The Intergovernmental Oceanographic Commission of UNESCO *December 2007*

HARMFUL ALGAE NEWS

An IOC Newsletter on toxic algae and algal blooms

http://ioc.unesco.org/hab/news.htm *No. 35*

• HANA

First IOC/HANA Workshop on Harmful Algal Blooms in North Africa

It was in Casablanca, Morocco, that twenty four experts from Egypt, Tunisia, Algeria and Morocco met from 18 to 20 October 2007, together with their eight guests, to discuss HAB problems in the HANA region. "HANA", or Harmful Algae in North Africa, is the network initiated by twelve young scientists from North Africa while attending an IOC training course in Salammbô, Tunisia in 2003. HANA was endorsed by IOC in 2005 as one of its regional networks for HABs.

The workshop programme was conceived with more than one objective in mind. It consisted of reports and scientific presentations, invited lectures and round tables.

The scientific presentations reflected the considerable work presently carried out by young and more advanced scientists on potentially harmful microalgae in the region. They also provide a picture of the state of the marine environment regarding these issues. This is particularly obvious where economically important bivalve resources are under threat, namely in Morocco and Tunisia, the only two countries of the region where an institutionalized monitoring programme is in place.

In Morocco, seven sites are monitored on both the Mediterranean and Atlantic coasts of the country. Of the diverse potentially harmful species recorded, some are of more concern than others: *Alexandrium minutum* (Nador Lagoon, Mediterranean) causing PSP contamination, *Lingulodinium polyedrum* (Abda Doukkala, Atlantic) contaminating shellfish with DSP, and three *Pseudo-nitzschia* spp. (coastal Atlantic waters). Work has begun on dinoflagellate cysts and their possible implication in outbreaks of toxic species in Walidia Lagoon.

In Tunisia, toxic blooms lead to heavy fish mortality in the Gulf of Gabes in 1995, inciting the authorities to launch

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Modified ichthyoviscometer shows high viscosity in *Chattonella* culture

Introduction

Striking amounts of mucus accompany some blooms of *Chattonella* spp. As *Hornellia marina, Chattonella marina* (Subramanyan) Hara et Chihara was first described in 1954 [1] from viscous, slimy blooms causing huge kills of wild fish. As *Hemieutreptia antiqua, Chattonella antiqua* (Hada) Ono was first described in 1974 [2] from blooms in which an enormous number of young cultured yellowtail died from "disturbance of respiration by mucous films" or "respiratory injury by mucus". A well-developed glycocalyx *invests C. antiqua* cells (Fig. 1), with fine filaments apparently continuous through the plasma membrane. This glycocalyx is microfibrillar, and rich in a neutral carbohydrate-protein complex and acidic complex carbohydrates [3], while *C. marina* glycocalyx shows immunologically mediated adhesion to fish gills [4]. More than any other phytoplankton, *Chattonella* cells also produce reactive oxygen species (ROS) [5], associated with the cell surface, the glycocalyx or both [6-7]. This ROS, as well as its accompanying fatty acids are toxic to bacteria and, separately or in concert, may modulate allelopathic action against ambient bacteria [8]. Nevertheless, since 2000, the ROS

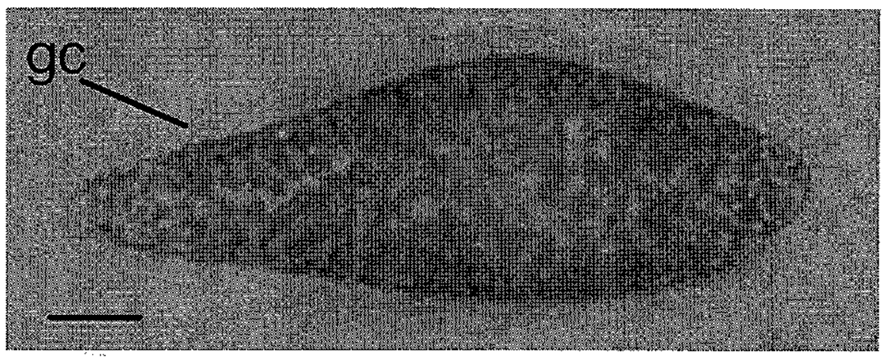

Fig. 1. Light micrograph of Chattonella antiqua *cell illustrating glycocalyx on the cell surface. Scale bar = 5 µm; gc: glycocalyx.*

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The publication of Harmful Algae News is sponsored by the Spanish Institute of Oceanography, Vigo, and the Department of Biology, University of Copenhagen.

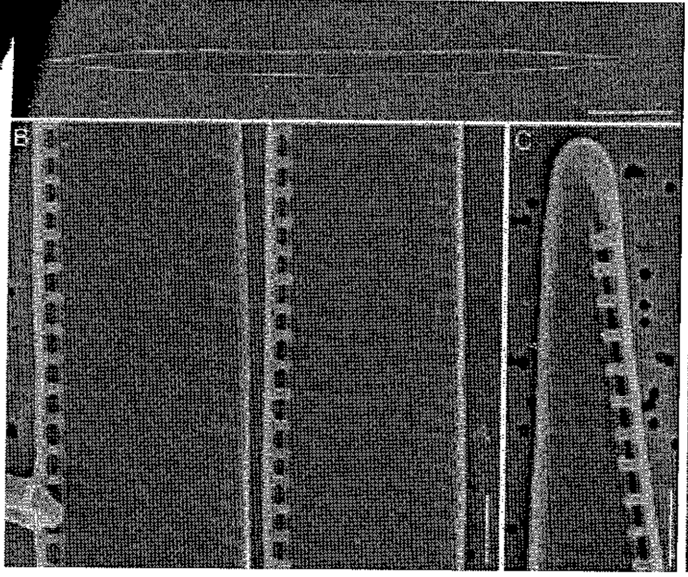

Fig. 3. Scanning electron micrographs of Pseudo-nitzschia multistriata *(A) Valve outline. (B) Part of valves showing two different patterns of interstriae. (C) Tip of valve. Scale bars = 10 µm (A) and 1 µm (B, C).*

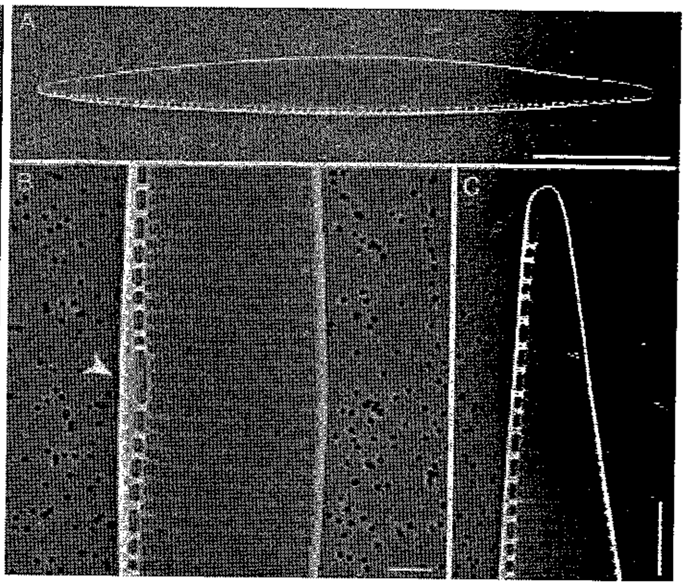

Fig. 4. Scanning electron micrographs of Pseudo-nitzschia subpacifica *(A) Whole valve. (B) Central part of valve showing central nodule (arrow). (C) Tip of valve. Scale bars = 10 µm (A) and 1 µm (B, C).*

phytoplankton monitoring. Thus, we can reasonably consider that it was not present earlier. In contrast, in spite of its asymmetrical shape in valve view, *P. subpacifica* could have been confused in light microscopy with *P. fraudulenta* with which it co-occurs.

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• Greece

The coincidence of an *Arthrospira* - *Anabaenopsis* bloom and the mass mortality of birds in Lake Koronia

An extremely dense bloom of the cyanobacteria *Arthrospira fusiformis* (Voronichin) Komárek et Lund and *Anabaenopsis arnoldii* Aptekarj (Fig. 1) occurred on 17 September 2007 in the shallow Lake Koronia. This is the first report of an *Arthrospira* bloom in Greek freshwaters. Cyanobacterial blooms however are common in eutrophic freshwaters in Greece [1-2]. Another dense bloom of the haptophyte *Prymnesium parvum* N. Carter coincided with a mass kill of birds and fish in Lake Koronia three years ago (September 2004) [3].

Lake Koronia (40° 40' 58" N, 23° 09' 33" E, altitude: 75 m a.s.l.) is located in N. Greece and over the past 20 years has undergone a dramatic decrease in water volume, surface area and depth due to anthropogenic activities. During this period the lake water became brackish and in the summer of 2002 the lake dried up completely. After increased rainfall in 2003, water reaccumulated in the lake and in 2004 the water level had a maximum depth of 1 m. In 2007 the prolonged dry and warm period resulted in a maximum depth of just 0.5 m.

Arthrospira fusiformis population density was extremely high with 23 x 10^6 filaments L^{-1} (2.99 x 10^9 cells L^{-1}, or 487.37 mg L^{-1} w/w) close to the highest values reported from African lakes [4-5]. At the same time, *Anabaenopsis arnoldii* exhibited high population density as well (0.12 x 10^9 cells L^{-1}). Euglenophytes were also present in the lake's phytoplankton. Zooplankton consisted only of individuals of the *Brachionus plicatilis* group complex that were present in low numbers.

A mass mortality of water birds was observed to coincide with the *Arthrospira-Anabaenopsis* bloom preceeded in June by a heavy *Microcystis aeruginosa* (Kützing) Kützing bloom (5.6 x 10^9 cells L^{-1}) with its epiphyte *Pseudanabaena mucicola* (Naumann et Huber-Pestalozzi) Schwabe (12.4 x 10^9 cells L^{-1}). The number of dead birds reported by the Hellenic Ornithological Society at the meeting organised by the Prefecture of Thessaloniki was estimated to be two hundred, including mostly flamingos *Phoenicopterus ruber* Linnaeus.

From the literature, it is known that mass mortalities of Lesser flamingos *Phoeniconaias minor* (Geoffroy) can be caused by the toxic *Arthrospira fusiformis* and *Anabaenopsis* species [4-6]. Ballot *et al.* [4] found that *A. fusiformis* strains produce

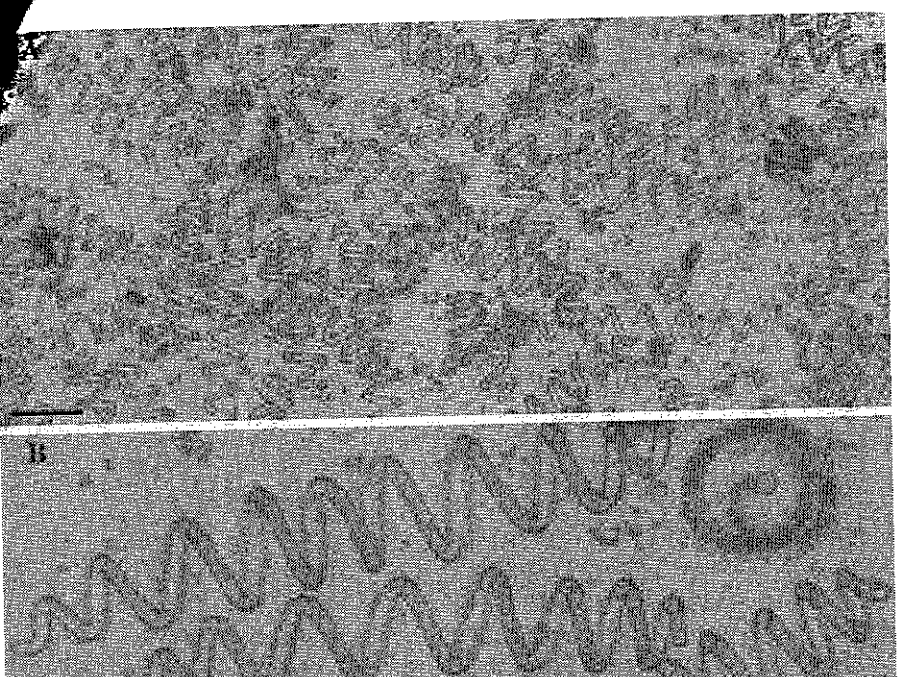

Fig. 1. Light micrograph of phytoplankton collected from Lake Koronia on 17 September, 2007. (A) Phytoplankton dominated by Arthrospira fusiformis. *Scale Bar: 50 μm. (B) Filaments of* A. fusiformis *and* Anabaenopsis arnoldii. *Scale Bar: 20 μm.*

microcystin-YR and anatoxin-a. Lanaras and Cook [7] first raised the possibility that *Anabaenopsis* species produce microcystins, reporting microcystin in a cyanobacterial bloom dominated by *Anabaenopsis milleri* Woronichin in a Greek water body. In 2001, the mass mortality of flamingos *Phoenicopterus ruber* and other water birds in southwest Spain was attributed to microcystins produced by toxic cyanobacteria (*Microcystis*, *Anabaena*) [8].

The bird mortality in Lake Koronia during September 2007 was most likely caused by the heavy bloom of toxic cyanobacteria in the lake. The mass development of *Arthrospira*, *Anabaenopsis*, *Anabaena* and *Microcystis* species in the lake the last three years presents a health risk for wildlife and especially for water birds, and underlines the need for cyanobacteria and cyanotoxins risk assessment and management. This is of great importance considering that Lake Koronia is covered by the Directives 79/409/EEC [9] and 92/43/EEC [10], the RAMSAR Convention (http://www.ramsar.org) and is part of a National Wetland Park [11].

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• Tunisia

First bloom of dinoflagellate *Alexandrium catenella* in Bizerte Lagoon (northern Tunisia)

Bizerte Lagoon is located in northern Tunisia (37° 8'-37°14' N, 9°46'-9°56' E). The surface area is about 128 km², maximum width 11 km, and maximum length 13 km; the mean depth is 7 m. The lagoon is connected to the sea via a canal 6 km long, as well as to Ichkeul Lake to the east via the 5 km long oued (= river) of Tinja (Fig. 1). In Tunisia, mussel and oyster farming are developed only in this lagoon.

In the context of the national surveillance network of bivalve production in northern Tunisia, two zones of clam production and five oyster and mussel farms are considered by the phytoplankton and phycotoxin surveillance programme for various products from the lagoon.

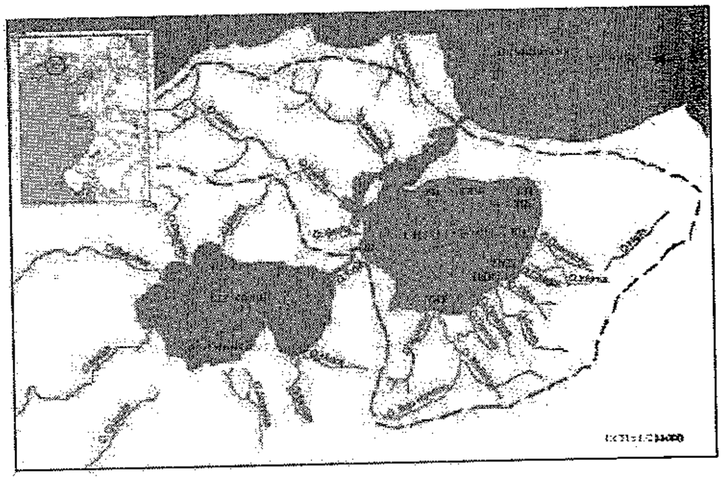

Fig. 1. Location of the sampling stations at the Bizerte lagoon.