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HARMFUL ALGAE NEWS

An IOC Newsletter on toxic algae and algal blooms *No. 20*

IX Conference on Harmful Algae

Convenor's report

The 9th International Conference on Harmful Algal Blooms (HAB2000) was held in Hobart, Tasmania, Australia, from 7 to 11 February 2000. The conference venue was the Wrest Point Convention Centre located on the magnificent foreshores of the Derwent River estuary, and the conference period was blessed with glorious summer weather conditions. HAB2000 was attended by some 500 participants (481 full and 45 day registrations) from 47 countries. This was the first time this prestigious conference series was scheduled in the Southern Hemisphere, but this appeared not to have deterred strong participation from Europe (122 participants), USA (77) and South East Asia (84).

A total of 130 talks and 308 posters were presented, and where parallel sessions were scheduled the plenary introductory session included reviews covering the full range of topics. The scientific programme focussed on new algal bloom species (e.g. *Pfiesteria*, new gymnodinioids), new toxic phenomena (e.g. azaspiracid poisoning, Californian seal mortality), new regional bloom events (e.g. Scotland ASP outbreak), ecophysiology and bloom dynamics, cysts and sediments, eutrophication, novel toxins, ecophysiology of toxin production, exotoxins, foodchain

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◆ **Spain**

Harmful algae events in the Mediterranean: are they increasing?

The reported world-wide increase in harmful algal blooms (HABs) has also involved the NW Mediterranean, where there have been numerous dinoflagellate blooms, especially *Alexandrium* species, in the last 50 years (1). Three explanations for this increase have been suggested, i) increased study and knowledge, ii) stimulation due to anthropogenic eutrophication, and iii) increase in the geographical dispersion due to transport of cysts in ballast water or to movement of mollusc stocks from one area to another. Here we propose iv) a new explanation, which may be important for calm tideless seas, and very much *humanised* like the Mediterranean. This stems from the ability of dinoflagellates to colonize and proliferate in habitats newly created by human activity. These four points are discussed below.

Without underestimating the importance that mesoscale phenomena can have in the Mediterranean in relation to the onset of algal blooms, the experience of the monitoring of HAB shows that the Mediterranean problem is associated, in the majority of cases, with phenomena on a lesser scale. Also, in recent decades, there has been an elevated population growth in coastal areas and a clear trend towards the exploitation of the coastline for recreational purposes. Recreational use leads in most cases to a demand for calm waters, and causes a significant increase in nutrients and in confined areas (ports, breakwaters, semi-closed beaches). This creates new microhabitats with modified hydrodynamic regimes (higher water stability and water residence time). Both factors favour dinoflagellate growth.

The Mediterranean region, especially the north-western basin, supports a very high population (100 inhabitants/m of coastline in some areas). In addition, the seasonal population related to recreational use of the coastline increases total population by more than 50 % in some regions. There has also been a marked increase of confined waters, for e.g. to 40 harbours in 400 Km of coast in Catalonia. We hypothesize that use of the coastal zone (man sheltered areas) is an important factor in HABs expansion and recurrence in the Mediterranean. In the NW Mediterranean, *Alexandrium* proportionally causes most HABs.

Three species of *Alexandrium*, two well known (*A. minutum* and *A. catenella*) and one recently described (*A. taylori*), have

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effects, population genetics, molecular probes, immunological methods, role of bacteria, and impacts on finfish and shellfish aquaculture operations. Being held in Australia, this was the first conference in this series which prominently covered problems caused by freshwater cyanobacterial blooms, including impacts of cyanotoxins on human health and aquatic food webs, and aspects of drinking water treatment (see separate report by Glenn Shaw). A public forum on "Algal blooms: impacts on health, environment and economy" was created to deliver the conference message to a wider public.

This forum coincided with a public art event entitled "Ecological Roulette", in which 30m large dinoflagellate images were projected on the outside of the Wrest Point building. Participants enjoyed mid-conference excursions to Tasmanian wilderness forests, wildlife park, and local shellfish and aquaculture operations. A highlight for many participants was a 35min theatre production "The Deadly Dinoflagellate", which portrayed in a powerful fashion the dire consequences of a Gym Nodinium ship ballast water introduction into pristine Tasmanian waters. The HAB2000 conference was dedicated to the life-time pioneering achievements of Prof. Max Taylor, who also presented the conference summary. The conference received extensive media coverage and made a significant contribution to wake up Australia from its "algal apathy".

Gustaaf M. Hallegraeff, University of Tasmania, GPO Box 252-55, Hobart, Tasmania 7001, AUSTRALIA.

Cyanobacterial presentations at HAB 2000

While the main focus of this conference series had previously been marine algae with dinoflagellate bloom presentations dominating, the organisers on this occasion were successful in incorporating a significant number of presentations and posters on freshwater cyanobacteria and their toxins. Parallel sessions tended to feature marine dinoflagellate presentations concurrently with cyanobacterial speakers where possible. It is hoped that this very successful conference is a model for the future incorporation of both toxic dinoflagellate and cyanobacteria research findings for future events.

Keynote speakers on toxic cyanobacteria were Professor Ian Falconer from the CRC for Water Quality and Treatment in Australia and Dr Gary Jones from the Australian Commonwealth Scientific and Industrial Research Organisation. Professor Falconer gave a presentation on toxic cyanobacterial blooms in Australia from a human and animal health perspective, and highlighted the large number of stock poisoning incidents that have been caused by cyanobacteria in Australia, which date back to the late 1800's. Of more recent concern was the bloom of Anabaena circinalis in the Darling River which stretched for 1000km, killed 10,000 livestock and required emergency water treatment facilities to be established to produce water safe for human consumption. Other aspects highlighted by Professor Falconer were the significant occurrence of toxic Microcystis aeruginosa and Cylindrospermopsis raciborskii blooms that regularly occur in water reservoirs and rivers in Australia, together with their health implications.

Dr Jones spoke on the Australian experience in cyanobacterial bloom ecology and management. In particular he highlighted the fact that Australian reservoirs tended to be stratified in the warmer months of the year and that at these times, Australian rivers tended to be very slow flowing or were comprised of a series of weir pools, all of which featured cyanobacterial blooms. The conditions for a large part of the year in water bodies in most of Australia favoured cyanobacterial dominance due to thermal stratification and short photic zone depths. Other aspects of Dr Jones' talk featured management strategies such as catchment management, and reservoir techniques such as destratification and biomanipulation.

A variety of speakers spoke on various aspects of toxic cyanobacteria. A number of sessions were organised, including: occurrence of toxic blooms; water treatment to remove cyanobacterial toxins; freshwater ecology of cyanobacteria; and the impact of cyanotoxins. In addition, a number of sessions featured presentations both on cyanobacteria and dinoflagellates. These included the ecophysiology of toxin production, control and management of blooms, population genetics and phylogeny, the use of molecular probes for detection of algae and immunological methods for toxin determinations. One interesting aspect that involved both cyanobacteria and dinoflagellates was a study on dissolved nitrogen release by the marine cyanobacterium Trichodesmium erythraeum and consequent uptake and bloom formation by marine dinoflagellates.

The marine cyanobacterium Lyngbya majuscula produces dense blooms in Southern Queensland marine waters, and has been responsible for human dermatological problems. Regional events featured included Cylindrospermopsis dominance in reservoirs, the effect of hydrological manipulation in reducing cyanobacterial blooms, Nodularia blooms in Finland, and the potential effects of global climate change on cyanobacterial abundance and toxin production. While microcystin producing cyanobacteria are still very important on a global scale, the presence of the hepatotoxin producing cyanobacterium, Cylindrospermopsis raciborskii is being recognised as significant in many countries around the world.

Some presentations dealt with methods to remove cyanobacterial toxins from drinking water such as ozonation, chlorination, bacterial degradation and photolytic degradation using UV/TiO2.

Toxicological issues discussed ranged from the toxicodynamics of microcystins ingested by dairy cattle and implications for milk contamination, to human health risk assessment of cylindrospermopsin, and an interesting evaluation of the effects of the lipopolysaccharide endotoxins in combination with microcystins. Ecological effects of cyanotoxins received considerable attention. such as the effects of toxins on aquatic organisms including fish, and uptake and metabolism by aquatic plants.

Population genetics and phylogeny of cyanobacteria are important areas of research. State of the art molecular techniques for species identification, and the identify toxin producing genes of cyanobacteria also received attention. So did rapid methods for analysis for cyanobacterial toxins and immunoassays for a number of toxins, including microcystins and saxitoxins. A novel and sensitive method for saxitoxins is the saxiphyllin assay, developed by Dr Llewellyn of the Australian Institute of Marine Science which involves the use of a naturally occurring saxitoxin binding protein.

Highlights of the conference from the cyanobacterial research perspective stemmed from the considerable number of participants interested in this field. Presentations covered a wide range of disciplines from taxonomy to health effects of the toxins. An integrated approach to the field was evident with various research groups interacting to evaluate environmental health aspects of cyanobacteria and to produce possible solutions to problems. These solutions arise from the understanding of the ecology of the organisms and toxin behaviour and lead to catchment management and water treatment protocols to reduce the effects of these organisms on man and the environment.

Glenn Shaw, National Research Centre for Environmental Toxicology, Queensland, Australia

A view from New Zealand

2nd February 2000, 100 Attendees met in Nelson, New Zealand for a pre-conference workshop, where the developers of the latest and greatest methods met to show their wares. Demonstrations were given of many of the techniques employed in algal/shellfish toxin research, covering all aspects from algal collection using nets, to remote telemetric sensing by tethered or roving buoys. Presentations from many countries showed off technologies including microscopy, nucleic acid hybridization, immunochemistry, bioassay applications, fluorimetry and more. The relatively small size of the workshop facilitated contact and exchange of information between attendees.

The vision for the 21st century "sea's" a self contained, remote early warning system, backed up by sophisticated laboratory analysis to ensure the safety of the consumer, and the health of the industry. For a report visit http://www.cawthron.org.nz/news_habtech2000_report.htm

7th February 2000, A brief hop across the ditch to Tasmania. About 500 Attendees met in Hobart, for the IX Harmful Algal Bloom Conference. My first thought was that it was great to travel such a short distance to an international meeting! Normally it takes a while for my time-clock to adjust to the time difference in travelling half way around the world to the Northern Hemisphere!! Previous meetings have concentrated on the harmful marine algae, and it was very noticeable that here the freshwater algae had surfaced to greet us. Indeed, as the conference opened, a bloom in one of the local reservoirs was making news headlines - just a coincidence Gustaaf tells us!

Concurrent sessions were required to accommodate the large number of papers presented, and while this must have been a logistical nightmare, in the main they were organized such that the overlapping of subjects from similar fields was minimized.

Much new data was presented in the oral papers, newly discovered HAB species (e.g. new *Pfiesteria* species), newly discovered toxins (e.g. Azaspiracid), new technologies for the detection of both (e.g. RNA probes, immuno-probes), and new understanding of the genetics of toxin synthesis (e.g. microcystin biosynthesis). The recognized distribution of harmful algae appears to be increasing, both as toxicities occur, and as more of the world community becomes aware of the issues (e.g. ASP in Scotland, *Gymnodinium* in Hong Kong). The introduction of freshwater cyanobacteria to this meeting was a good move, as many attendees' research involves only one, or other environment. There is much that we can learn from the techniques applied across both these fields. The death of cattle and sheep from PSP, for example. Where else but in Australia could these animals die from shellfish poisoning!! The chemistry and mechanism of action of the saxitoxins produced by the marine and freshwater algae are naturally exactly the same. It was again a difficult task to visit all 390 posters, and to take in the large amount of new information presented here. The meeting design was conducive to spending a large amount of time at the posters, but of course, as always much more time seems to be needed to view and digest these, and to catch up with colleagues and plan collaborations. Fortunately the latter was facilitated at an establishment called Irish Murphy's, and at the conference functions so well provided. Thanks Gustaaf and the organizing committee for a very well run conference. We appreciate your hard work. The beauty of the HAB series of conferences to me is the range of disciplines that the field encompasses, and the degree of cross-fertilization of ideas that this generates. There are few other conferences that I have attended where this happens to the same degree. This one again achieved this goal.

The conference is growing larger each time, and extrapolations produced by our after dinner speaker showed that by the time we travel to South Africa in 2004, we should have over 800 attendees representing every country in the world. I look forward to meeting many old friends, and new friends from landlocked countries in Florida, October 2002 for the Xth International Conference. Our turn for the jet-lag next time!!

The final question for attendees from the North, Did you check which way the water turned as it went down the plug hole??

Dr Ian Garthwaite, AgResearch Ruakura, Hamilton, New Zealand.

Reflections on the Hobart Symposium

The Ninth International Conference on Harmful Algal Blooms convened in Hobart during 7 - 11 February 2000 continued the tradition that has characterized these Conferences. Gustaaf Hallegraeff and his organizing committee are to be commended for their good efforts on our behalf. Attendees were once again exposed to new discoveries, techniques and insights; opportunities to communicate in formal and informal settings; to interact socially; to form new friendships, and to continue old ones; to plan collaborative research; to "talk shop", and to experience the novel, "red tide" theatre. The Conference also revealed both the remarkable esprit that continues to characterize the harmful algal bloom community, and its equally successful and diverse scientific, pedagogical and societal efforts. The multitude of workshops and training courses given to date; the establishment of the IOC Science and Communication Centres on Harmful Algae; IPHAB; national and regional programs of HAB research, the highly informative Harmful Algal News, and planned new initiatives such as GEOHAB, are some of the tangible results that have accompanied the ever-deepening scientific insights into harmful microalgae. To me, this collective spirit was vividly reflected by the great enthusiasm with which Yasuwo Fukuyo distributed his CD Discs from his booth in the Convention Center lobby, and in continuance of his great service to the HAB community.

Don Anderson's photographic journey depicting the development of the HAB initiative was enjoyable, but this "remembrance of things past" made me wonder whether we are now en route to a different future. I fear that we are in danger of compromising, if not losing, the historical conditions that have engendered the HAB community esprit and achievement. I wonder about this because the Conference revealed some worrisome features spawned by our remarkable growth as a subdiscipline: we are becoming too big and have outgrown the Conference format traditionally followed! The 130 oral presentations and 308 posters scheduled, and crammed into only four days of formal meetings (with concurrent sessions) were too concentrated a dose. I found that there was not enough time to hear and review adequately my many selections from among the nearly 450 presentations. The 100 minutes allotted for Tea and Poster Review Sessions equaled 3 minutes per poster. And the approximately 500 attendees, while delightful, made it difficult to find individuals with whom I wished to talk. I offer these personal inconveniences not as a criticism of the Conference organization, but as a reflection of the great attendance and scientific presentation pressures placed on the conveners confronted also with providing social and tourism venues expected by attendees. Do we lengthen future Conferences and/or reduce tourism options? How do we accommodate the growing demand for presentations? How do we prevent splintering into sub-groups compromising valuable interdisciplinary exchange? Is the quest for diversity, such as inclusion of freshwater cyanotoxicity issues, for example, compromising effective communication of pressing marine HAB issues? Karen Steidinger and her co-conveners in organizing the St. Petersburg meeting will probably face even greater attendance and presentation pressures. It seems that we can now safely say that the traditional HAB Conference format will not accommodate those expected pressures.

The Conference revealed some fissures that are accompanying the growing scientific maturity and size of the harmful algal bloom community. The issues of publication of Conference presentations and "what is a meaningful contribution" remain unresolved, made even more difficult by some sensitive issues embedded within this controversy. Scientific observations become information only after communication, usually through publication; thereafter, this information belongs to everyone: it is a principle that we must protect. Decisions as to what is, or is not worthwhile information deserving of publication can easily become a policy of censorship unless based on clear and acceptable criteria. While I do not believe that the proposed "new" criteria of manuscript selection were adequately defined at Hobart to warrant changes in publication of Symposium papers, this valid concern over publication should revive discussions as to the merit of starting a journal dealing with HAB issues. I support this option and the derivative publication opportunities which it presents.

The selection of future Conference sites continues to be an unstructured process, with need for a revamped approach to this important decision. For, once again, an element of arm-twisting seems to have been a factor. I am very pleased that Grant Pitcher will host the 2005 Conference in South Africa, but many attendees missed the proposal from Ireland, and there was confusion (and loss of vote) over the voting procedures to be followed. Convening a Conference is a formidable task, obviously, and proposers need to be encouraged, but clearly there is need to develop standard procedures of proposal and voting.

The still embarrassing and marginally successful efforts to organize ISSHA seven years and three conferences since Nantes (1993) are inexplicable. It was hoped that ISSHA would be off and running after Hobart, and take a lead role in helping to guide the HAB community through its continued growth and in coming to grips with the issues mentioned above. I was not encouraged by the society meeting, and now wonder whether a society is too soon, too structured, too manipulatable, or even needed to serve our collective needs. The esprit and achievement of the HAB community to date could easily be dampened by overly organized regulation of our diverse scientific, pedagogical and societal efforts. Should we revisit the need to have a society?

In summary, Gustaaf Hallegraeff and his co-organizers provided a great service in organizing a stimulating Conference: scientifically, socially, aesthetically, and in its revelation of a number of logistical, organizational issues which we, now forewarned, can more effectively deal with, modify and build upon to ensure continued success of future Conferences.

Ted Smayda, Graduate School of Oceanography, University of Rhode Island, U.S.A.

Marine Toxins

Many important presentations on algal toxins were given at the recent HAB conference in Hobart. Dr Burkholder gave the opening plenary address on the toxicity of *Pfiesteria piscicida* under different conditions. The type and nature of toxins produced by P. piscicida, and whether "never-toxic" strains exist in the wild require clarification.

Dr Lewis reviewed ciguatera, highlighting the significant milestones achieved over the last 50 years. These include:

· In the late 1950s, Banner established a program of multidisciplinary research that has led modern ciguatera research;

· Based on the hypothesis of Randall (1958), Yasumoto et al. in 1997 identified G. toxicus (subsequently confirmed) as the origin of Pacific CTXs;

· In 1981, extending earlier studies of Rayner in Hawaii, Lazdunski's group determined that CTX was a "site 5" VSSC activator;

· Palafox et al. in 1988, following its chance use in an undiagnosed severe case of ciguatera in the Marshall Islands, mannitol was introduced as a treatment for severe ciguatera;

· In 1989, following the pioneering work of Scheuer's group, Yasumoto's group determined the structure of Pacific CTX and its likely precursor from *G. toxicus*;

· In 1998, taking advantage of high field NMR techniques, the structure of Caribbean CTX was determined by Lewis et al.

Despite this progress, many important new milestones in ciguatera research remain to be achieved. These included:

· Determining the specific environmental and genetic factors that influence toxin production and the proliferation of *Gambierdiscus* species;

· Determining the origin of Caribbean and Indian Ocean ciguatoxins;

· Determining the structure of Indian Ocean ciguatoxin(s);

· Development of simple (oral) therapies for ciguatera;

· Development of rapid polyether synthesis;

· Development of a commercially available, validated, cost-effective screen (antibody and/or VSSC) for ciguatoxins in ciguateric fish;

· Development of improved analytical methods (LC/MS etc) to confirm and accurately quantify ciguatoxins in fish, humans, and dinoflagellates.

Achieving these new milestones represents a number of significant scientific challenges requiring well-funded multidisciplinary research, probably with an increasing emphasis on interlaboratory collaborations.

Professor Yasumoto led a session on ciguatera, describing an exciting new mass spectrometric (MS) method for the elucidation the primary structures of polyether toxins with microgram quantities of material. The strucutres of 20 ciguatoxins were defined using this method. The technique offers for the first time the prospect for elucidating the structures of all minor ciguatoxins, and will allow detailed studies of the biosynthesis and food chain transfer of ciguatoxins. Professor Yasumoto also described some collaborative work with Dr Legrand, describing liquid chromatography/MS methods for identifying new ciguatoxins.

Professor Shimizu reported studies that confirmed a dual mechanism of methyl introduction in brevetoxin biosynthesis. This unusual incorporation pattern may apply to the synthesis of polyketides by dinoflagellates in general.

A new approach towards the development of antibody based tests for ciguatoxins was reported by Dr Pauillac. High affinity antibodies were produced to fragments of ciguatoxin and are being evaluated in simple assay formats.

Kevin James reported on Azaspiracid Poisoning (AZP), an important new shellfish toxic syndrome in Europe. This class of toxin has caused human intoxications, following the consumption of Irish mussels (*M. edulis*).

Three toxins have been isolated and structurally elucidated and they contain a novel spiro ring assembly. The origin and pharmacology of Azaspiracids are under investigation.

The pharmacology yessotoxin, a marine toxins with uncertain human health impacts, was reported on by Dr. Botana. This group found that yessotoxin acts to increase the release of calcium from intracellular stores and to inhibit cAMP levels in resting lymphocytes. Thus yessotoxin may be an important new tool for the study of signal transduction mechanisms.

Dr Goto reported that pectenotoxin-2 and analogues were identified for the first time from Chile in two species of mussels, and in *Dinophysis norvegica* collected along Swedish coast. In the Baltic Sea, hydrolysis of *D. norvegica* extracts revealed dinophysistoxin-1 and okadaic acid. The Chilean mussels also contained high concentrations of yessotoxin (YTX) and 45-hysdroxy-YTX. These studies indicate the need to expand the list of toxins screened in certain locations.

Richard J. Lewis, University of Queensland

Tasmanian delights

Hobart, 7-11 February, 2000

As an exercise in solid geometry, one can calculate the maximum possible separation of three points on a spherical surface. It's easier than you think! A rough approximation has been achieved by **Hirofumi Goto** from Tokyo with colleagues in Chile and Sweden. This simply shows the "reach" of harmful algologists. We will continue to argue about whether HABs are spreading, but this example suggests habologists cannot spread out further without getting nearer again. Maybe habologists are spreading the HABs? Did anybody *en route* to Hobart check their shoes or their pockets for cysts? Even the Arctic is full of *Alexandrium*. Why, they've found phycotoxins in Antarctic lakes; would you credit that? Earlier worry that the relative remoteness of Hobart might limit attendance at the 9th HAB conference has proved unfounded. As **Max Taylor** said to me, somewhat bemused, as the first plenary began, "The whole family's here." Capo di capos! The family has grown too, this is I think the first time we have seen participants from Bangladesh, Hungary, Kuwait and Qatar. We also had a wedding; **Mark Poli** and **Sandra Flynn** tied the knot on Mount Nelson. An old quip maintains that Sydney,

Australia, is the most populous Irish city in the world. The press of Irish in the conference bar might have suggested Hobart is; their numerical participation, calculated as a national *per capita* quotient, normalized for distance travelled, could be a record. The Danes may have run them close; someone should do the sums. I don't know the population of Denmark. There was a good turnout from China, but then aren't there rather a lot of them?

My personal short list of highlights from the conference would include the recently discovered parasite *Parvilucifera*, especially the beautiful pictures shown by **Marie-Josèphe Chrétiennot-Dinet**, the notion of **Chris Scholin** that domoic acid can hide in the mud and kill later (it surely was not evolved to do that!), and the continuing saga of the *Alexandrium* dynasty. The morphospecies *A. tamarensis* occurs in environments as distinct as the Arctic (**K.C. Ho**) and the Gulf of Thailand (**Gires Usup**). Three *tamarensis* genotypes have been identified from Australia and New Zealand by **M.F. de Salas** who thinks they are endemic in the region. **Linda Medlin** showed that the *tamarensis* bloom encountered in the Orkneys in 1997 is "American", and considered by which Arctic sea route it might have entered the Atlantic from the Pacific. Did they come on the feet of capelin which made the same journey? The dispersal of *Gymnodinium* species with reticulate cysts was discussed by **Chris Bolch**; these are not found in high northern latitudes and their dispersal must have been by warmer routes. Tropical *tamarensis* strains would perhaps have accompanied them. At the Key Biscayne conference in this series (1978), Ramon Margalef introduced his famous mandala, a phase space in which phytoplankton strategies can be ordinated. **Ted Smayda** explored some of the ramifications of this mandala at the Vigo conference, and at Hobart had a closer look at the turbulence axis. Provocative stuff. **Yasuwo Fukuyo**, as usual, was dispensing free gifts, this time a magnificent CD.

A few new species have been added to the HAB cuisine, a *Nitzschia* from shrimp farms in Vietnam (**Yuichi Kotaki**) which produces domoic acid, a second *Pfiesteria* (**Howard Glasgow**), and some may need to be reduced among *Dinophysis* (**Beatriz Reguera**) and *Chattonella* (**Yoshihiko Sako**). There is also a *Gyro-/Gymnodinium* boundary dispute (**A.J. Haywood**), and a new *G. breve* imposter in New Zealand (**F. Hoe Chang**). A quick look at the Latin-name stakes, the guys that keep us in business (the grass roots of Habology); *Alexandrium* still seems to be our best loved genus (not counting the newcomer cyanophytes), as it always has been in this conference series, *Pseudo-nitzschia* is currently running second, close behind are *Dinophysis* and *Pfiesteria*, and the *catenatum's, mikimotoi's,* and other sundries are awaiting their chances.

On the toxin sideboard, we have a new dish, azaspiracids. Ask **Sandy Shumway** how to say it with an eastern US accent. These were first found in Irish mussels, later elsewhere in northern Europe, and **Kevin James** suspects a dinoflagellate source for them. We can anticipate that they will shortly turn up all over the planet (in time for the next conference, and in further illustration of the global spreading hypothesis). Their impact on the intestinal villi (**Emiko Ito**) sounds rather like that of *psilosis*, tropical sprue, (of obscure aetiology; is this a clue?). Our society magician, **Takeshi Yasumoto,** has introduced new toxin extraction procedures. There is growing attention to the functional rôles of toxins (too long classified as defensive chemicals) by **Allan Cembella** (polyethers), **Eden Rue,** and **Nicolas Ladizinski** (domoic acid). There were around seventy contributions on toxins, and reviews from experts would be very welcome, volunteers please. (Hey, you! Can you play music? Then come and help carry this piano). Still with the molecules, it has now been shown that DNA sequencing can be done with single *Dinophysis* cells, even those preserved in lugol (**Bente Edvarsen**) or methanol (**Angeles Aguilera**). This quantum leap will allow new questions to be asked about *Dinophysis* and other taxa which have not yet been brought into culture.

Neurological disorders, and especially symptoms like vomiting and diarrhoea *run* like refrains through the professional lives of habologists, but we rarely give a thought to the diagnostic problems such complaints pose the medical profession. Some conference posters highlighted these difficulties. **Susan Gerber** took us inside a Chicago restaurant where an amberjack dish gave diners ciguatera; she showed us how tracking credit card records can lead to better diagnoses. Physician performance itself was scrutinized with respect to ciguatera in Dade County, Florida, where the condition is endemic (**Donna Blythe**). Epidemiological data on *Pfiesteria* exposure is also now being brought into better focus (**L.M. Grattan**). Still on the medical front, there is an urgent need for toxicological studies of the effects of the *new* pecteno- and yessotoxins on human consumers.

At the Takamatsu conference in 1987, **Masaaki Kodama** reported experiments which he claimed indicated that *Alexandrium* toxins are synthesized by intracellular bacteria (reviving an earlier suggestion of Estela Silva). This continues to be a hot research topic, but remains unresolved. **Jane Lewis** now shows that bacteria (including intracellular ones) are associated with all life history stages of *Alexandrium*, but **Ya Hui Lu** says that toxicity is not enhanced by bacteria in culture, and **Michael Schweikert** failed to detect toxins in extracellular bacteria. **Masao Adachi** thinks bacteria may promote encystment, and suggests a symbiotic rôle for them; **R. Brinkmeyer** and **G. Gerdts** both noted a close association between bacteria and an *Alexandrium* bloom in the Orkneys. In contrast to these studies of *Alexandrium*, some bacterial strains may enhance domoic acid synthesis in *Pseudo-nitzschia* (**Susan Gallacher**). New techniques may be required to fully untangle the secrets of bacteria living on and in phytoplankton cells.

Algicidal bacteria, capable of killing *Coscinodiscus wailesii*, a pest of *Porhyra* culture, were described by Satoshi Nagai and Imai at the Vigo conference. Several studies presented in Hobart built on this theme, and we now know more about bacteria which can kill *Chattonella* (**Achiro Imai**), *Heterosigma* (**Hirotaka Kitaguchi**; **Noriko Kuroda**), *Gymnodinium breve* (**Xavier Mayali**), *G. catenatum* (**J.H. Skerratt**), *G. mikimotoi* (**Ikuo Yoshinaga**), and a variety of other algae. In several of these studies, it has been established that extracellular substances are involved in the lethal mechanism.

Mitigation is not a new idea, but this is the first time in this conference series that it has been served as a main course. Parasites and algicidal bacteria may eventually be used for biological control of HABs, but so far the general impression is that they are not very choosy about their victims, so their selective application will not be straightforward. *Parte beatum.* **Patrick Gentien** panicked at the thought that such delicious commodities as oysters might be secondary hosts to *Parvilucifera*. What would it do for their flavour? Even less

selective is an algal doomsday gadget already being marketed; if you want to kill *all* the algae, get in touch with **Hilaire Thomas**. But mitigation at present is mostly about mud, which can be modified to improve its flocculent action (**Sun Xiaoxia**). Throwing mud about (what mud does to the flavour of Coquille St. Jacques is another problem) is a technique with a promising future according to **Jack Rensel**, who gave an excellent overview of practical alternatives for saving aquaculture stock from algal threats. One of them, towing, saved a lot of money in China last year (**Lu Songhui**). Chemical mitigation procedures also offer some promise; two cysteine compounds tested experimentally reduce fish mortality due to *Gymnodinium* (**Ian Jenkinson**), and electrolytically generated NaOCl reduces dinoflagellate concentrations in laboratory cultures (**Hae Jin Jeong**).

Mechanisms which put the B in HAB were examined in more than twenty contributions. There was an intriguing display of how inoculating *Alexandrium* populations might adopt different distribution patterns under the influence of wind-controlled advection in a buoyant coastal plume (**Don Anderson**); but we shall have to wait longer to learn how the planozygotes find their way back to the cyst bed to close the life cycle. A prize to Don for coordinating his talk with three simultaneous movies. Advection inoculates coastal waters with offshore populations, *Gymnodinium breve* to Texas (**Tracy Villareal**) and Florida (**Gabriel Vargo**), *Gymnodinium* cf *aureolum* to Donegal Bay in Ireland (**Robin Raine**), *G. catenatum* to the Galician rías (**Ignacio Sordo**), *Alexandrium* to Maine (**David Townsend**), and perhaps *Pseudo-nitzschia* to Rio Grande shores in Brazil (**Clarice Odebrecht**). The new *Gymnodinium* from New Zealand catches rides on the East Auckland Current (**F. Hoe Chang**). Advection is implicit too in the putative link between *Dinophysis* and the buoyancy frequency (**Yolanda Pazos**). Conditions dependent on upwelling favour blooms of pennate diatoms including *Pseudo-nitzschia* in California and Oregon waters (**Vera Trainer**), and *Dinophysis* and other dinoflagellates in the southern Benguela region (**Grant Pitcher**) and off the Portuguese coast (**Teresa Moita**). In some species, cyst beds provide the basis for inoculation, and **Barrie Dale** stressed the need to learn more about the processes which control tranfers of cysts between the water column and the mud. Coastal engineering seems to have eliminated *Nodularia* blooms from an Australian estuary (**Wasele Hosja**), presumably by increasing flushing (see article by **Esther Garcés** in this issue for the opposite effect). Something analogous may have occurred in Alexandria Harbour in Egypt, where *Alexandrium* has abandoned the type locality (**A.A. Ishmael**). The harbour engineers' records might help to track this one down.

It is obvious that phytoplankton *stock* (advective and diffusive losses aside) is the difference between production and the yield to planktonic or benthic consumers, to parasites, to the sediments. Thus, as has been pointed out many times, correlations between stock levels and nutrient uptake rates are not to be expected. Then the correlation between eutrophication and the sedimentation rate of *Pseudo-nitzschia*, as in the Mississippi plume (**Michael Parsons**), can be interpreted as an increase in yield (to the sediments in this case), but not necessarily in planktonic stock levels. Increase in the latter must be due to a change in the balance between production and yield, the (R - G) term of many models. But measuring the growth rates and loss rates of field populations is no doddle, as anyone who has tried will vouchsafe. This may be why no estimates of *in situ* growth rates were presented, and only one field study looked at phyto-/zooplankton relations (**David Rissik**). Interesting results obtained in "semi-natural" grazing experiments were reported by **Gregory Teegarden**. Modellers of algal population dynamics did not obtain a full meal from this conference.

HAB 2000 introduced several innovations. Parallel sessions – these have been resisted in past conferences in this series. Here they worked. This was due I think to excellent planning as well as timing - it was possible to sample both courses with a judicious choice from the menu. The combination of posters with *in situ* lunches – this was a balancing act, and for my part the cuisine won several times; perhaps people with more self-discipline saw rather more of the posters than myself? Art – as well as the **Gym Nodinium** theatre and a habological light show, we were regaled by a virtuoso performance from **Barrie Dale** who delivered his lines with the instinctive timing of music hall comedy. A mediaeval English monk, **William of Ockham**, was mistaken for a Greek. But his famous *Principle of Parsimony* (*Ockham's Razor*), variously rendered as "plurality is not to be posited without necessity", or "it is vain to do with more what can be done with fewer", can be found in Aristotle ("Nature operates in the shortest way possible", something like that), who was more reliably Greek. M.J. Dunbar said "to hell with parsimony...it is essential to abandon all subservience to the Razor of Ockham and to have the courage to construct outrageously untestable hypotheses" (1). This too happened in Hobart, and my prizes for outrageous (and essential) speculation go to **Chris Bolch** for his phylogenetical musings, and to **John Walsh** and **Karen Steidinger** for their inspired but quite unbelievable conjecture, that Saharan dust blown across the Atlantic Ocean promotes production on the west Florida shelf by cyanobacteria, and that the nitrogen these latter extract from the atmosphere is released to feed *Gymnodinium breve*. Far out! Do people still say that?

Reference:

1. Dunbar, M.J., 1980. Canadian J. Zool., **58**: 123-128

Timothy Wyatt, Instituto de Investigaciones Marinas, Consejo Superior de Investigaciones Científicas

Corrigendum for Harmful Algae News, no. 19

On P. 4, middle column, the first two sentences in the first paragragph, "The Wellington Harbour toxin is stable …..".
As it was written, these sentences do not make much sense. They should read: "The Wellington toxin is stable within the range from pH 3 to 9. The instablity of this toxin beyond pH 3 makes it less likely to pose any human health risk when it is eaten."

Dr F Hoe Chang
Taihoro Nukurangi - National Institute of Water and Atmospheric Research
NIWA Greta Point
P.O. Box 14-901
Wellington 6041
NEW ZEALAND
Email: h.chang@niwa.cri.nz

Molecular genetics at HAB2000

The increasing use of molecular techniques in the HAB field was clearly evident at the Hobart HAB2000 meeting. Two entire sessions and more than 20 oral and 30 poster presentations, all of an exceptional standard, featured or incorporated molecular approaches to HAB organisms or blooms. The cross-fertilisation of methods and approaches between cyanobacteria bloom and marine HAB workers at the Hobart meeting was a particularly valuable experience for all. The meetings presentations covered an impressive range of topics, over which I admit to skating thinly in my summary of the main themes. The prominence of cyanobacteria blooms in Australian fresh and coastal waters ensured a strong representation of molecular studies in this area. Molecular characterisation of toxic species and populations, using a variety of gene sequences and approaches, featured in presentations of **Brett Neilan** and **Chris Saint**, the posters of **Julianne Dyble** and **Carolina Beltran**, and the study of bloom variation by **Judy Baker**. Of great interest to those of us struggling with toxin biosynthesis and genetics in marine HAB species, was the presentation by **Elke Dittmann** (**Thom Borner**) describing the structure, function, expression and *de-novo* biosynthesis of microcystin by the microcystin synthase enzyme complex of *Microcystis* spp.

Molecular methods are now becoming a useful tool to examine variation at the intraspecific and population level, showing a surprising level of population and individual variation in bloom-forming phytoplankton. **Christopher Bolch** kicked off the molecular sessions by presenting population genetic data and biogeographical hypotheses to explain the phylogeny and regional variation of the dinoflagellate *Gymnodinium catenatum*. A range of posters extended understanding of global rRNA gene variation among *Alexandrium* species **Leinonen-DuFresne**, **M.F. de Salas**, **Wendy Higman**, **Antonella Penna**, **Gires Usup**. **Martin Lange** demonstrated the huge individual variability and spatial structure of Orkney *Alexandrium* populations using amplified fragment length polymorphism (AFLP) fingerprinting techniques.

The use of ribosomal rRNA gene sequence data for HAB taxonomy and phylogeny featured strongly with the following reports filling significant gaps in rRNA phylogeny of dinoflagellates:

· **Alison Haywood**'s detailed study of the morphological/biochemical characteristics and rRNA sequence phylogeny of Gymnodinoid species including 2 new species.

· **Bente Edvardson** reporting rRNA sequences of species of *Dinophysis* spp.

· **Malte Elbrächter**'s studies to resolve benthic and planktonic *Prorocentrum* spp. and re-evaluate their position among the dinoflagaellate crown taxa (GPP complex *sensu* Saunders et al.).

Development and application of genetic probes from this increasing base of rRNA phylogenetic data continues apace as more sequences become available. Reports of new probes, new probe detection approaches, and most encouragingly, the incorporation of the DNA probe technology into HAB research and monitoring programs, were highlights of the meeting:

· New species and probes for *Pfiesteria* and *Pfiesteria*-like species by **Dave Oldach** and **Geraldo Vasta**

· Integrating flow cytometry and in-situ hybridisation with rRNA probes for field studies **Louis** Peperzak, **Rene Groben**, **Joachim Brenner**, **Yoshihiko Sato**)

· New electrochemical detection approaches for probes using PNAs from **Wayne Littaker**

· The use and integration of rRNA probes into New Zealand's routine plankton monitoring program by **John Tyrrell** and **Lesley Rhodes** and the development of autonomous in-situ monitoring systems by **Chris Scholin**.

Christopher J. S. Bolch, Centre for Coastal and Marine Sciences, Dunstaffnage Marine Laboratory, Oban, Scotland

A note on abstracts

Is it not time to give a little editorial attention to books of abstracts? For example, does an abstract really need to tell us that dinoflagellates have two flagella? Is it not rather obvious that toxins are pharmacologically active? And so on. Abstract books being the size they are these days, given too that they quite often get cited, even in the *primary* literature, pending the arrival of the proceedings, a good index is a help; it doesn't take too long with appropriate software. Abstracts which come to a sudden end because the page stopped, missing titles, things like that, rather sloppy. Non-native English speakers, too, deserve a little help in getting their 200-odd words into reasonable shape. *Ed*

Intergovernmental Panel on HAB Meets

The IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB) was formed in 1991 in order to identify adequate resources for a broad international programme to try to solve some of the problems caused by harmful algae. The Fifth Session of the Panel was held 22-24 November 1999 at UNESCO Headquarters in Paris. The Session was attended by representatives of: Canada, Finland, France, Georgia, Germany, Greece, Italy, Japan, Kuwait, Norway, Philippines, Portugal, Spain, Sweden, United Kingdom, United States of America, Uruguay, Korea (observer), Scientific Committee on Oceanic Research (SCOR), International Council for the Exploration of the Sea (ICES), International Society for the Study of Harmful Algae (ISSHA), and the International Union of Pure and Applied Chemistry (IUPAC). The Chair of the HAB Panel is Dr. Adriana Zingone (Italy),

During its meeting the Panel reviewed the actions completed by the IOC HAB Programme the last 3 years, and decided upon the workplan for the coming years.

Regional IOC-HAB Groups

The Panel reviewed the results and reports under the regional components of the HAB Programme, WESTPAC/HAB (Western Pacific), IOC/FANSA (South America), and IOCARIBE/ANCA (Caribbean), and noted with satisfaction the establishment of a working group on harmful algal blooms in the Caribbean and adjacent regions (IOCARIBE-ANCA)

The Panel recognized the importance of the work carried out by the regional project leaders.

Harmful Algae News

"Harmful Algae News" has been published since January 1992 and has more than 2000 subscribers. The Panel reappointed the Editor (Dr. Tim Wyatt), and recommended that special issues on selected topics is prepared, and that HAN should be issued more regularly, even if some issues would then have relatively few pages.

(Cont'd on p. 13)


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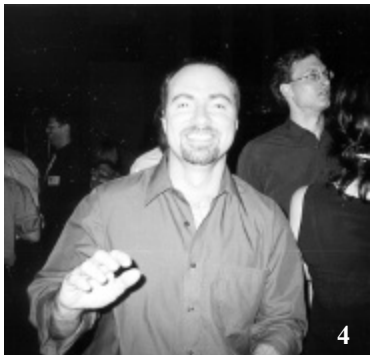
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Some of the habologists at HAB2000:
1, 7, & 13 facets of food web dynamics; 3 & 6 various Mediterranean haptotypes and an introduction from the South Atlantic, and 9 three more from the Gulf of Thailand; in 11 a view of the conference bar reveals compatible strains from Munster and Connaught waters; 2, 4, 5, 8, & 10 distinctive (and distinguished) morphotypes from around the world, and 12 one example (from many sighted at the conference) of «North meets South» (remember Bermuda? - see HAN 15, p22)

(Cont'd from p. 1)

provoked new incidents in the region over the last decade, and are associated with areas modified by human activities. Their blooms are recurrent and frequently cause public health, economic, and political problems.

Alexandrium minutum is a widely distributed PSP organism. This is the toxic species most widespread in the Mediterranean basin and in the last decade, recurrent blooms have been described in various harbours and shellfish farms. Substantial economic losses are associated with this organism Since the record of Halim (2), blooms of this species have been only sporadically detected, with an evident increase of reports in the last decade in the Mediterranean (see table 1). On the Catalan coast, since 1995 when pilot HAB monitoring of harbours began, the number of harbours where *A. minutum* has been detected increased. This species appears along much of the Catalan Coast (1) but only proliferates massively in concrete harbours; recurrence is evident in at least one of them (Arenys Harbour).

Alexandrium catenella is widely distributed in cold temperate waters. In the Mediterranean basin, Margalef and Estrada (3) reported it as rare in oceanic waters. Since the first bloom detected in Barcelona harbour in 1996, there has been growing evidence of an increase in abundance and geographical range of *A. catenella* on the Catalan Coast (table 2). In late spring 1998, the first toxic event was described in the Mediterranean Sea, not only in some harbours but in open-sea waters. In 1999, a huge bloom of *A. catenella* was again observed (4).

Alexandrium taylori was described in 1994 from the Atlantic. The presence of intensely green-brown coloured water during summer months at some tourist beaches in the Balearic basin was known to the local population since the early 1980s, at La Fosca (Catalan coast), Cala Tarida, Pagera, Cala en Porter (Balearic Islands) (5) causing deterioration of water quality for recreational uses, and economic losses to the tourist industry. No explanation of the phenomenon was found until the cause of the water discoloration was described as a non-toxic bloom of *A. taylori* Balech. *A. taylori* does not appear to be mentioned in the Mediterranean prior to its identification at La Fosca (Catalan coast) (6); since then, it has been recorded mainly on beaches (Table 3 and ref. 7).

This species appears in several places in the NW Mediterranean (Costa Brava, Balearic Islands, Sicily) during summer, reaching concentrations 10^2 cells L^{-1} (8). In some places concentrations reach 10^5 cells L^{-1}, but dense (>10^6 cells L^{-1}) recurrent blooms in July and August occur only at certain beaches.

The maintainance of concentrations in excess of 10^6-10^5 cells L^{-1} for 6 weeks is rare during *Alexandrium* blooms (9). The blooms at La Fosca beach have been studied since 1995. *A. taylori* blooms are manifestations of large-scale proliferation in specific areas where the local environmental conditions and life history features interact to amplify numbers. The factors involved are moderate *in situ* growth (0.4 d^{-1}), low water renewal rates, i.e., weak flushing), formation of temporary cysts (80% of population daily) and their retention in the sediment acting as a reserve of the population (10). These species (*A. taylori*, *A. minutum*, *A. catenella*) are responsible for new, emergent problems and it can be deduced from the advance of the species range that new beaches and harbours will be affected in the near future.

Increased knowledge

In recent years (1997-99), areas with *A. taylori* blooms in Mediterranean coastal waters have certainly increased. This is the case in Eivissa Island where 3 more sites have been detected since 1997 (table 2). Also there has been an increase in dense blooms of *A. taylori*. In places where it was formerly found in low numbers, it now forms concentrations up to 10^6 cells l^{-1}. Also, since summer 1997, *A. taylori* blooms have occurred at St Pol (Costa Brava) where previously water discoloration was not detected. At present this species is limited to the northern Catalan Coast (Costa Brava). Future work should reveal whether this is due to local environmental conditions here and in the Balearic Islands, or is a prelude to range expansion.

Eutrophication

It does not seem that *Alexandrium* has been favoured by enrichment over other species, and in any case there is no evidence of near-shore enrichment in the northern part of Mediterranean basin in the last 30 years, since human population growth on the coast has been accompanied by better

Table 1. Areas of A. minutum *blooms (> 10^4 cells L^{-1}) in Mediterranean.*

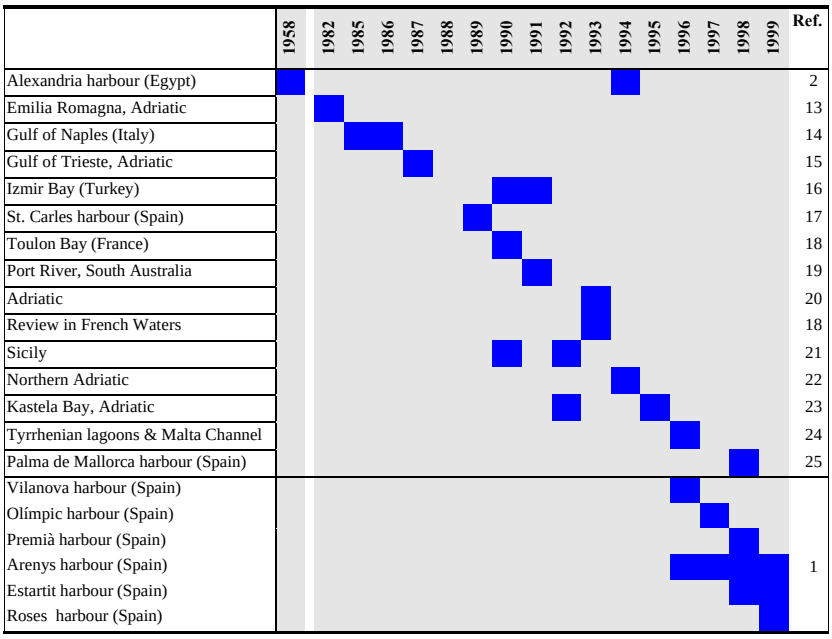


Table 2. Areas of A. catenella *blooms (> 10^4 cells L^{-1}) in Mediterranean.*

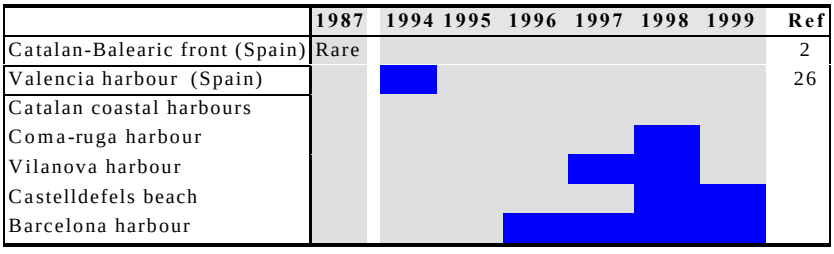
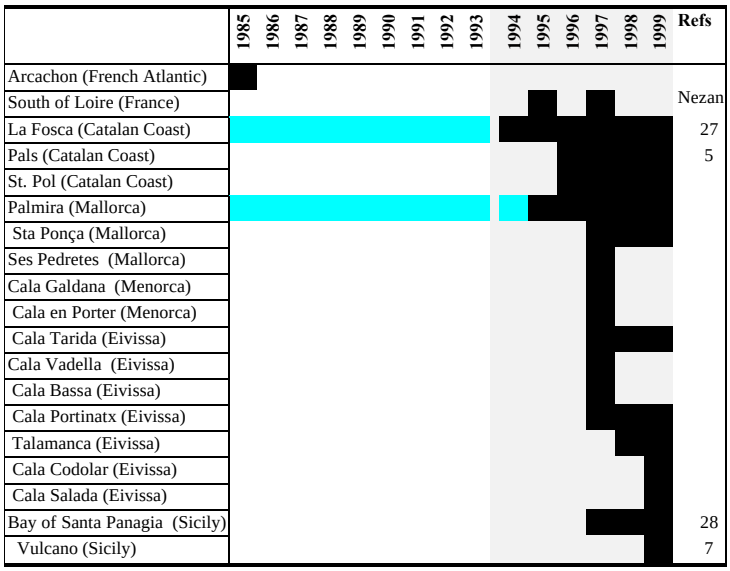


Table 3. Areas of A. taylori *blooms with up to 10^5 cells L^{-1} in Balearic basin.*



* this species is most probably under-estimated since it is easy to confuse it with other species of the sub-genus *Gessnerium*.

wastewater treatment. Nor do changes in nutrients ratios seem likely to have been involved (11).

Species introductions

The problem of introductions in ballast water or mollusc shipments has not yet been studied in the Mediterranean. The present distribution of *A. catenella,* known in the Mediterranean since 1987, may indicate a ballast water origin. A preliminary study of *Alexandrium* genetics (7) has established that Italian and Spanish strains of *A. taylori* are closely related, and very distinct from morphologically similar species such as *A. margalefi* recently found in the Tyrrhenian Sea.

Newly created habitats

The fourth aspect proposed here, the capacity of dinoflagellates to colonize and proliferate in man-made sheltered areas, has received scant attention. This aspect may be particularly relevant in regions like the Mediterranean Basin which are calm and have weak tides. Information on *Alexandrium* supports this view. Many *Alexandrium* species have a benthic resting which allows them to survive in sediments; then population development is possible in more locations. Reservoirs of resting cysts may be of great significance in sheltered waters. Two of the species analysed here, *A. minutum* and *A. catenella*, appear preferentially in harbours and in most cases recurrently. Thus confined waters may play an essential role to maintain high numbers of resting cysts, which would otherwise be dispersed, at specific sites. The behavioural strategies (swimming patterns, active migrations and self-regulated aggregation) of these species allow them to reach high levels of biomass in these particular localities.

What is certain is that *Alexandrium* blooms in Mediterranean coastal waters have increased in recent years, and that areas created or modified by human activities may be responsible for this increase. We must therefore examine the role of confined areas created or modified by human activity in the expansion and diversification of *Alexandrium* blooms, and establish the basis for integrated coastal zone management in coastal recreational waters (i.e. formulate new criteria for use of near-shore waters). Obvious questions that emerge are; How important are confined areas (proximity, number, area) for the expansion of some species? Are there causal links between mesoscale blooms and those in man-made sheltered areas? Could the adaptive potential of *Alexandrium* together with the existence of man-made sheltered areas lay a base for future speciation?

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Esther Garcés, Mercedes Masó, Magda Vila and Jordi Camp., Institut de Ciències del Mar, P. Joan de Borbó, s/n, 08039 Barcelona, SPAIN, e-mail: esther@icm.csic.es

◆ **Mexico**

Should Bahía Concepción, Mexico, be a model for Harmful Algal Blooms?

An analysis of the information of microalgal blooms in Mexico since 1970 shows that during the second half of the 1990s, records of Harmful Algal Blooms (HAB) have increased notably (Fig. 1). Of the total blooms recorded in Mexico, about 78% have occurred on the coasts of the Gulf of California. The dinoflagellate *Noctiluca scintillans* and the ciliate *Mesodinium rubrum* were the most recurrent species (1,2). Other microalgae involved in blooms, in order of importance, are dinoflagellates, diatoms, cyanophytes, silicoflagellates, and a haptophyte.

Most of these events were innocuous, though toxic species such has *Alexandrium catenella, Pyrodinium bahamense* var. *compressum*, *Gymnodinium catenatum, Gymnodinium breve,* and *Pseudo-nitzschia* spp. have been asociated with health, economic, and environmental issues in Baja California Sur (3,4,5), Guerrero (6), Oaxaca (7), Sinaloa (1,8), and Veracruz (9) (Fig. 2). Moreover, other potentially toxic dinoflagellates have been recorded along the coasts of Mexico; *Alexandrium pseudogonyaulax, A. minutum, Prorocentrum dentatum, P. lima, P. minimum, P. mexicanum*, *Dinophysis acuminata, D. hastata, D. rotundata, Gambierdiscus toxicus, G. yasumotoi, Pseudo-nitzschia australis,* and *P. delicatissima* (10, 11,12).

At times, the toxin concentrations exceeded the maximum level allowed for human consumption of clams, and human intoxication by paralytic shellfish toxins has occurred. Around 136 human poisoning cases have been recorded and 9 fatal cases have been confirmed. However, these are underestimates since many clinical diagnoses are inaccurate. Other adverse impacts are mortality of fish, birds, marine mammals, and economic losses in aquaculture, fisheries, and tourism (4,9). Not only paralytic toxins have been detected, but also diarrheic, amnesic, neurotoxic, and ciguatera toxins have also been confirmed in marine organisms (6,7,8,11,13,14). Despite these adverse impacts, Mexico does not have a permanent monitoring program and most studies have been limited to reporting and describing these events.

To contribute research under the objectives proposed by the Intergovernmental Oceanographic Commission, the Northwest Biological Research Center (CIBNOR) began, in 1993, to investigate the biological and hydrological processes that regulate the occurrence of harmful species in the large Bahia Concepcion, Gulf of California (Fig. 3). It supports extensive shellfish fisheries and tourist activity. PSP and DSP toxins in mollusk (3,14), toxic dinoflagellates (10), and high concentrations of dinoflagellate cysts in sediments (15) have been confirmed.

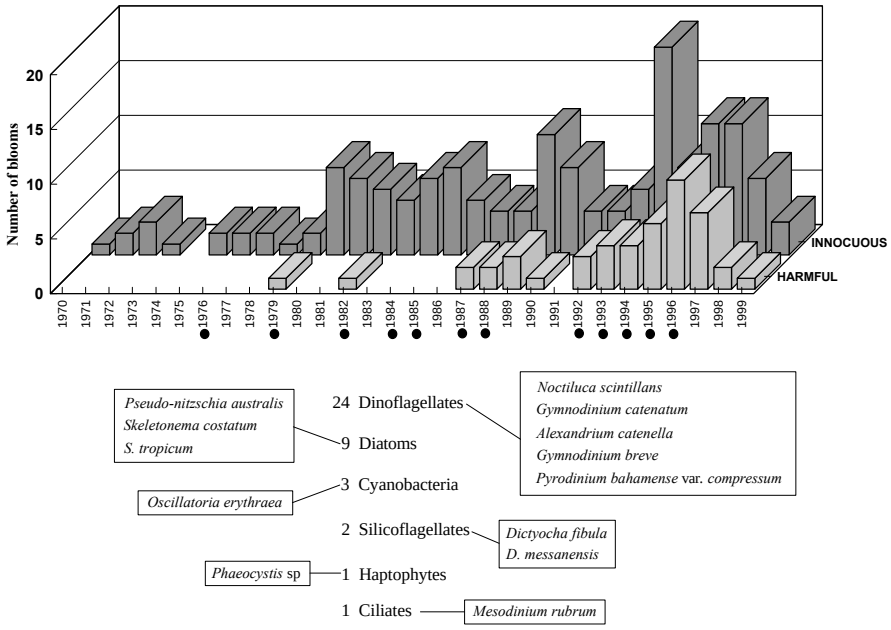

Fig. 1. Record of harmful and innocuous microalgae blooms in Mexico (1970-1999). Toxin activity was detected in the years indicated with black circles.

In this bay the assemblage of harmful microalgae is composed by *G. catenatum*, *A. catenella*, *A. pseudogonyaulax*, *A. minutum*, *P. minimum, P. dentatum,* and *D. acuminata. N. scintillans* is a recurrent species forming red tides, mainly in fall and winter. Other occasional blooms have been produced by *Gonyaulax verior*, *Dinophysis caudata*, *P. mexicanum,* and the cyanobateria *Oscillatoria erythraea.* PSP toxins in shellfish were found in Bahía Concepción, but no human poisoning has been reported though the toxin concentration has exceeded the allowable limits for human consumption of shellfish (3,10).

In winter, before harmful dinoflagellates appear, the water mass is characterized by a diatom-dominated community, and a well-mixed water column. The decline of the diatom population, increased temperatures, and the beginning of thermal stratification are present when dinoflagellate populations such as *Dinophysis* and *Alexandrium* increase. Thereafter, the increasing water temperature and the development of strong stratification are accompanied by *Ceratium* and *Prorocentrum*, and *Alexandrium* and *Gymnodinium* decline(3).

Our research is now attempting to define small-scale hydrobiological conditions that are involved in the presence of toxic dinoflagellates to describe the phytoplankton community before, during, and after the toxic dinoflagellate upsurge. To explain the dinoflagellate vertical distribution, and the influence of the hydrodynamic structure of the water column, we started intensive monitoring (since 1997). We also recently started to investigate the contribution of cysts to the population dynamics of dinoflagellates, including the beginnings and ends of blooms, survival during long periods, and recurrence of blooms. We will try too to

Fig. 2. Locations in Mexico where toxin activity have been detected. The species responsible for this toxicity are indicated for each area.

determine the influence of hydrodynamic conditions on the dinoflagellate life cycle, particularly the cyst phase. To do this we will characterize the cyst assemblages in marine sediments, define their distribution patterns, and determine the principal period and hydrodynamic conditions that promote cyst formation and germination under laboratory and natural conditions. Controlled laboratory experiments are under way to study exogenous (temperature) and endogenous factors (pigments, enzymatic activity, and toxins) inducing cyst germination in toxic species of *Alexandrium* spp. and *G. catenatum*. Bahia Concepcion is far from free of urban and industrial influences, so is a huge natural laboratory for HAB studies.

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Fig. 3. Map of Baja California (Mexico) illustrating the location of Bahia Concepcion and the Northwest Biological Research Center (CIBNOR).

Lourdes Morquecho, Christine Band-Schmidt, Carlos Lechuga-Devéze and Diana Góngora; Centro de Investigaciones Biológicas del Noroeste, S.C. (CIBNOR). Apartado Postal 128, La Paz, B.C.S., Mexico 23000; e-mail: lourdesm@cibnor.mx; http://www.cibnor.mx/proyecto/maltox/imicnoc.html.

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IOC Manual on Harmful Marine Microalgae

The IOC Manual on Harmful Marine Microalgae (IOC Manuals and Guides No. 33) has proven to be one of the most successful products of the IOC HAB Programme, and is now out of stock. The Panel endorsed the preparation of a second revised and expanded edition of the IOC Manual on Harmful Marine Microalgae. The second edition of the Manual will have the same editorial team as the first edition: D. Anderson (USA), A. Cembella (Canada), G. Hallegraeff (Editor in Cheif), and H. Enevoldsen as Technical Editor.

Database on HAB events - HAE-DAT

The IOC-ICES Metadatabase on Harmful Algal Events, HAE-DAT, is now accessible via the IOC home-page. The Panel recommended it as a high priority to start establishing a mechanism for non-ICES countries to contribute to HAE-DAT. This will be done jointly by the IOC HAB Centres in Vigo and Copenhagen, WESTPAC/HAB, IOC/FANSA, and IOCARIBE/ANCA.

Training

Over the last years significant support has been provided by Denmark, Japan, and Spain for training and capacity building activities, and there has been cooperation on training activities with the Asian Pacific Economic Cooperation (APEC) and the Nordic Research Academy (NorFa). The Panel noted the difficulties in evaluating the impact of the significant training efforts under the IOC HAB Programme, and requested the Centres and the Secretariat to propose to the next session of the Panel a model for assessment of the IOC HAB Training Programme.

GEOHAB

The overall goal of the IOC-SCOR international research programme on the global ecology and oceanography of harmful algal blooms, GEOHAB is to develop the scientific knowledge needed in this field in order to increase the capability of mitigating the impacts of HABs. The Chair of the IOC-SCOR Scientific Steering Committee (SSC) for GEOHAB is Dr. Patrick Gentien (France).

The GEOHAB SSC and the SCOR and IOC Secretariats are working on the establishment of an International Project Office

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◆ Morocco

Pseudo-nitzschia pseudodelicatissima bloom in Atlantic Moroccan waters 1999

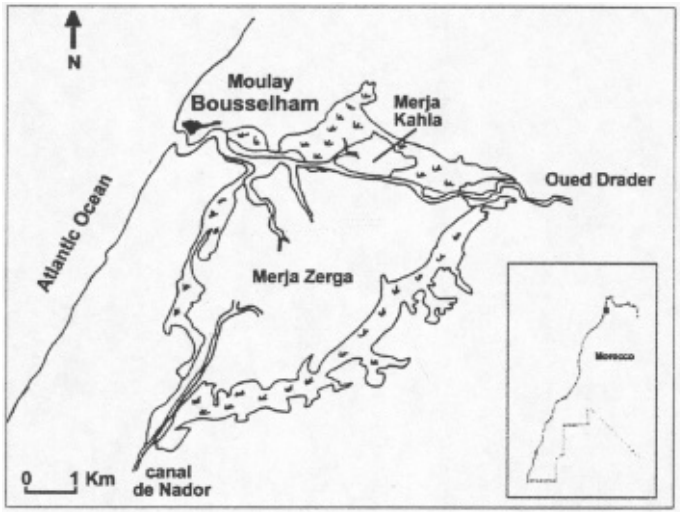
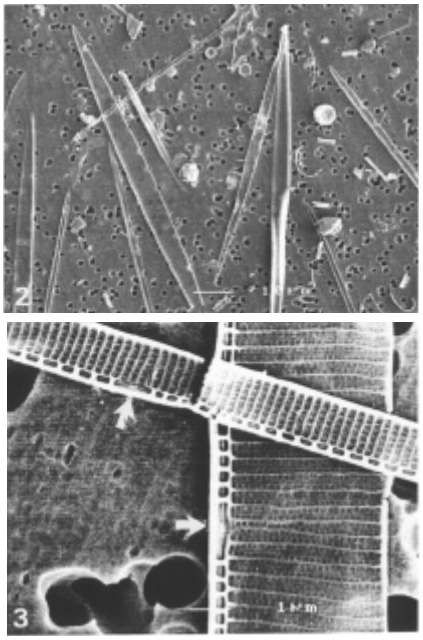


***Fig. 1**. Location of the Moulay Bousselham site*

Various harmful algal blooms (HAB) have been recorded since 1966 on the Mediterranean and Atlantic coasts of Morocco, including blooms causing fish mortalities [1] or human casualties due to PSP [2]. Whereas toxic phytoplankton may be a permanent phenomenon on the Mediterranean coast, HABs are sporadic on the Atlantic Moroccan coastline [2]. Causative species have not always been identified due to the absence of a coordinated network for monitoring red-tide events in Morocco.

In 1998 and 1999 we performed phytoplanktonic surveys on the Atlantic coast between Moulay Bousselham and Témara. On 18 April 1999 high concentrations of pennate diatoms of the genus *Pseudo-nitzschia* were observed in the lagoon of Moulay Bousselham. This lagoon (Merja Zerga) is a natural park area and the most important wintering site for migratory birds in Morocco. The phytoplankton community featured various dinoflagellates (including *Prorocentrum micans*, *Dinophysis acuminata*, *D. acuta*, *Ceratium furca* and *Protoperidinium diabolus*), the silicoflagellate *Dictyocha speculum* as well as centric diatoms (*Coscinodiscus concinnus*, *Rhizosolenia imbricata* and *Chaetoceros curvisetus*). Sampling was conducted at the mouth of the Merja Zerga lagoon (Fig. 1) which is known to receive substantial amounts of micropollutants such as organochlorates [3]. Water temperature and salinity during the study were 18 ± 1°C and 35.8 ± 0.1 respectively, corresponding to local spring conditions.

Scanning electron microscopy of acid-cleaned frustules was necessary for a critical identification of the species of *Pseudo-nitzschia*. In the 18 April 1999 sample, a total of five species of *Pseudo-nitzschia* belonging to two different size groups were formally identified (Fig. 2). Although exact cell densities of individual species are unknown, *P. pseudodelicatissima* was the most abundant species of *Pseudo-nitzschia*. It was readily recognized by its narrow linear frustules (transapical axis ca. 3 µm or less), single rows of square poroids, along with the presence of a central larger interspace (Fig. 3). The other species present were *P. fraudulenta* (larger frustules seen Figs 2 & 3), *P. pungens*, *P. subpacifica* and *P. delicatissima*.



***Figs 2 and 3**. Scanning electron microscopy of the* Pseudo-nitzschia *species. **2**. General view showing species belonging to two different size groups. **3**. Details of* P. pseudodelicatissima *(narrow frustule) and* P. fraudulenta *(large frustule); arrows indicate the central larger interspace.*

In this assemblage *P. pseudodelicatissima* is a potentially toxic species, some clones being domoic-acid producers. In Canada the presence of *P. pseudodelicatissima* in 1988 was correlated with high levels of domoic acid in mussels and clams [4] and very recently in France (1998) low levels of domoic acid detected in mussel tissues (Z. Amzil pers. com.) coincided with local blooms of *P. pseudodelicatissima* (C. Billard, unpubl. results). Other clones of this species are known to be non-toxic.

Four of the five species of *Pseudo-nitzschia* (including *P. pseudodelicatissima*) were still present at Moulay Bousselham in June 1999, while *P. fraudulenta* had disappeared. This is the first report documenting the presence of *Pseudo-nitzschia* species in North African waters. The high abundance of *P. pseudodelicatissima* in the lagoon of Moulay Bousselham had no harmful consequences. However it remains a potential threat and monitoring for domoic acid in the shellfish harvested in the area could be considered in the future.

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Rachida Akallal & Aziza Mouradi, Laboratoire de Biochimie et Biotechnologies marines, Faculté des Sciences, Université Ibn Tofail, 14000 Kénitra, Morocco

Thierry Givernaud, SETEXAM, B.P. 210, 14000 Kénitra, Morocco

Chantal Billard, Laboratoire de Biologie et Biotechnologies Marines, Université de Caen, Esplanade de la Paix, 14032 Caen cedex, France

International Society for the Study of Harmful Algae -ISSHA-

The second General Assembly of ISSHA was held on 10 February 2000 during the Ninth International Conference on Harmful Algal Blooms, in Hobart, Tasmania. As current President of ISSHA Max Taylor presided over the Assembly meeting. He gave a brief history of ISSHA and outlined its affiliation with other organizations and the possible direction the Society could take in relation to other international bodies that deal with HABs.

The results of the election for the new Executive were announced and are as follows:

Vice-President (Taxonomy/Genetics/ Evolution): **Karen Steidinger**
Vice-President (Toxicology/Pharmacology/ Epidemiology): **Yasukatsu Oshima**
Vice-President (Ecology/Monitoring/ Management): **Allan Cembella**
Treasurer: **Henrik Enevoldsen**
Secretary: **Stephen Bates**

The election of a new President from among the three new Vice-presidents was postponed as Dr. Oshima was absent and would thus be unable to give a statement at the meeting. Second, there was considerable debate about the current Society Statues and related election procedures. During April it became clear that Yasukatsu Oshima and Allan Cembella have decided not to run for President, and therefore Karen Steidinger becomes the new President by default.

Secretary's and Treasurer's Report

The leaving secretary (Allan Cembella) reported on the initiatives carried including the establishment of a Society website (http://www.cbr.nrc.ca/issha/) and Society awards (see below). The Treasurer (Henrik Enevoldsen) presented the 1999 Financial Statement for ISSHA, and the very generous contribution of 10,000 US$ from the Organizing Committee of the Seventh International Conference on Toxic Phytoplankton (Sendai) was acknowledged.

Statutes debate

Some members pointed out that the Statutes had never been ratified by Society members; others stated that because ISSHA is a legally registered society in Denmark, the Statutes are legal. It was decided that the Statutes, which were originally mailed to members on 4 January 1999 and are also available on the ISSHA website, will be mailed to the membership for amendments. Members can send their proposed amendments to the Secretary, who will post them on the ISSHA website. A deadline of 6 months from time of receipt of the current Statutes was given to propose amendments. Amendments may be approved by postal ballot, providing two thirds of the membership support the amendment (Article XVII of the Statutes).

Student Membership

After a brief discussion, it was agreed that the Society is presently too small to warrant a student representative to sit on the Executive. Efforts should be made to encourage student membership in the Society. A related debate ensued about the Student and other Awards. Questions were raised about the following: How much membership participation is there in voting? Is there a bias for high tech labs and against good science? Do awards promote competition rather than co-operation? Some strongly felt that the Society should not provide such awards. Members of the past Executive explained the rationale behind the awards and the process for choosing them. A vote was then held and it was decided that the Society should provide Awards as planned by the Executive.

Future Initiatives of the Society

Max Taylor outlined the importance of membership initiatives and of input from members. A number of initiatives remain from the first General Assembly, including creation of a Society logo. No proposals have been received so far. Also the involvement of the Society in future conferences and meetings of the international HAB community need to be discussed. How much input and involvement should there be from the Society Executive or International Organizing Committee? Should the International Organizing Committee be maintained? How should the Proceedings be published?

Another issue which has been discussed among ISSHA members is the need for a specific HAB or Society Journal. Nevertheless, the discussion at the Assembly was very short as it was announced that an international journal for HABs is already planned, independent of the Society.

ISSHA Awards

The ISSHA awards mentioned above were presented during the HAB 2000 Conference dinner. The nominees for the awards were selected jointly by the ISSHA Executives and the HAB 2000 International Organizing Committee prior to the HAB 2000 Conference.

The Yasumoto Lifetime Achievement Award is given in recognition of long time outstanding contribution to the HAB field. It is named after Professor Takeshi Yasumoto in recognition of his unique contribution to HAB research. The Award was presented to Prof. F.J.R. Taylor, University of British Columbia, Canada, for an outstanding lifetime contribution to harmful algal research, including major achievements in the field of taxonomy, evolutionary biology, and marine ecology.

The ISSHA Award was given in recognition of recent scientific excellence in HAB research. The Award was presented to Dr. Chris Scholin, Monterey Bay Aquarium Research Institute,USA, for the development of molecular probes for harmful algal species, major advancements in biogeographical studies on the dispersion of key taxa (e.g., Alexandrium spp.), the "global spreading" hypothesis, and the recent characterization of the events leading to sea lion mortalities caused by domoic acid in California.

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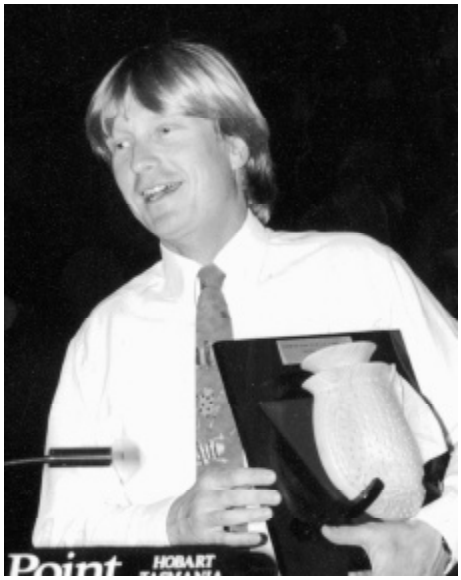

Chris Scholin recieves the ISSHA Award 2000. The award winners received magnificent dinoflagellate wood carvings made by Dr. Haruyoshi Takayama.

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The ISSHA Student Awards are named after Dr. Maureen Keller. Maureen Keller died rather suddenly on Wednesday, November 17, from a highly aggressive form of cancer. She was active in a wide variety of scientific research projects related to harmful algae. For example, she was deeply involved in work on DMS production by Phaeocystis blooms in the Gulf of Maine and her key presentation on haptophytes at the NATO-Advanced Study Institute in Bermuda will be remembered by all participants. Maureen was also responsible for an important component of the US ECOHAB project on Alexandrium dynamics in the Gulf of Maine. In earlier work with Bob Guillard, Maureen made valuable contributions to the development of nutrient media for marine phytoplankton. In honour of Maureen's efforts in the field of harmful algal research, ISSHA has initiated the Keller Student Awards for best oral and poster presentations by students and post-doctoral fellows attending the international HAB conferences. These awards were presented for this first time at the HAB 2000 meeting to Kathi Lefebre (Univ. of California) for best oral presentation: "Outward excitotoxic effects and tissue distribution of domoic acid in a prominent vector species, the northern anchovy (Engraulis mordax)"; to Lizeth Botes (Univ. of Cape Town) for best poster: "An investigation of the identity and potential toxicity of Gymnodinioid species present in False Bay, South Africa"; and to David Seaborn (Old Dominion Univ, US), Torstein Tengs (Univ. of Maryland, US), and Judy Baker (Univ. of New England, AU) for posters with honorable mention.

All interested can find more about ISSHA and instructions about how to apply for ISSHA membership at the ISSHA web URL (http://www.cbr.nrc.ca/issha/).

Stephen Bates and Henrik Enevoldsen
Secretary Treasurer

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for GEOHAB. France has offered to host the Project Office at IFREMER, Centre Brest, and the USA has offered to investigate their possibilities for providing support.

The Panel focused its discussions on the strategy to provide an efficient mechanism for promoting GEOHAB at both the global, regional, and national levels. To this effect, the Panel made recommendations to Member States on how to build up GEOHAB.

Taxonomy

The Panel decided to continue the work with a reference list on potentially harmful algae, which is very needed in the international research and management community.

Toxins

The Panel noted with concern the potential incompatibility of regional and/or national regulations on aquatic biotoxins, and the associated potential impediments to trade with seafood products. The concern was in particular expressed with respect to compatibility of EU and APEC regulations. The Panel offered itself as a mechanism to strengthen interaction between the relevant expert groups which advice e.g. EU and APEC on biotoxin regulations.

Resource protection

The Panel established a Task Team to draft a document providing guidelines on emergency measures for harmful algal events. The Panel decided that the draft document should be reviewed by the IPHAB Members and the ICES-IOC Working Group on Harmful Algal Blooms Dynamics. The Panel also endorsed the potential publication by IOC jointly with APEC of a revised version of a major report on design of HAB monitoring strategies prepared by a consortium of international experts and originally published by Hong Kong in cooperation with APEC.

HAB monitoring and GOOS

The Global Ocean Observing System, GOOS, has included HABs among the issues to be considered in designing a global observation system that meet the needs of a wide range of end-users. It has also been acknowledged that HABs and their consequences on human health and mass mortality of natural and cultivated living resources are among the prominent indicators of changes in coastal waters. A global and long-term observing system of HABs would allow to detect general trends and distinguish them from locally driven phenomena. It would also offer a link between complementary data sets at high spatial and temporal resolution, which allows integrated data analysis and increases the reliability of models. It would constitute a mechanism for the intercalibration and optimisation of monitoring operations, world wide dissemination and safe long-term archival of data. The overall result is an improved capacity of predicting HABs over different time scales. It was recognized that existing HAB monitoring is not uniform neither in methodology or scope, and it was decided that an information document on the nature of HAB monitoring, including identification of HAB monitoring parameters, and examples of national HAB monitoring and management is prepared and presented to GOOS in order to facilitate the identification of HAB monitoring parameters suitable for inclusion in a long term global ocean observing system.

The full report and the detailed recommendations of the Panel can be found at: http://ioc.unesco.org/hab/act2.htm

Subscriptions

Subscriptions to HAN and change of address at: *http://ioc.unesco.org/hab/news.htm*, or send an e-mail clearly marked "Harmful Algae News" to Ms. F. Schiller at *f.schiller@unesco.org*

HARMFUL ALGAE NEWS

Compiled and edited by Tim Wyatt, Instituto de Investigaciones Marinas, CSIC, Eduardo Cabello 6, 36208 Vigo, Spain; Tel.: +34 986 23 19 30/23 19 73; Fax: +34 986 29 27 62;
E-mail: twyatt@nautilus.iim.csic.es and Cristina Sexto, Instituto Español de Oceanografia, Centro Oceanográfico de Vigo. Aptdo 1552, 26280 Vigo, Spain; Tel.: +34 986 49 21 11; Fax: +34 986 49 20 03; E-mail: cristina.sexto@vi.ieo.es

Project Coordinator: Henrik Enevoldsen, IOC Science and Communication Centre on Harmful Algae University of Copenhagen, Botanical Institute, Øster Farimagsgade 2D, DK-1353 Copenhagen K, Denmark
Tel.: +45 33 13 44 46, Fax.: +45 33 13 44 47
E-mail: hab@bot.ku.dk
Production Editor: Botanical Institute, Copenhagen

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