaries of northern Brittany, whereas *A. catenella* has been abundant since 1995 in Thau Lagoon (South of France).

From these meetings, nine topics were identified for a multidisciplinary working programme focused on the study of *Alexandrium* spp: their origins, the dynamics and monitoring of the blooms, environmental impacts, and the possibility to reduce their harmful effects.

The first subject, “origin, dynamics and monitoring” aims to improve the early detection, dynamic forecasting and understanding of the mechanisms that support bloom development:

1. Long-term regulations of blooms by parasitic infections.
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2. Population dynamics of invasive *Alexandrium* spp. migrating along the Chilean coast.
   lguillou@sb-roscff.fr, mseguel@uach.cl, dvarela@ulagos.cl.
3. Genetic cartography of the *Alexandrium* cysts from sediments by genetic tools.
   lguillou@sb-roscff.fr, mseguel@uach.cl, dvarela@ulagos.cl.
4. Evaluation of hyperspectral remote sensing application for the assessment of *Alexandrium* blooms.
   Denis.de-labroise@univ-brest.fr, golivares@mail.ulagos.cl, lguzman@ifop.cl, alexcle@telsur.cl.
5. Impact of *Alexandrium* blooms on the natural macrofauna.
   caranda@ulagos.cl, alexcle@telsur.cl.
6. Impact of *Alexandrium* blooms on fishes in aquaculture.
   genevieve.arzul@ifremer.fr and gvidal@ifop.cl.
7. Use of cystein in salmon farming as a tool against mucus overproduction in HAB impacted salmon.
   genevieve.arzul@ifremer.fr and gvidal@ifop.cl.

The second subject “environmental impact and reduction of effects” aims to characterise *Alexandrium* interactions with the environment:

   Denis.de-labroise@univ-brest.fr and caranda@ulagos.cl.
2. Comparison of *Alexandrium* sensitivity to toxic compounds (metals, pesticides) in relation to their geographical origin.
   genevieve.arzul@ifremer.fr, francoise.quiniou@ifremer.fr, alexcle@telsur.cl, dvarela@ulagos.cl.
3. Use of cystein in salmon farming as a tool against mucus overproduction in HAB impacted salmon.
   genevieve.arzul@ifremer.fr and gvidal@ifop.cl.

Actions will start in 2007 with scientific and student exchanges, and ideally should serve as the basis for a future collaboration under the next European FP7 calls. Thus, in this context, we are interested to develop collaborative projects that may concern these nine actions together with other EU members.

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HAB XII – Responses to the Conference

Clay flocculation, and other Mitigation topics at the XIth ICHA, Copenhagen 2006

One might suppose that one of the principle preoccupations at a conference on Harmful Algal Blooms would be mitigation of the harm they do. Yet, based on my perusal of the Book of Abstracts, mitigation of HABs was the subject of 0 out of 112 oral presentations (0%) and 19.5 (joint principle subject counted as 0.5) out of 374 posters (5.2%), giving only 4.0% overall. Corresponding percentages for presentations on Monitoring, Management and Forecasting were 22.5, 1.2 and 2.5% respectively. In mitigation, the above figures do not take into account that 1 out of the 5 mini-symposia that took place on Wednesday was devoted to the mitigation topic, “HABs and clay flocculation: Some species, some places, but not a silver bullet”.

This mini-symposium, led by Mario Senga and Kevin Sellner, was a lively and dynamic event, and comprised oral presentations, no posters, and plenty of discussion; the room was packed. As preliminary information on the mini-symposium pointed out, the use of natural clays to control HABs has been investigated for over 10 years in Japan, China, and South Korea, to minimise their impacts on aquaculture, and in Australia to treat blooms of the cyanobacterium Microcystis in fresh water. In the USA, clays have been used effectively against marine and brackish water species, but the chief research effort is concentrated on Karenia brevis blooms around Florida.

Senga gave an overview of the use of clays in the USA, particularly against K. brevis. While clay use over large areas of the coastal ocean would be prohibitively expensive, it may be economically feasible in limited areas of high amenity value. Phosphatic clays generally give the best results. However, there are concerns that toxins in cells thus sedimented to the bottom could remain to intoxicate benthic organisms, and Kevin Sellner, Monica Bricelj and Anne-Gaelle Haubois presented careful work on this problem, showing that the benthic layer of sedimented clay and flocculated cells can indeed transfer a relatively small amount of brevetoxin and its derivatives to deposit-feeding clams.

An important research effort, including large-scale trials in aquaculture areas, is being conducted in South Korea, and Chang-Kyu Lee presented aspects of this. The material favoured is yellow clay, because it works and is readily available locally. A suspension of clay in seawater is sprayed at high pressure onto the sea surface from barges. It has been found quite successful in reducing large-scale blooms of Cochlodinium polykrikoides. Zhiming Yu explained how clays have been used successfully, particularly when modified with quaternary ammonium compounds, to eliminate Heterosigma and Prorocentrum, with no apparent impact on co-cultured oysters. Yu also explained how various clays are used to eliminate dense, wind-concentrated floating mats of material from decaying Microcystis blooms, which disfigured an arm of Xuanwu Lake, where the 10th Chinese National Games were to be held. This technique completely eliminated the problem in time for the games, but required considerable socio-economic commitment. Nevertheless, in freshwater, clays have flocculent properties different from those in seawater, and so are less efficient at HAB removal. To replace the need to truck in huge quantities of clay, Yu’s Chinese colleagues have been working with modified local soils (MLS). Binding material, such as chitosan, is combined with local earth, and flocculates Microcystis well. The authors have even been adding macrophyte seeds to the MLS that subsequently germinate, and can help turn a lake from a turbid plankton-dominated ecosystem into one of clear water dominated by benthic plants.

In the Philippines, the efficiency of clays has been investigated in removing the toxic Pyrodinium bahamense, as well as Amphidinium and Chattonella. Local ball clay was found the most effective, with >99% removal (Larry Padilla).

Although not concerned with clays, I thank the organisers for allowing me to give an impromptu presentation about the potential role of cysteine in mitigating the harm done by HABs. In the laboratory, cysteine has been shown to fluidify potentially suffocating slimes produced by cultures of Karenia and Gymnodinium, to reduce haemolytic action due to their production of active oxygen, and to increase fish survival. Cysteine, also by fluidifying mucus, can in addition protect fish against suffocation following inhalation of the diatom Chaetoceros. Studies in situ are still required to show what protection cysteine may afford to aquaculture installations.

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Book Review


Price: EUR 129.95; GBP 100.00; USD 169.00

ISBN: 978-3-540-32209-2

This book (GT), claim the editors (p6), is intended to provide an ‘updated synthesis of HA ecology’ vis a vis the Bermuda volume (ACH) [1]; the latter was based on the proceedings of a NATO Advanced Study Institute held at the Bermuda Biological Station in 1996, and also published by Springer. GT contains thirty chapters in about 360 pages (excluding front and back matter), so each chapter is only about 12 pages long including bibliography. This brevity may be the reason for the rather telegraphic style adopted by some contributors. How much can really be said about the molecular biology of...
It could be argued that progress in defining the critical parameters regulating bloom dynamics ... has been disappointing.” This view, echoed in GT (p60), is no longer tenable. Big steps forward have been made in modelling in the last decade; there are some excellent papers published in a special volume of Deep-Sea Research [2]. Although the focus there is on the Gulf of Maine, the volume has lessons which can be transferred to all regional seas. In any case, the kind of “coupled physical-biological model” implied (p60) is not the only kind of model worth exploring. The updating intent of the editors has failed on this score.

Chapter 18 introduces the ideas of “up-shock” and “down-shock”, the first of which I take to be synonymous with “shift-up”, a term borrowed from bacterial chemistry, and introduced to phytoplankton ecology by Maclsaac[3]. This chapter tells us that “The only nutrient levels and ratios that ultimately matter are internal, not external” (p237), which reminds us of Droop’s cell quota model, and recalls for example the finding that oceanic Rhizosolenia mats have internal nitrate pools 10⁶ times higher than the nM external concentrations [4]. What rate of change in external nitrate concentration would be needed to “up-shock” (p229) these Rhizosolenia populations? What possible processes in nature, other than those of the cells themselves, could remove nitrate in such a manner as to cause “down-shock”? It is almost a relief to be told that the experimental results “may be of little or no ecological consequence” (p237). Also, “changes in toxin content are associated with disturbed (unbalanced) physiology ...”, which I take to mean pathological. Fogg [5] listed some elementary cytological signs of pathology due to nutrient problems in algae. Such signs have been observed in nature, but are rare; that being so, could we claim that eutrophication is not a problem, at least for microalgae? A distinct view of the relation between nutrient limitation and toxin production is summarized on p218.

We do not seem to be any closer to a resolution of the bacterial conundrum than we were ten or even twenty years ago (chapter 19), despite the now long-standing Silva-Kodama-Doucette prokaryotic hypothesis. The idea that bacteria play an important rôle in toxin synthesis still seems to be making heavy weather of it, so this is perhaps not a topic that a wise supervisor would want to point a graduate student at.

Grazing is dealt with in chapter 20, but only by zooplankton, amongst which are copepods. It fails to refer to an apparently important point made in chapter 27 (by the same author!), that copepods do not eat HA directly! Grazing by bivalves, which after all are the most important vectors of algal toxins to humans, is not mentioned in chapter 20, but gets a showing chapter 22, and is identified as an important control of brown tides in chapter 9. Chapter 21 is about pathogens of HA, and includes parasites. The interesting idea that HA activity might be regulated by the bacteria on seaweeds (p275) provokes the question, are some HABs due to sea urchins? I refer of course to the urchin barrens from which seaweeds have been removed by overgrazing. More of this sort of approach, and the old fashioned ‘natural’ ecosystems which are being so badly mismanaged in many regions will call for their own reconstruction.

Major (Pyrodinium, a significant human killer) and minor (Noctiluca) players in the HA field, both treated fully in ACH, are hardly mentioned here (the former gets a sentence, no more, on p61, the latter is merely listed, p6), neither is in the index. Several new toxin groups were discovered in the mid-1990s, but are not dealt with in this volume, such as azaspiracids (only mentioned once, p59) and spirolides (not mentioned at all).

The opus magnum of Justus von Liebig [6] (not Leibig, p304) has been described as “... a mixture of lasting truths, exaggerated conclusions, and plainly erroneous assumptions”, clearly a successful recipe, since this highly influential book went through nearly fifty editions in various languages, nineteen in North America alone, and increased in length by about a 1000 pages in the process. Liebig is often maligned, since he explicitly linked his argument about limiting nutrients to agricultural systems, and was careful to exclude ‘natural’ ecosystems, for which he stressed the mutual dependence of plants and animals. “A long-standing paradigm” (p343) does not have to stand forever.
For some decades, cultural eutrophication of fresh waters and coastal waters has been almost universally regarded as a bad thing, while the same process is a virtue on agricultural land and in algal cultures. The Greek root of the word after all gives us the sense of healthy, well-nourished. But this conventional wisdom is now being questioned; in the Seto Inland Sea for example, mandatory reduction of phosphorus inputs has been linked to an increase in toxin-producing dinoflagellate abundance and reduction in fishery yields [7]. Yet here (p346), an increase in phosphorus inputs in Tolo Harbour is linked to an increase in dinoflagellates. Growth of brown tide species *Aureococcus* and *Aureoumbra* is depressed by inorganic nitrate additions (chapter 9). Thus new questions emerge, how much eutrophication is desirable, and at what stage does it become undesirable.

Lord Taverne’s *March of Unreason* (2005) decries those who “use evidence selectively and unscrupulously to bolster prejudice, and who go through the motions of inquiry only to demonstrate some foregone conclusion”. This is exactly what Taverne himself does in pursuit of his own ideological agenda. The same tendency can be recognized here. For example, fig 26.4 (p346) purports to demonstrate a “broad relationship between nitrogen loading and HAB proliferation” (p345); it does nothing of the kind, as even a cursory glance reveals, and as is admitted by the authors on the next page. The apparently simple idea that the size of a population is regulated by the capacity of its environment to supply it with resources is remarkably difficult to confirm [8]. But however weak these arguments are scientifically, their obvious concern is well placed; there is a broad consensus that we cannot continue overexploiting nature much longer if we are to survive. “Our total inheritance took billions of years to assemble; it is being squandered in decades” [9]. One way forward is to estimate how resilient HA ‘infected’ coastal waters are; there is a large literature on ecological resilience. It is not the amount of nitrogen, say, that causes problems, but the ways in which its production and consumption are uncoupled [10]. Ideology appears elsewhere too. The mantra “HABs are increasing ...” appears in its canonical form (p159), but mercilessly only once. That *Phaeocystis* “disturbs the food-web” (p159) can also be viewed as dogma, as a major contributor to primary production, it perhaps structures it.

The various known toxins are frequently thought to play allelopathic roles (not allopathic as on p189, 197, which refers to harsh medical practices), in the sense that one plant or algal species suppresses another. This view is raised in the introduction (p4), and again in later chapters (12, 15, 17). So far, evidence in favour has proved elusive, and convincing experiments are difficult to accomplish. *Chrysocromulina* may be toxic to a bryozoan “when given as the only food source” (p178), so too are hamburgers to our children if eaten to the exclusion of other food. Nor is there strong support for the view that the known toxins are grazer deterrents (chapter 20). A rôle in either iron uptake or copper detoxification is proposed for domotic acid (p209). There are several reasons to doubt that any of these views is a strong candidate for a general hypothesis. For example, if simple aldehydes really are synthesized by diatoms for allelopathic ends, why go to the trouble of constructing the much more complex polyethers like ciguatoxins, brevetoxins, or yessotoxins, or the expensive (in terms of nitrogen) detoxification is proposed for domotic acid. Ideology appears its production and consumption are uncoupled [10]. But mercifully only once. That *Phaeocystis* “disturbs the food-web” (p159) can also be viewed as dogma, as a major contributor to primary production, it perhaps structures it.

The editors claim that every chapter was reviewed by themselves as well as some toxins may aid predation (summary on p183).

The reasons expressed escape their attention, like “a planktonic phytoplankton bloom” (p39), “In marine and coastal waters, nitrogen and phosphorus are seldom in high enough concentrations to sustain the growth of the full array of phytoplankton species co-existing in time and space.” (p198), “borrow” chloroplasts (p164)? Do they give them back afterwards? “This limited functionality, essentially being selection-neutral ...” (p239). Whatever it means, how do we know that? What is the difference between natural and bacterial degradation (p249)? The discoloured water witnessed by Darwin during the Beagle survey off Chile is generally agreed to have been due to *Mesodinium*, not to a dinoflagellate as stated here (p3); Darwin even provided a recognizable sketch. Readers of this newsletter may remember that the same organism had been described by the German naturalist Pöpper in 1827, seven years before Darwin’s visit, in the same region [11]. Surely at least one referee should have noticed this small detail? In summarizing experiments, there is no reason to avoid providing numerical data if it is available; thus, “*Karenia mikimotoi* was somewhat reduced ...”, “... the ciliates appear to have been extensively consumed by copepods ...” (p361); somewhat? Appear to have been? “... zooplanktivorous fish appeared to decrease copepod biomass ...” (p362), well did they or didn’t they?

References

6. Liebig v J 1840. Die organische Chemie in ihrer Anwendung auf Agricultur und Physiologie. Liebig’s ideas are available online in English in his “Chemical Letters”.

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Our current understanding of oceanic ecosystems and particularly of phytoplankton population dynamics largely depends on the ability to observe distributions and processes at different scales. To this effect, a 3-week field trip of the R/V *Thalassa* (Ifremer) in the Bay of Biscay (France) was partly funded by the European Commission and US-NSF under the programme HABIT (Harmful Algal Blooms in Thin Layers). A team of 25 scientists from the different partner institutions (MRI, IFREMER, IEO, CEFAS and Johns Hopkins University) deployed a wide variety of innovative instrumentation and methodology over the continental shelf.

The Scanfish and an Autonomous Underwater Vehicle (AUV) allowed us to describe the chlorophyll maximum located in the pycnocline, and its continuity at different scales from 1 to 100 km. The stability of the AUV allowed measurements of the velocity field around the pycnocline at a resolution of 20 cm. The in-house Ifremer particle-size profiler was equipped with a new in situ 2D-imaging fluoromicroscope: it can resolve very thin-layers (<20 cm) containing monospecific populations of *Chrysochromulina* sp., and it provided samples at the same resolution on the vertical axis. One of the important outcomes of this cruise was the detection *en route* of phytoplankton accumulations with a specific configuration of the Simrad ER-60 echo sounder. It revealed internal waves breaking on the shelf and the propagation of solitons generated at the shelf break. The zone where waves break is likely to have a great impact on populations distributions.

Three members of the GEOHAB Core Research Programme on Stratified Environments (P. Gentien, R. Raine, B. Reguera) participated in the cruise, together with L. Fernand from CEFAS and E. Malkiel (Johns Hopkins University)

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Regional Meeting on Future Focus and Cooperation in HAB Research

2nd Asian GEOHAB Meeting organized by the GEOHAB SSC in cooperation with IOC/WESTPAC and the IOC HABViet Project

Nha Trang Vietnam, 28 January-1 February 2008

The Scientific Steering Committee for GEOHAB (GEOHAB SSC) and WESTPAC/HAB is pleased to announce that a regional meeting on future focus and cooperation in HAB research, a Second Asian GEOHAB Meeting, will be held 28 January-1 February 2008 in Nha Trang, Vietnam. The local host will be Institute of Oceanography Nha Trang and the IOC HABViet Project.

Scientific Programme:

The First Asian GEOHAB meeting was held in Tokyo 15-16 March 2007. The Second Asian GEOHAB Meeting will provide an opportunity to develop further ideas and outlines of regional and national research relevant to GEOHAB, establish partnerships and identify research components that may merge into the GEOHAB Core Research Projects. The Meeting will consist of two parts.

- The first part will be a two-day seminar with broad participation and presentations on various aspects of harmful algae. This part will also serve as a forum for exchange of new regional research results and ideas between researchers, industry, government and local users, and other interested parties in Vietnam and regionally.

- The second part will be a two-day workshop for presentation and discussion of ongoing and planned research relevant to GEOHAB. The workshop will consist of plenary and subgroup discussions on development of specific new research projects or coordination and cooperation among ongoing projects. It is the objective to draft a plan for the development of Asian GEOHAB.

Organizing Committee:

- Ken Furuya, Japan (GEOHAB SSC and WESTPAC/HAB)
- Ming-Jiang Zhou, China (GEOHAB SSC)
- Nguyen Ngoc Lam, Vietnam (Local host)
- Doan Nhu Hai, Vietnam (Local host)
- Robin Raine, Ireland (Chair GEOHAB SSC)
- Patricia Gilbert, USA (Chair GEOHAB Core Research Project of HABs in Eutrophied Systems)
- Jacob Larsen, Denmark (HABViet Project IOC Science and Communication Centre on Harmful Algae)
- Henrik Enevoldsen (IOC)

Important Dates:

- Final Date for Receipt of Abstracts: 1 January 2008.

Registration:

- There is no registration fee to attend the meeting.

Financial support:

- There will be possibilities for financial support to invited participants and people applying for support. Please submit applications for support by 1 November 2007 to h.enevoldsen@unesco.org. Please indicate in applications which part of the cost can be covered from own sources.

Venue:

- The meeting will be held at Institute of Oceanography, Nha Trang, Cau Da 01, Nha Trang, Khan Hoa Province, Vietnam. Nha Trang has an international airport as well as frequent domestic connections to Hanoi and Ho Chi Minh City. Please use the web site www.geohab.info to register and to keep up to date on meeting developments.

Harmful Algae News

Previous issues of HAN and newsletters of the IOC HAB Programme can be downloaded at http://ioc.unesco.org/hab/news.htm

Requests for subscription

Subscription to HAN is made by sending a request with a complete address to Ms V. Bonnet: v.bonnet@unesco.org.
ISSHA President’s Corner

Plans are underway for the 13th International Conference on Harmful Algae scheduled for 3-7 November 2008 in Hong Kong. Professors K.C. Ho from the Open University of Hong Kong and Mingjiang Zhou of the Institute of Oceanography, Chinese Academy of Sciences in Qingdao will Co-Host the Conference. Members of the ISSHA Organizing Committee and the Local Organizing Committee will meet on the 16th of June 2007 to select the themes of the conference and discuss candidates for plenary speakers. The venue for the 2008 meeting will be the Hong Kong Disneyland Hotel. Watch the ISSHA website (www.issha.org) for updates on the Conference preparations.

In the coming year ISSHA will prepare a slate of candidates all offices for an election to be held prior to the 13th Conference. The Executive Committee Members will be renewed and our standing committees can always use new talent. If you are interested in serving the Society, please contact an officer or Council member or send your nomination to Karen Steidinger (Karen.Steidinger@MyFWC.com). Remember that you must be an ISSHA member at the time you make the nomination and your nominee must also be an ISSHA member. Top check on your membership status see the ISSHA website or contact Tracy Vallareal (tracy@utmsi.utexas.edu). To become an ISSHA member or renew your membership, please contact Nina Lundholm (nlundholm@bi.ku.dk).

Pat Tester, ISSHA President

Executive (2004-2007)
President:
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Past President:
Karen Steidinger
Karen.Steidinger@MyFWC.com

Council (2004-2007)
Donald Anderson (USA)
Barrie Dale (Norway)
Greg Doucette (USA)
Yasuwo Fukuyo (Japan)
Edna Granéli (Sweden)
Hai-Gyoon Kim (S. Korea)
Jane Lewis (UK)
Øjvind Moestrup (Denmark)
Marina Montresor (Italy)
Ted Smayda (USA)
Adriana Zingone (Italy)

Committee on Elections
Chair: Karen Steidinger.
Member: Stephen Bates.

Committee on Membership
Chair: Pat Tester.
Members: Kim Hak-Gyoon, Beatriz Reguera, Gustaaf Hallegraeff, Ted Smayda.

Committee on Finances
Chair: Nina Lundholm.
Members: Don Anderson, Karen Steidinger, Edna Granéli, Yasuwo Fukuyo.

Committee on Conference Program
Chair: Øjvind Moestrup.
Members: Don Anderson, Allan Cembella, Barrie Dale, Greg Doucette, Jane Lewis.

Committee on Achievement Awards
Chair: Marina Montresor.
Members: Allan Cembella, Henrik Enevoldsen, Beatriz Reguera, Barrie Dale.

Committee on Travel Awards
Chair: Don Anderson.
Members: Allan Cembella, Henrik Enevoldsen, Beatriz Reguera, Karen Steidinger, Yasuwo Fukuyo, Edna Granéli.

Committee on Publications
Chair: Jane Lewis.

Ad hoc Committee on Special Projects
Co-chairs: Henrik Enevoldsen, Pat Tester, Adriana Zingone.
OCTOBER 2007

AGU Chapman Conference: Long Time-Series Observations in Coastal Ecosystems: Comparative Analyses of Phytoplankton Dynamics on Regional to Global Scales

This Chapman Conference will compare phytoplankton dynamics in coastal marine ecosystems where perturbations from terrestrial, atmospheric, oceanic sources and human activities converge to cause changes that ramify across local and global scales. The objective is to assemble and synthesize multi-decade observations toward quantitative and descriptive depictions of phytoplankton variability as an indicator of environmental change across the full diversity of coastal ecosystem types. The visions are a global phenology of phytoplankton at the land-sea margin and a conceptual model from which coastal ocean observing systems can be built. Detailed information, including instructions for abstract submission, is available at www.agu.org/meetings/chapman/2007/bcall/

OCTOBER 2008

Ciguatera and related biotoxins
A workshop on the latest developments in ciguatera research, covering environmental influences, causative organisms and socio-economic and medical aspects:
- Tentative programme:
  - Toxinogenesis.
  - Environmental influences.
  - Chemistry of involved ciguatoxins.
  - Clinical treatment and folk remedies.

NOVEMBER 2008

The 13th International Conference on Harmful Algae 2008
3-7 November 2008. Hong Kong-China.
The International Society for the Study of Harmful Algae (ISSHA) is pleased to announce that the 13th International Conference on Harmful Algae will take place in Hong Kong on 3-7 November, 2008. Supporting organizations include School of Science & Technology, the Open University of Hong Kong and the Association of Harmful Algal Bloom of South China Sea (AoHABSCS).
The Conference will address all issues related to the causes and effects of Marine and Freshwater harmful microalgae and, to serve as a forum for the exchange of the new research results and relevant ideas among researchers, industries, government and interested groups.
The Conference will address the following areas of interest:
- Allelopathy.
- Climate change- impact on harmful algae.
- Ecophysiology and autecology.
- Ciguatoxin.
- Cyanobacteria associated event.
- Genetic diversity, biogeography and dispersal vectors.
- Genomics.
- HAB population dynamics.
- Increased occurrence of harmful algae following natural or man made disasters in the sea and freshwater ecosystem.
- Monitoring for harmful algae and observing systems.
- Public health and economic impacts.
- Taxonomy and phylogeny.
- Toxin synthesis and chemical structure of toxins.
- Toxin analysis and detection methods.
- Toxicology.
- Regional events.

More information at: www.hab2008.hk

HARMFUL ALGAE NEWS

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