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Reflections on the 13th International Conference on Harmful Algae

The 13th international conference on harmful algae was convened in Hong Kong from November 3–7, 2008. The meeting was attended by approximately 375 participants from 22 countries. Historically, this represents a decrease in attendance from recent conferences, which have had more than 500 participants and representation from 40–50 countries. The decrease may reflect the financial crisis that was sweeping the world at the time of the meeting, as well as funding shortfalls for HAB research in a number of countries. This was certainly the case with a number of colleagues from the U.S. who usually attend our conferences, but were unable to do so because of a lack of travel funds. There was also a shortage in travel funds for students, postdocs, and for scientists from developing countries.

The venue was unique in that the meeting was held at the Disneyland Resort located outside Hong Kong. The main park with its rides and attractions was a 10-minute walk from the hotels and the conference rooms, but the Disney theme was still evident everywhere, from the names of the conference rooms (Cinderella, Sleeping Beauty), to pictures and statues of Disney characters, to the elevators that called out the floor numbers with the voice of Mickey Mouse. The facilities and rooms were modern and spacious. Hong Kong is an extraordinary city, and those who made trips downtown experienced the spectacular skyline and the other sights and sounds that few will forget. Conference convener K.C. Ho and his assistant Ginnie Kai worked very hard to coordinate a meeting that entertained the participants while also providing opportunities to communicate in formal and informal settings, to interact socially, to form new friendships, and to renew old ones.

As I look back on the conference, I am struck by the maturity of our field. In my summary talk, I went back through the past HAB conferences, pointing out how the complexity of the

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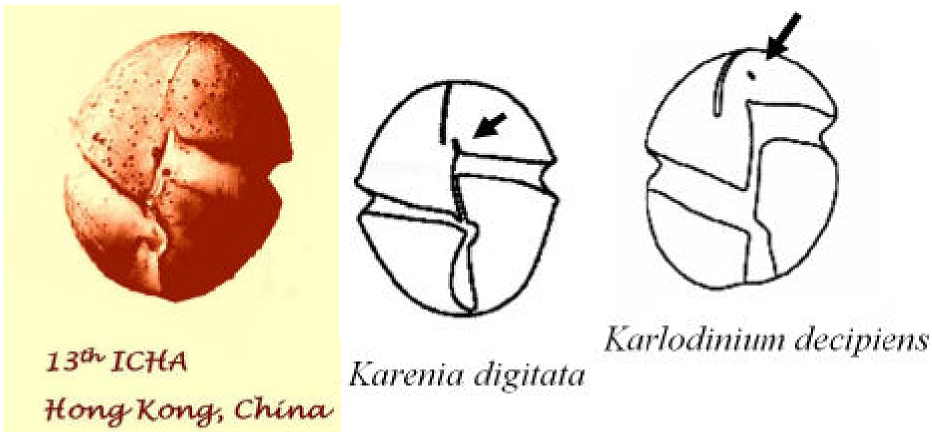
Who is the Hong Kong dinoflagellate on the ICHA13 conference logo?



Karenia digitata Yang, Takayama, Matsuoka & Hodgkiss 2000 as featured on the ICHA13 logo was newly described as the causative organism of the extraordinary red tide and fish kills in Hong Kong waters in 1998 [1]. This event which originated offshore attracted significant media coverage and caused 35B dollars (RMB) loss. This species was allocated to the genus *Karenia* because of the presence of a straight apical groove and the absence of a ventral pore then considered to be diagnostic for the genus *Karlodinium* [2], while the species name refers to the finger-like (*digitata*) protrusion of the sulcus on to the ventral epicone surface. Unfortunately, no live type cultures of *K. digitata* are available and no molecular sequences were obtained, something which is strongly recommended to be included in modern HAB species descriptions (as discussed by Karen Steidinger in Hong Kong). At the HAB13 conference, Miguel de Salas, Ben Mooney, Gustaaf Hallegraeff and co-workers presented a stunning 5 new *Karlodinium* species obtained from a single cruise in the Southern Ocean south of Tasmania [3]. One of those new species, *Karlodinium decipiens* de Salas (*decipiens* means deceiving!),

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now known from Tasmania (Australia) and Spain bears a striking similarity to *Karenia digitata*, except for the presence of an inconspicuous ventral pore and the absence of the finger-like sulcal protrusion. Soon after lodging our LSU rDNA sequences of this taxon in GenBank we were approached by Haifeng Gu of the Third Institute of Oceanography, Xiamen, China, who had established cultures from Hong Kong waters with an identical sequence.

We carefully considered the possibility that *Karlodinium decipiens* could be a junior synonym of *Karenia digitata*. However, the morphological differences between the descriptions of the two species are significant, and further communication with Takayama who prepared the original scanning micrographs of *Karenia digitata* confirmed that the material from Hong Kong and Japan never contains a ventral pore. A further *Karlodinium* species described by de Salas and co-workers, *K. ballantinum* de Salas, now known from Tasmania and Italy (Zingone, unpublished), while genetically undoubtedly being related to *Karlodinium*, does not possess a ventral pore however. As many of you may remember, the significance or not of the presence or absence of a ventral pore for the taxonomy of the PSP dinoflagellate genus *Alexandrium* was hotly debated for nearly two decades. Perhaps *Karenia digitata* still belongs in *Karlodinium* (it is not flattened like most *Karenia*) but potentially is distinct from *Karlodinium decipiens* now also known from Hong Kong. The fish-killing mechanism by *Karlodinium* blooms, whether due to karlotoxins (only known thus far from *K. veneficum* and *K. conicum)* [4], reactive oxygen species, lipophycotoxins [5] or other still uncharacterized chemical fractions, also remains to be fully elucidated.

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field had grown through time, with new species or toxins or poisoning syndromes or impacts being discovered every few years. In recent meetings, the nature of that discovery has changed, as has the pace. We still learn of an occasional new toxin, but for the most part, they are derivatives or metabolites of known compounds. Another sign of the maturity of our science was the sophistication of the analytical instrumentation and approaches being applied, as well as the complexity of the molecular techniques and numerical models used. These are state of the art in every way.

A conference summary is truly a challenging undertaking given the structure of the meeting. For the first time, our HAB conference had three concurrent sessions, making it difficult to obtain a broad perspective on the science presented. Accordingly, I sought the assistance of a number of colleagues and obtained their insights and opinions, some of which are reflected here.

When I asked my colleagues what struck them about this meeting, a frivolous but common answer was “the food”. It clearly is part of Chinese culture to treat guests to a fine meal, to feed them until they can eat no more with food still on the table, and this conference certainly achieved that goal. Beyond that however, there were a number of scientific highlights that I offer here with a concurrent apology to all those who might not be recognized, despite equally important scientific contributions. These are simply my own observations, interspersed with those of some colleagues, and clearly represent a limited view of the large and diverse conference.

One of the major findings reported at the meeting was the identification by **Tillmann** of the causative organism for azaspiracid shellfish poisoning (AZP) — a new dinoflagellate species which will be published in the next issue of Eur. J. Phycol. This was an important discovery for several reasons. It reversed the long-held view that AZP toxins are produced by *Protoperidinium crassipes*; it also demonstrated how well a team of scientists can work together. I was very impressed by the way an LC-MS instrument was taken on board a research vessel and used to screen water samples for minute quantities of HAB toxins. Once azaspiracids were detected in a sample, the team was able to size fractionate the plankton and analyze those fractions to see where the toxin was, and then to isolate many of the organisms in the appropriate size range, testing them all for toxicity. This led to concurrent taxonomic, genetic, and toxicological characterizations of this important organism. It was a beautiful piece of teamwork.

The second highlight for me was new information on *Dinophysis*. At HAB 12, **Park** and his colleagues opened a major door into the study of the DSP syndrome by demonstrating they could culture *Dinophysis acuminata* by feeding it the ciliate *Myrionecta*, after the latter had consumed the cryptophyte *Teleaulax*. As expected, two years later, the Hong Kong conference had a number of papers that followed up on this breakthrough. Some explored, but did not resolve, whether *Dinophysis* chloroplasts are permanent plastids (strongly indicated by ultrastructure of chloroplast membranes; **Garcia, Moestrup**) or kleptoplastids stolen from *Teleaulax* via *Myrionecta* (suggested by chloroplast gene sequence data and by flow cytometric separation and real-time PCR of dividing chloroplasts during the cell cycle of *D. norvegica*; **Minnhagen).** This talk entertained the audience with its clever artwork, shown in the figure below. **Park** used long-term starvation studies to address this question, and concluded that the plastids in *Dinophysis* were permanent. Stay tuned for a resolution of the issue, perhaps in Crete at HAB14. Other important contributions were by **Hansen** on *Dinophysis* grazing and nutrition, and

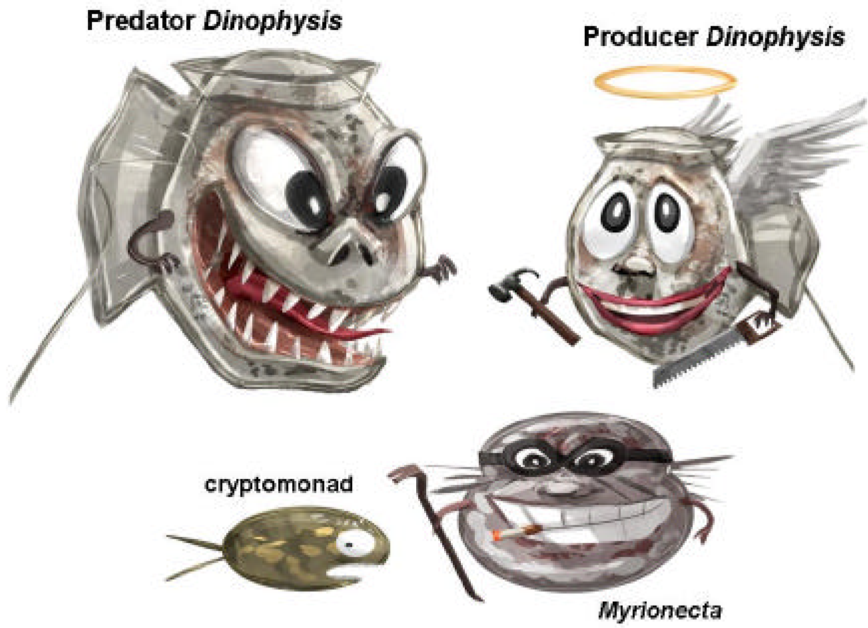

Illustration by Mats and Susanna Minnhagen.

by **Reguera** who elucidated further aspects of the ecology and complex life cycle of *Dinophysis*, including indications that these cells may have a novel approach to sexuality whereby one cell engulfs another. This mechanism is distinct from the manner in which *Dinophysis* species feed on *Myrionecta* using a peduncle, and is also different from the more normal "fusion" of gametes in many dinoflagellates. The conference also provided a valuable opportunity for those working on *Dinophysis* species to meet together and discuss their findings in an informal, after-session meeting, looking for common pathways to progress.

Another highlight was a talk by **Scholin** who described a major development in our field – not a new one, but one that has to be viewed as a major step towards a technology that I believe will ultimately revolutionize the way we manage and study HABs. Chris described the latest developments of the Environmental Sample Processor (ESP), a robotic device that can be moored remotely and programmed to collect water samples, filter them, and perform all of the complex chemistries (e.g., sandwich hybridization and qPCR) needed to not only identify and count HAB cells, but their toxins as well, the latter using antibody-based methods developed by **Doucette**. This instrument has been under development for some time, but recent advances are still impressive. The ESP and instruments like it are needed to transition our genetics, toxicity and physiology into management. The ESP takes technologies developed in laboratory settings and brings them into the field in a way that has direct practical applications. This is especially important these days given the major investments in Ocean Observing Systems (OOSs) worldwide. Of the many societal benefits attributed to these OOSs, "red tide or HAB detection and forecasting" is often listed, yet the vast majority of these observing networks have no capabilities to detect or measure HAB cells or toxins. The ESP can provide them.

A molecular approach to HAB population analysis based on microsatellites was used by **Nagai** and co-workers to study the relationship between HAB populations in different areas of the world, from *Alexandrium* species in the Mediterranean (**Masseret**), western Europe (**Alpermann**) or Asia (**Genovesi**); there was a particularly interesting study of *Cochlodinium* in Japanese and Korean waters in which N**agai** and colleagues identified distinct populations and biogeographic boundaries, but also showed that the flow between these populations could be related to human activities such as species dispersal facilitated by the pearl oyster industry.

Another area of great progress also involved molecular biology, this time following up on another breakthrough first announced at HAB 12. There, **Kallmann** identified the saxitoxin gene cluster for the first time –the Holy Grail for those working on toxin genetics. He identified and characterized the gene cluster in cyanobacteria, and I fully expected that in Hong Kong we would see a burst of papers built on that discovery. That was true in part, as there were several talks about cyanobacterial toxin genes — their evolution (**Murray**), where they might have been acquired, how common they are, and so forth. Another important study was by **Stucken** who not only confirmed the presence of the gene cluster in other cyanobacterial species, but also found "tailoring" genes with the cluster –genes that take the toxin backbone and make changes to it to form derivatives. This progress with cyanobacteria was noteworthy, but it is also worth pointing out that two years after that major discovery, we heard nothing about saxitoxin genes in dinoflagellates. A number of research teams are working on this, including my own, but none have succeeded as yet. This demonstrates how difficult it is to do this type of genetic work on dinoflagellates, even when a potentially homologous set of genes from another organism is available to guide that search.

Yet another molecular highlight was that of **Lin** on the spliced leader sequence in dinoflagellates; this is a base sequence unique to dinoflagellate mRNAs, and part of the dinoflagellate molecular architecture that facilitates splicing of gene transcripts. This was not a new report, as he and **Van Dolah** have separately reported this finding previously, but this was the first opportunity for many to see how the spliced leader could be used to address questions about dinoflagellate ecology and physiology. This is important because it can be used like a piece of Velcro or a hook to pull dinoflagellate gene transcripts from a sample. In this way, one can take a complex assemblage of organisms and isolate the transcripts from just the dinoflagellates in that sample. It is thus possible to do gene regulation studies in the field, to see how certain cells respond to the environment around them without interference from the other organisms that are present.

Once again, we have a new tool that opens up doors for many different lines of investigation.

Nagasaki gave a detailed study of host and viral bloom dynamics that included reproduction, infection, host range, genetics, and even molecular structure. He showed us that multiple viruses may be present in a *Heterocapsa circularisquama* bloom, each infecting distinct susceptible populations. If similar host/virus relationships are widespread (and it appears they are), then this might be a major evolutionary force driving the high level of cryptic speciation among HABs.

Another general comment relates the complexity of the systems that we study. Mingjiang **Zhou's** plenary talk emphasized that we cannot just study HABs in isolation. We need to identify the linkages with climate change, land use practices, alteration in trophic structure, eutrophication, and many other factors before we can begin to understand bloom dynamics at a level that can lead to effective management. Several papers demonstrated the value of this comprehensive approach.

Talks on toxin chemistry described diverse analytical approaches, such as a method using surface plasmon resonance for PSP toxin detection (**Campbell**), or in vitro cell-based assays as screens for toxicity, and SPATT bags for passive toxin adsorption and detection (**Hermann, Fux**). **Quilliam** demonstrated the power of LC-MS techniques – in effect the "universal method" for biotoxin analysis, or at least for lipophilic toxins. But, his identification of more than 90 metabolites of yessotoxins, or 67 spirolides (and still counting) made it clear that there is a need for functional assays and other methods that can quantify and integrate the potency of these different toxin congeners and metabolites in samples. The chemists are increasingly able to identify compounds of many different types in samples, but the potency of many of those is not known. Managers are bewildered by the plethora of toxins being described, and they can legitimately ask whether they need that much detail for their decisions. In those cases, functional assays like bioassays, immunoassays, and receptor-based assays hold great promise, though of course, they have their own problems.

There were many talks on genomics, with presentations of EST libraries and even entire genomes for a number of HAB organisms (**Cembella, Gobler, Yang, Lin**). but in most cases, the results were underwhelming, given a common problem facing all such studies with HABs – namely that the majority of the genes that can be identified are common, "housekeeping" genes, and the ones that we are most interested in (like toxin genes) are not found in databases, and thus are "unknowns". A clear challenge for those working in this field is to slowly characterize the thousands of HAB genes of unknown function. Microarray studies abounded, but while providing useful indicators of changes in gene expression, the biological and biochemical interpretations present considerable difficulties in HAB organisms. **Place** argued that new approaches are needed that look specifically at gene products that are about to be synthesized (by focusing on polysomes), rather than looking to mRNA pools alone. On a different tack, some talks and posters evidenced a sophisticated understanding of the genetic mechanisms and structure underlying gene expression in several key HAB species. **Van Dolah, Place**, and **John** all described studies of polyketide synthases (PKSs) – compounds linked to toxin production in three different HAB species.

Molecular probe technology is firmly established in HAB science – in many ways, HAB workers have paved the way for this approach to cell counting in other areas of phytoplankton ecology since we were among the first to need species-specific detection methodologies. Demonstrating how far this field has advanced, **Medlin** described a hand-held sensor for molecular probe-based detection of 17 HAB species using electrochemistry, while **Chen** showed how the use of electrochemiluminescence in sandwich hybridization assays could achieve higher sensitivity and more stable assays. **Dyhrman** and others showed how quantitative PCR could be used to provide cell abundance estimates that correlate well with shellfish toxicity measurements in monitoring programs. Another highlight was the application of sniffer dogs on research vessels to spot floating whale feces from which minuscule domoic-acid producing *Pseudo-nitzschia* diatom fragments could be visualized (**Doucette**).

In a manner analogous to the chemistry talks, molecular approaches to species identification have started to unravel the complexities of our plankton communities to a level that can boggle the mind. What was formerly thought to be a population of a single species can now be shown by microsatellites or other approaches to be a community of many different individuals. This information is very interesting and important scientifically, but just as with the many new toxin congeners and metabolites, from a practical perspective at least, it is sometimes more important to pull back to the big picture, to ignore the detailed population structure within a HAB community so that information useful for management decisions can be made.

At many previous HAB meetings, microbial interactions and allelopathy have been considered interesting concepts, but their significance for HAB bloom dynamics and toxin production remained unclear, poorly understood and sometimes met with scepticism. However, HAB13 proved a significant turning point, not so much due to significant advances, but more to the widespread acceptance that allelopathic (algal-algal) and microbial interactions (among algae-bacteria and viruses) *are* important influences on phytoplankton population dynamics. While only 10 oral and 6 poster presentations at the meeting focused specifically on microbial interactions, many presentations acknowledged the potential of microbial interactions to explain their data.

No "Eureka moments" emerged, but evidence of steady progress was abundant. Much of the work presented continued to carefully document the microbial partners in the interactions, and the diversity of stimulatory (**Bolch**), algicidal (**Vargas**) physiological and toxicological effects attributed to microbial interactions with other algae, algal grazers (**Hogfors, Sun** and

Weigand) and other fauna/flora. Chemical "warfare" is clearly widespread in the marine environment.

Significant challenges remain before we can advance our understanding of microbial interactions. The bewildering array of potentially synergistic and antagonistic interactions among the microbial community is now well documented and experimental models presented by **Bolch** and co-authors offers one way to proceed. However, we clearly must combine chemical, biochemical and molecular approaches to unravel the mechanisms and compounds mediating microbial interactions if we are to understand how algal cells respond at the physiological and molecular level. A number of presentations (e.g. **Yin, Zheng, Ma**) have taken tentative steps in this direction, but much more is needed.

Likewise, the role and influence of bacteria in production of toxins (STX, domoic acid, etc) remains unresolved. In this context, one interesting talk that certainly warrants further study was that by **Takata** who showed that the dinoflagellate *Alexandrium* can produce domoic acid after addition of a bacterium isolated from an area where bivalves accumulate this toxin. The conclusion was that domoic acid is produced by multiple species of phytoplankton when certain species of bacteria contact them. But, which partner produces the toxin? Or is it a combined effort? If verified, this reopens the discussion started by **Kodama** decades ago about the role of bacteria in saxitoxin production by dinoflagellates.

There were several dozen talks or posters on cyanobacteria in addition to those related to toxin genetics described earlier. There were presentations on bloom control and prevention using "cyano-cidal" bacteria **(Nybom),** novel chemical treatments, and even aquatic macrophytes to mitigate toxins, nutrients, and blooms **(Nimptsch).** Several talks or posters **(Pinto, Wickramasinghe, Downing, Esterhuizen)** highlighted the increasing concerns over the new cyanotoxin: beta-methylamino-L-alanine (BMAA), a possible cause of Alzheimer's disease. New cyanotoxin detection methods were described,

including Ultra- Performance Liquid Chromatography-Tandem Mass Spectrometry **(Oehrle)** and solid phase adsorption toxin tracking technology (SPATT; **Wood).**

In a pattern that characterizes most of our HAB conferences, there were relatively few talks on bloom control, though several papers addressed impact mitigation techniques. A plenary talk by **H.K. Kim** was a fascinating presentation of the many innovative strategies used by the Koreans to control *Cochlodinium* blooms threatening fish farms. The use of clay was highlighted, including an entertaining analysis of the choreography of the ships that disperse it in different patterns ("merry-go-round","cranes wing", "frontal", and "parallel"). There was also an informative analysis of ecological impacts as well as the surprisingly low costs of these control operations.

Gustaaf Hallegraeff provided the following perspective on taxonomy at the Hong Kong Conference. **Karen Steidinger** reviewed the evolution of the morphospecies concept as it applies to the dinoflagellates *Karenia, Alexandrium* and *Pyrodinium*. Increasingly, DNA sequences are included in new species descriptions, a practice strongly encouraged and which perhaps should be formalized in the codes of nomenclature. **Medlin** outlined the protocol for correcting numerous taxonomic misidentifications associated with widely used GenBank sequences. A lively discussion ensued as to how much genetic distance separates species. **Hallegraeff** and colleagues described 5 new species of *Karlodinium* (including a new karlotoxin producer, **Mooney, Place**) from a single cruise in the Southern Ocean south of Tasmania. While most species were well supported by morphology and genetics, where large genetic distances received limited morphological support, the recommendation was to further scrutinize morphological ultrastructure. Similarly, **Litaker, Tester** and colleagues redefined 10 *Gambierdiscus* species based on combined morphology and rDNA sequences. We should not forget that morphospecies remain the backbone of HAB monitoring, and we echo Max Taylor's early words of wisdom, to "discriminate to the level required to answer the question you are asking". An important breakthrough by **Tillman** and German colleagues has been the identification of the causative dinoflagellate organism of AZP, to be named *Azadinium spinosum* in a phylogenetic position intermediate between the Peridiniales and Gonyaulacales. This can now pave the way for trophic transfer studies.

Grant Pitcher provided an overview of modeling presentations. There is a clear need he feels for the incorporation of models in many aspects of HAB research, to ensure progress within this field, but an assessment of the presentations at this Conference suggests this need is not being met. Of the approximately 190 oral presentations, only 6 or 7 specifically addressed the use of models while 2 or 3 of the 142 posters included the use of models.

The low number of presentations incorporating models in research activities does not bode well for the HAB scientific community and this shortcoming needs to be addressed. The use of models is specifically required for predictive purposes and although many scientists in this field motivate their research through the promise of prediction, few presentations at this meeting have addressed this using models. One of the reasons for this is a shortage of modeling capacity in many countries, especially for modelers interested in coupling physics to biology. This is clearly an area where support is needed to train modelers for work on HABs, as identified as a priority activity in GEOHAB.

Species-specific models are important in the prediction of HABs, yet of those presented, most do not progress beyond the use of physical models utilized in predicting bloom transport or dispersion. Those that incorporate a biological component typically only attempt to predict biomass (red tides).

On the positive side, a small number of presentations at this meeting did incorporate the use of models in examining bloom dynamics, of *Pseudo-nitzschia* (**Palma, Davidson**), and of *Alexandrium* (**Fauchot, Anderson, Levasseur**). The *Alexandrium* models presently demonstrate the most promise as they are "cyst-based" and through this approach are able to successfully initialize models. A noteworthy development was the successful forecast of a major regional bloom of *A. fundyense* by **Anderson** and co-workers for the Gulf of Maine in 2008. Those workers also are predicting a decade or more of frequent and high toxicity blooms for the region, based on analyses of cyst abundance and past patterns of toxicity following major blooms.

Finally, climate change was a theme that a number of speakers pursued. **Dale** demonstrated that it is possible to separate large-scale weather patterns from anthropogenic influences in the fossil record of dinoflagellate cysts. **Balode, Graneli, Tester**, and others discussed possible effects on HAB species of global warming. In my view, this is yet another area where we need to exercise caution, since it is too easy for the public and the press to conclude from these types of studies that certain HAB species will become more abundant and problematic simply because they will grow faster as global temperatures increase. This is where Zhou's emphasis on the complexity of the systems we study comes into play again – that we cannot study these species in isolation. Climate change will affect zooplankton, fish, currents, rainfall, winds, sunlight, and many other factors that are inter-related with HABs. Without detailed analyses of these factors, it is difficult to say whether global warming will decrease or enhance the threat from a given HAB species in a region. Climate change and global warming will continue to be important topics at future HAB conferences, but we need to keep this "big picture" perspective in mind. One forecast that many will agree on is that climate change will drive broad shifts in the distribution of HAB species. This will bring them into areas not historically affected, and thus ill prepared to deal with them. Conversely, this also means that some areas with HAB problems may find those problems disappearing, as species no longer find a region suitable for growth.

HAB13 was a meeting that highlighted the breadth and maturity of our field. I personally am not fond of three concurrent sessions, and could return to two sessions at most for future meetings, with more posters and more poster viewing time. I miss the old days, when we had single sessions, where the chemists sat with the taxonomists and everyone learned about each other's fields. Those days are gone forever, sadly, but perhaps we can keep a semblance of that community feeling when we all meet in Crete in 2010.

I want to express special thanks to the following individuals who provided ideas and in some cases, written text that was useful in both the oral and written versions of this summary: Ian Jenkinson, Per Juel Hansen, Allan Cembella, Uwe John, Pat Glibert, Susanna Minnhagen, Greg Doucette, Gustaaf Hallegraeff, Christopher Bolch, Grant Pitcher, Chris Gobler, Linda Medlin, and Jane Lewis.

This conference was noteworthy for the way it showcased Asian HAB science. Japan has always been a leader in our field, and continues to demonstrate this with a number of papers again at this meeting, including a talk by **Kodama** about the manner in which saxitoxins can be bound by proteins within scallops. Korea also continues to work at the forefront of a number of topics with papers like those of **Park** on *Dinophysis*, by **H.G. Kim** on bloom mitigation, **Jeong** on heterotrophic and mixotrophic dinoflagellates, **C.H. Kim** on *Cochlodinium* cysts, and **Tang** on *Cochlodinium*. But a new highlight was the overall contribution from Chinese HAB scientists. Here I have a personal perspective to offer. In 1992 I made my first trip into China to work with Professor Qi in Guangzhou. At the time, in the entire country, there were only a handful of scientists who worked on algal blooms, and most were taxonomists. Laboratories had almost no equipment or funding, culture collections were non-existent, and the threat from algal toxins was very poorly understood along the vast coastline. In contrast, in Hong Kong we saw a huge range of topics presented by more than 50 Chinese participants. Plenary talks by **Zhou** and **Wu**, and presentations from many others, ranging from large-scale oceanography to genetics, proteomics, toxin chemistry, numerical modeling, taxonomy, toxicology, and physiology. The transformation is truly remarkable, and this meeting made that progress very evident, and drew attention to the many challenges faced by China with its expanding HAB problems.

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GEOHAB issues at 13th ICHA

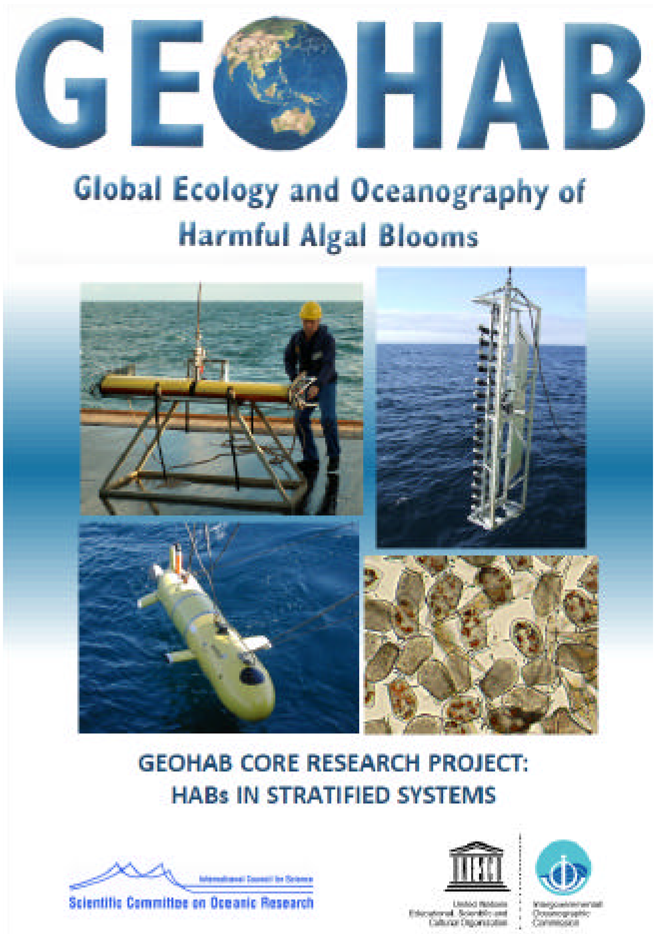
Several presentations during the 13th ICHA Conference addressed key questions identified within the GEOHAB Core Research Projects. Two papers were presented, from the EU HABIT (Harmful Algal Blooms in Thin Layers) project, one given by **Lourdes Velo-Suárez** on the demonstration of how modelling can explain the disappearance of a *Dinophysis acuminata* bloom through physical dispersion. The other was by **Hazel Farrell** showing the transport of a high density sub-surface thin layer of *Dinophysis acuta* in a coastal jet along the coast of Ireland. On the subject of *Dinophysis*, a presentation by **Beatriz Reguera** showed new findings on *Dinophysis* nutrition. The use of FISH probes to carry out comparative studies on the dynamics of three co-occurring *Alexandrium* species was shown by **Nicolas Touzet**. The importance of comparative studies in ecology was emphasised by **Robin Raine** who compared *Alexandrium minutum* dynamics across Europe, and also demonstrated by **Grant Pitcher** who gave a talk on the effects on HABs of irregularities in the shape of coastlines adjacent to upwelling regions. Upwelling and the prediction of *Pseudo nitzschia* blooms was the topic presented by **Sofia Palma**, who showed a consistency in the time interval between blooms and (weak) upwelling event. Prediction of *Alexandrium* blooms in the estuaries of Brittany was discussed by **Juliette Fauchot** who showed the importance of physical dilution in controlling the timing of blooms there. A colourful and thought-provoking talk was given by Ian Jenkinson who rather graphically gave a lecture on the effects of biological substances such as mucopolysaccharides on the viscous properties on water and hence their effect on small-scale mixing.

Ecology and oceanography were the topics of two plenary lectures, one by **Paul Harrison** who explained how blooms originating on the shelf were maintained by nutrients coming in the Pear River plume. The talk by **Ming Jhang Zhou** focused on eutrophic coastal waters of the East China Sea.

R. Raine & P. Gentien,
www.geohab.info

New GEOHAB release

The *GEOHAB Implementation Plan* (GEOHAB, 2003) specifies the formation of Core Research Projects (CRPs) related to four ecosystems types: upwelling systems, fjords and coastal embayments, eutrophic systems and stratified systems. These CRPs are initiated through small, focused open science meetings.An open science meeting on HABs in Stratified Systems was held in Paris, France, 5–8December 2005. The Meeting concentrated on small scale hydrographic features which may be encountered in any of the above mentioned environments. The present report outlines the justification and research priorities for the study of relationships between HABs and stratification, as well as some of the new approaches and advanced instrumentation that may be considered.The following key questions were identified:



What are the relative contributions of biological and physical processes to the initial formation of thin layers in stratified systems?

What are the key processes defining the different strategies that maintain phytoplankton in thin layers?

What are the biological and chemical outcomes of the physical concentration of plankton into high-density thin layers?

What causes a high-density population in a thin layer to collapse?

Download it at www.geohab.info

• Argentina

SEM observations of *Pseudo-nitzschia* from the Beagle Channel: *P. seriata* in the southern hemisphere?

Pseudo-nitzschia seriata (Cleve) H. Peragallo is known as a potentially toxic diatom species [1, 2] and has also been related to domoic acid accumulation in mussels, resulting in the recurrent closure of shellfish harvesting in Prince Edward Island, Canada [3, 4]. Its strong morphological resemblance to *P. australis* Frenguelli has led in the past to common misidentifications and also to great confusion about the worldwide distribution of both species [5]. However, based on an extensive literature survey, it has been noted that *P. seriata* is confined to cold waters of the Northern Hemisphere while *P. australis* is found in the Northern as well as the Southern Hemispheres [6].

Traditionally, the presence of striae composed of 3–5 rows of poroids has been the most distinctive character to discriminate *P. seriata* from *P. australis*, which has only 2 rows of poroids per striae [5, 7]. Nevertheless, this difference is not definite, since it has been demonstrated that strains of *P. seriata* can also show only two rows of poroids in laboratory cultures [2]. As a consequence, the density of poroids per striae seems to be the most reliable character to discriminate between them (4–5 and 6–8 in 1µm in *P. australis* and *P. seriata*, respectively) [8]. Unfortunately, time-consuming examination using electron microscopy is essential to observe this ultrastructural character.

Located in extreme southern South America, the Beagle Channel separates islands of the Tierra del Fuego Archipelago (Fig. 1). The biggest settlement on the channel is Ushuaia in Argentina followed by Puerto Williams in Chile, two of the southernmost settlements of the world [9]. Within the framework of a monitoring program of toxic algae carried out in the eastern sector of the Beagle Channel, we focused on the diversity of *Pseudo-nitzschia* species for the first time in this area. For this study, phytoplankton net samples were examined by phase contrast, DIC and scanning electron microscopy (SEM) following traditional methods. Sampling points included Bay Brown (inside and outside) and Punta Paraná (Fig. 1) where both biological and oceanographic variables have been weakly examined. These areas are usually closed to harvesting each year during the summer, when toxic algal blooms are a serious problem for consumer's health and therefore to the economy of the area [10].

Fig. 1. Map of the study area showing the location of sampling sites in the Beagle Channel, Argentina.

Based on the valve shape and morphometric data (length, width, density of striae and fibulae and the lack of central interspace), light microscopy observations suggested the presence of *P. australis* in the Beagle Channel. This was not too surprising considering that this species is commonly found both in coastal and shelf waters of the Argentine Sea [11–13]. However, subsequent SEM analyses revealed the fine structure of the striae, which disagreed with classical descriptions of *P. australis* [5, 7]. In contrast, it was strikingly similar to unusual specimens of *P. seriata* isolated from Scottish waters [2]. The analyzed specimens showed slightly asymmetrical lanceolate valves with rounded ends (Figs 2a–b), 80.5–103.5 µm long and 7–8.9 µm wide. Interstriae and fibulae were usually distributed in equal number (14–19 in 10 µm) and without a central interspace (Figs 2a–c). The striae were composed of two rows of small poroids (7–8 in 1 µm) (Fig. 2d), but in some cases, a few single poroids (incipient striae?) were visible between them (Fig. 2b).

The observed specimens are in conflict with classical descriptions of both *P. seriata* and *P. australis* (Table 1). The presence of striae mainly perforated by two rows of poroids (typical of *P.*

Table 1. Morphometric summary of specimens observed in the Beagle Channel, Argentina. Data in Fehling et al. (2004) and Hasle & Lundholm (2005) are added for comparative purposes.

Taxa	Length (µm)	Width (µm)	Fibulae (in 10 µm)	Interstriae (in 10 µm)	Rows of poroids	Poroids (in 1µm)
Observed specimens (n = 18)	80.5–103.5	7–8,9	14–19	14–19	2 (+ a few single poroids)	7–8
P. seriata (Hasle & Lundholm 2005)	91–160	4,6–8,0	14–20	14–20	2–more, usually 4	6–8
P. seriata (Fehling et al. 2004)	–	4,6-6	14-20	14-20	2 (+ 1)	6–8
P. australis (Hasle & Lundholm 2005)	75–144	6,5–8,0	12–18	12–18	2	4–5

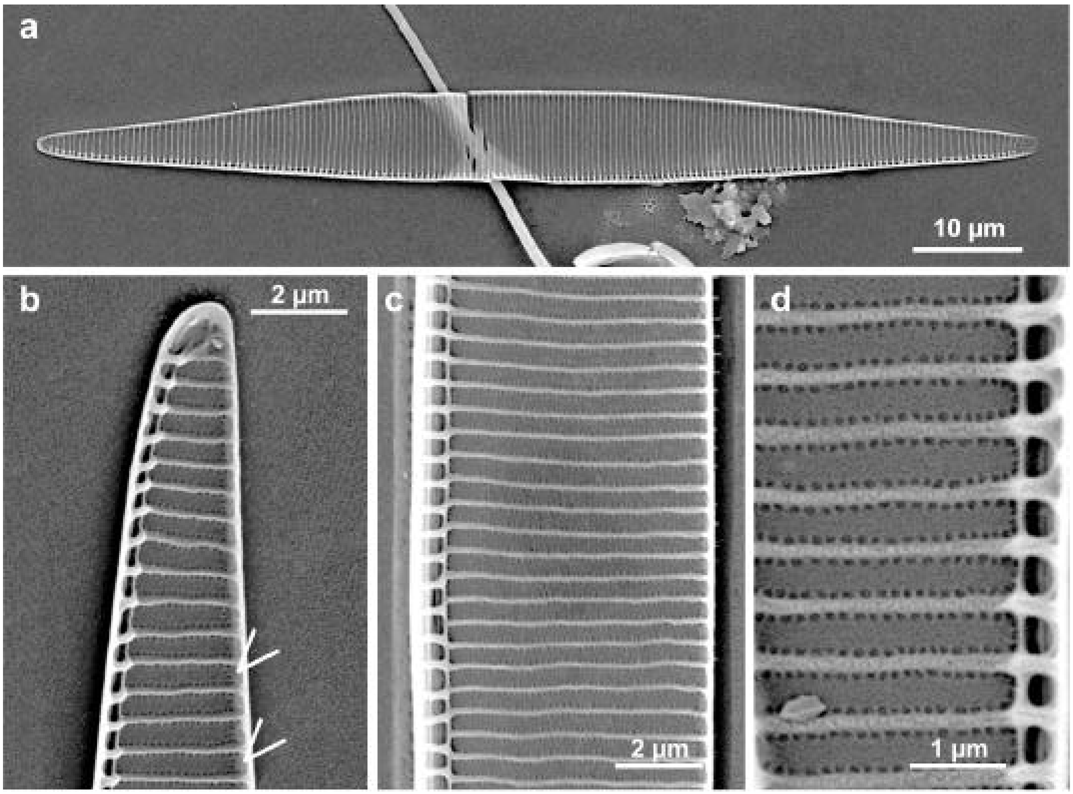


Fig. 2. SEM micrographs of specimens found in the Beagle Channel (Argentina), showing the valve shape, apical and central part details.

australis) but in number of 7–8 in 1 µm (as in *P. seriata*) was rather disconcerting. However, the results are similar to those unusual specimens of *P. seriata* identified in Scottish waters by means of TEM analyses and DNA sequencing [2]. Unlike the traditional description of *P. seriata*, which has 3–5 rows of poroids per striae [5], Scottish strains showed two rows of poroids plus just a few single poroids, or lack a third row visible between the two rows of poroids; whereas a third complete row was only rarely observed [2]. These authors attributed this unusual morphology to the fact that the cells had been kept in culture for approximately six months before the TEM observations. Therefore, our field study could provide additional information supporting the finding of this unusual morphology in natural populations and prompt new questions regarding the morphological differentiation of *P. seriata* and *P. australis*. Moreover, if the identity of specimens collected in the Beagle Channel could be confirmed as *P. seriata* by additional TEM and molecular analyses, the geographical distribution of this species would be greatly extended.

Given the increasing number of semi-cryptic *Pseudo-nitzschia* species being mentioned [e.g. 14–17], we consider that further more detailed morphological investigations in combination with molecular data are required to elucidate the variability and geographical distribution of *P. seriata* and *P. australis*. With this in mind, we are now attempting to establish cultures of these specimens, and have also started to examine other diatom samples from different regions of Argentina for this unusual morphology. Likewise, it would be highly beneficial to work in collaboration with colleagues with previous experience in DNA extraction, amplification and sequencing of species from the genus *Pseudo-nitzschia*.

Acknowledgements

This work is part of a specific agreement between the Government of Tierra del Fuego Province and CADIC, entitled “*Monitoreo de condiciones biológicas y oceanográficas determinantes de floraciones algales tóxicas en la zona de Almanza, Canal Beagle*”. It was supported by grants PIP-5603 CONICET and PICT 25509 ANPCyT.

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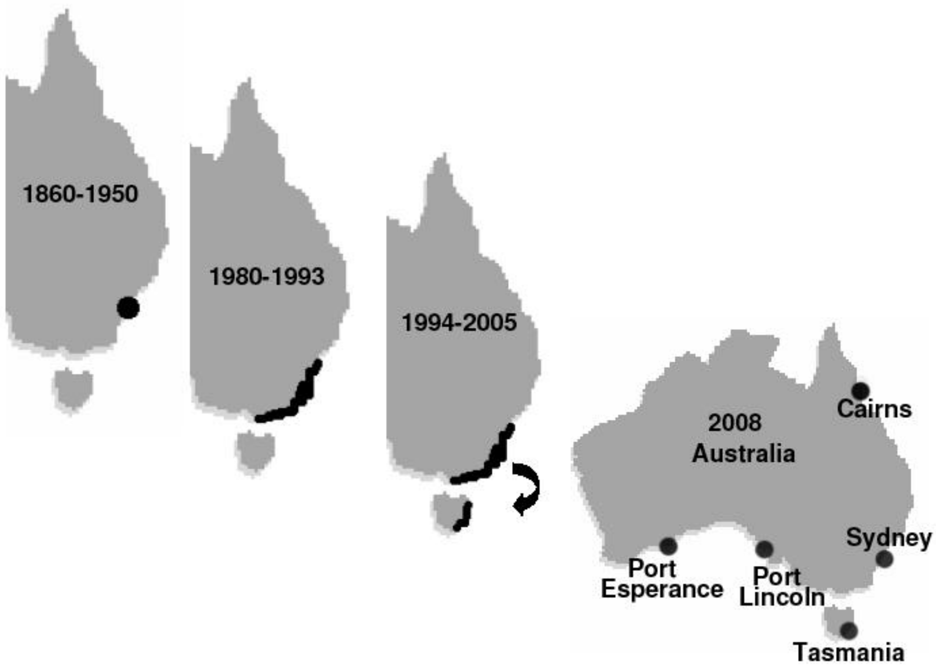
• Australia

Recent range expansion of the red-tide dinoflagellate *Noctiluca scintillans* in Australian coastal waters

Aerial photograph of red Noctiluca *slicks in Parsons Bay, Tasmania (Australia), in March 2002. The circular salmonid fish farm pens accumulated up to 4m thick surface scums of* Noctiluca *acting as an irritant to the fish (photo: J.Marshall, University of Tasmania).*

The large (200–1000 µm diameter) phagotrophic dinoflagellate *Noctiluca scintillans* has long been present in Australian New South Wales coastal waters, with the first report of bioluminescence in Sydney Harbour (34ºS) dating back to 1860 [1]. Dakin and Colefax 1933 [2] observed this species to be a minor component of the phytoplankton of New South Wales coastal waters and Wood 1954 [3] in his extensive Australia-wide net phytoplankton surveys reported this taxon to occur only in Australian east coast estuaries. The first visible *Noctiluca* “red tide” event was not reported until August 1982 in Lake Macquarie, central New South Wales [4]. However, from a rare bloom former in the 1980s, starting in 1993 this organism has developed into one of the most prominent red-tide organisms in Sydney coastal waters, soon after the commissioning of 3 deepwater ocean sewage outfalls off Australia’s largest coastal city. El Niño years such as 1997 have exhibited the densest *Noctiluca* blooms [5], which occasionally have forced closures of Sydney public beaches during spring and summer. While *Noctiluca* was virtually absent during a seasonal study of Sydney coastal waters during 1978-79 [6], in a repeat survey in 1997-98 the species was present in 61% of samples [4]. Irregular influxes of *Noctiluca*, most likely carried by the East Australian Current (moving up to 40 km/day), have also been seen in Port Phillip Bay, Melbourne (since 1993) and Tasmania (since March 1994). No *Noctiluca* bloom reports are known from Tasmania (43ºS) prior to this date. A bloom event which apparently started off the East Coast of Tasmania in September 2001 culminated in March 2002 into a significant threat to the salmonid aquaculture industry in Nubeena on the Tasman Peninsula. *Noctiluca* blooms have persisted in Tasmanian waters ever since, notably in the period 2001–2006. While in New South Wales this dinoflagellate proliferates at water temperatures of 19-24ºC, in colder Tasmanian waters it now has established permanent overwintering populations and thrives even in winter months at temperatures of 10-12°C. We speculate that the gradual warming of East Coast Tasmanian waters (up 1.6ºC in the past 50 years which is 3x the global average warming), associated with a greater influence of the East Australian Current [7], has paved the way for the apparent range extension of this warm-water



Apparent range extension of Noctiluca scintillans *in the Australian region, comparing distribution records in 1860-1950, 1980-1993 (expansion of blooms in the Sydney region), 1994-2005 (range extension into Tasmania), and in 2008 (first reports in Queensland, West Australia and South Australia).*

organism into Tasmanian waters. An example of a similar recent climate-change driven range expansion from New South Wales waters into Tasmanian waters is the spiny sea urchin *Centrostephanus rodgersii* [8]. In the last decade some 36 species of marine fish have shown similar changes in distribution in Tasmania, including range shifts further south and the appearance of new fish species never previously recorded in the area.

Finally, in the year 2008, the first tropical red *Noctiluca* bloom was reported from Cairns Harbour in Queensland in March, followed by bloom reports from Port Esperance, Western Australia, and Port Lincoln, South Australia, in May-June. The latter two events are most likely associated with an extension of the Leeuwin Current. The organism had never previously been reported in Queensland, Western Australia (monitored since 1993 [9]) nor Southern Australia (monitored since 1994 [10]). This "climate-change hotspot" is now increasingly being monitored by sophisticated Continuous Plankton Recorder technology (AusCPR) operating between Brisbane, Tasmania and Antarctica [11].

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In Memoriam

Ralph Lewin of the Scripps Institute of Oceanography, known to some as 'the father of green algae genetics', and maybe best known for his work on prochlorophytes, died last month. As well as his science, he left us a collection of verses. HAN readers may enjoy the two printed here.

Toxic Blooms

Toxic blooms, toxic blooms
Vie with smog and sonic booms,
Bigger, thicker, redder tides
Taint the sea with plankticides.
Toll the tocsins! Tides of doom!
Woe to us the bloody bloom.

Neurotoxicants attack
Herrings in the Skagerrak,
Decimating fishes that
Used to throng the Kattegat,
Dooming them to dismal fates:
Death by dinoflagellates.

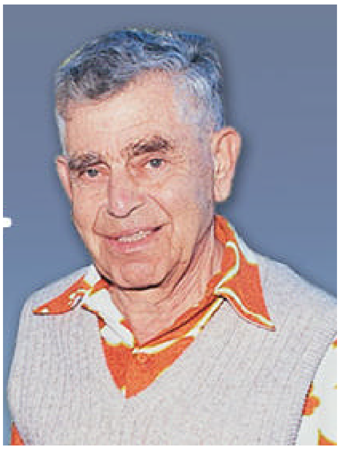

Photo from the Scripps News Web site (http://scrippsnews.ucsd.edu)

Phycology by fiat

The blue-greens are not algae any more … any more
It seems that they're not lost but gone before.
By a stern decree despotic,
Since they're all prokaryotic
The poor blue-greens can't be algae any more.

Euglena's not an alga any more … any more,
Whatever people thought of it before.
Its form is somewhat plastic
And its pellicle's elastic,
So *Euglena*'s not an alga anymore.

Spirogyra's not an alga any more … any more,
Though it passes nuclei from pore to pore.
Since it hasn't swimming gametes
It's reclassified with *Trametes*.
Spirogyra's not an alga anymore.

Red algae are not algae anymore … any more
Though the reddist weeds abound on every shore.
Since their microsporulation
Is devoid of flagellation,
The red algae can't be algae anymore.

You cannot regard an alga as a plant … as a plant,
However much you want to, you just can't.
If it's not too late to switch
You should throw away your Fritsch,
For the algae are not algae anymore.

• Angola

Okadaic acid in the clam *Semele proficua* in Luanda Bay, Angola

Diarrhoetic Shellfish poisoning (DSP) is a gastroenteritis caused by ingestion of bivalve molluscs contaminated with dinoflagellate toxins. Japan was the first country to report this toxin [1], but DSP is now known in many parts of the world. The areas most affected are Japan and Europe. Studies have shown that the DSP syndrome is usually triggered by dinoflagellates of the genus *Dinophysis*. The dominant symptoms, which typically develop within 4 hours and may last up to 3 days, include diarrhoea, nausea, vomiting and abdominal pain.

In Africa, the first DSP episode was recorded on the coast of South African in 1991, and attributed to *Dinophysis acuminata* [2]. In the Austral region, including the coasts of Namibia [3] and Angola [4], various species of *Dinophysis* have been recorded, but shellfish in these two countries have not previously been tested for DSP. Here we report the occurrence of DSP toxins in shellfish in Luanda.

From 6 June to 10 December 2007, a pilot programme to detect biotoxins in bivalve molluscs was conducted in Luanda Bay, where there are large landings of shellfish from natural banks, consumed only locally. Twenty samples of *Semele proficua f. radiata*. (common name *ameijoínha*) were bought from artesanal fishermen and frozen until analysis.

Analyses of whole body extracts of the *Semele* samples were run in the Biotoxin Laboratory of the Instituto Nacional dos Recursos Biológicos (INRB) in Lisbon, Portugal, following the LC-MS method [5]. Okadaic acid (OA) was detected in eight samples (Table 1). Okadaic acid was present mainly in August and September, with a maximum concentration on 15 August (7.4 µg/100g). Other foci were recorded on 4 July and 15 October.

Rangel & Silva [4] noted that phytoplankton density is highest on the Luanda coast when the weather is changing from winter to summer (August to October), coinciding with the highest okadaic acid levels measured. Luanda Bay is affected by strong anthropogenic pressures including eutrophication.

Table 1. Okadaic acid concentrations (µg/100g) in Semele proficua *samples Detection limit: 0.8 ± 0.2 µg/100g; quantification limit: 2.7± 0.8 µg/100g.*

Sampling date	OA (µg/100g)
06.06.07	0
20.06.07	0
04.07.07	4.8
18.07.07	0
02.08.07	0
08.08.07	2.9
15.08.07	7.4
20.08.07	6.9
27.08.07	2.1
10.09.07	2.5
18.09.07	0.0
24.09.07	5.6
01.10.07	0.0
08.10.07	0.0
15.10.07	2.2
22.10.07	0.0
19.11.07	0.0
26.11.07	0.0
03.12.07	0.0
10.12.07	0.0

Dinophysis known on the Angola coast include *D. acuminata*, *D. caudata*, *D. fortii*, *D. norvegica* and *D. tripos* [4]. *Prorocentrum*, which also produces DSP toxins, is present in Luanda waters too. Although OA was detected, we unfortunately did not determine which species were present in the water on these dates, so we cannot assign the presence of this toxin to either of these genera.

Acknowledgements

To the Instituto Nacional de Investigação Pesqueira that supported travel and accomodation in Portugal, to the Biotoxin Laboratory of INRB/IPIMAR, and to Ms Alcina and Ms Delfina for help with sample preparation.

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Now available for purchase

Proceedings of the 12th International Conference on Harmful Algae have recently been released. Copies of this publication can be ordered through the IOC site at the following link:

http://www.ioc-unesco.org/hab/ and go to *Publications*.

RANDOM SAMPLES

HAB13

Photos from the 13 ICHA Web site (www.hab2008.hk) and courtesy of L. Escalera, B. Lapointe, I. Baula, L. Velo & D.M. Anderson.

International Society for the Study of Harmful Algae

ISSHA President's Corner

The International Society for the Study of Harmful Algae (ISSHA) sponsored the 13th International Conference on Harmful Algae (ICHA), held in Hong Kong (3-7 November 2008), and celebrated there on 6th November its Sixth General Assembly.

Pat Tester (President) opened the meeting. The minutes from the previous assembly were approved and council members summarized the activities and achievements of ISSHA in the previous two years: Nina Lundholm (Treasurer) presented the financial statement, covering the period September 2006 to October 2008, and detailed expenditures and funds raised from member's fees, book sales, and the auction; Don Anderson (Travel Awards Committee) thanked the Conference Organizers, the Society, and UNEP-MAP for providing partial financial support to 26 young scientists (19 predoctoral, 2 master and 5 post docs) from 16 countries, who presented oral and poster communications at the Conference. Øjvind Moestrup (Conference Organization Committee) announced the recent publication of the proceedings from the previous conference (12th ICHA, Copenhagen, September 2006). These include 111 communications accepted from 140 submissions reviewed.

Beatriz Reguera (Achievement Awards Committee) reviewed the procedure followed by the Committee to examine nominations, by ISSHA members, for the *Yasumoto Lifetime Achievement Award* and the *ISSHA Young Scientist Award*. The same committee had the task of securing double evaluations for 56 students who competed for the *Maureen Keller Award* for best oral and poster communications.

Karen Steidinger, Yasumoto Life Time Achievement Award (bottom left), and Iris Baula, Honorable Mention for Student Oral Presentation (top left) with supervisor and colleagues.

2008 was a election year in ISSHA with a major renewal of its Executive and Council. Results of the elections were presented by Karen Steidinger (Elections Committee). Three members of the previous executive— first vicepresident Gustaaf Hallegraeff (Australia), second vicepresident Beatriz Reguera (Spain), now new President, and Treasurer Nina Lundholm (Denmark)—were elected to continue serving the society in the new executive, with the newly elected second vicepresident Jennifer Martin (Canada) and Secretary Karin Rengefors (Sweden), and past president Pat Tester (USA). The whole Council was renewed: new members are: Lorraine Backer (USA), Eileen Bresnan (Scotland), Marta Estrada (Spain), Martha Ferrario (Argentina), Esther Garcés (Spain), Kin Chung Ho (China), Rita Horner (USA), Ichiro Imai (Japan),

Photo by B. Lapointe

Members of the old and new ISSHA Executive and Council pose at the Jumbo Conference Banquet. From left to right, front row: Ichiro Imai, Gustaaf Hallegraeff, Beatriz Reguera, Pat Tester, Karen Steidinger, Rita Horner, K.C.Ho; back row: Lincoln MacKenzie, Greg Doucette, Hak-Gyoon Kim, Henrik Enevoldsen, Don Anderson, Ian Jenkinson, Øjvind Moestrup, Nina Lundholm, Barrie Dale, Jennifer Martin, Jane Lewis and Eileen Bresnan.

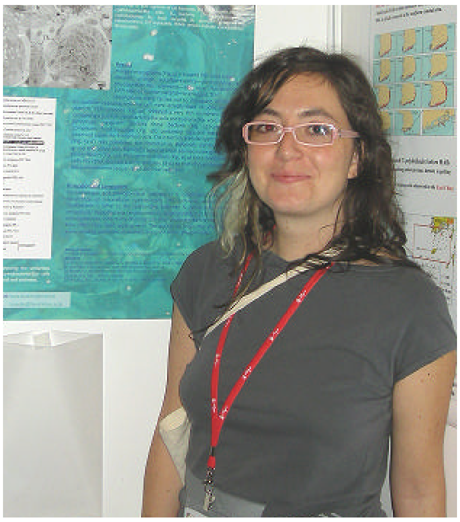
The last Conference Proceedings presented by Øjvind Moestrup.

Ian Jenkinson (France), Anke Kremp (Finland), Lincoln McKenzie (New Zealand), Clarisse Odebrecht (Brazil), Jong-Gyr Park (Korea) and Carmelo Tomas (USA).

Henrik Enevoldsen (*Ad hoc* Committee on special projects) related future plans concerning the HAB-MAP project, that will be linked to the Encyclopedia of Life (EoL) initiative under the name HAIS (Harmful Algae Information System). The proposal is to map the biogeography of all species which cause toxic outbreaks—ASP, AZP, CFP, DSP, NSP, PSP, YTX, spirolides, fish kills—with references. The IOC Taxonomy Reference List will be merged into the world register of marine organisms (WoRMS/OBIS).

All ISSHA members present welcomed the bid by Hak-Gyoon Kim (Pukyong National University) and colleagues to host the 15th ICHA (October 2012) in Changwon City (Busan, Korea).

Following the success of the first ISSHA auction (Copenhagen 2006) to raise funds for the society, a second one was arranged when the assembly adjourned. Once again, Barrie Dale thrilled the audience with hilarity and his sense of ***mise en scène.***



Laura Escalera, Best Student Poster.

During the 13th ICHA closing ceremony, details of the 14th ICHA venue (Hersonissos, Crete, Greece, November 2010) were presented by Kalliopi Pagou (Hellenic Centre for Marine Research, Athens).

All achievement awards were announced during the luxurious conference banquet that took place on 7th November at the *Jumbo Kingdom Floating Restaurant* in main Hong Kong Island.

The *Yasumoto Lifetime Achievement Award* was given to Karen Steidinger (Fish and Wildlife Research Institute, Florida, USA), for her contributions to dinoflagellate taxonomy, biology and ecology. Karen is a warm, generous and expansive character and has made major contributions to the HAB community with her articles, books, projects and scientific management, and her frequent participation in international courses on advanced taxonomy. Her work is recognized by taxonomists in the new genus *Karenia*—formerly *Gymnodinium breve*—a nuisance dinoflagellate species in the Gulf of Mexico and one of Karen's main research interests. *Karenia* segregates

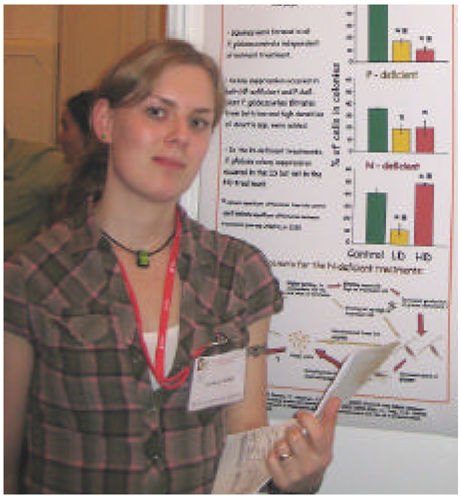
Shi Hong, Best Oral Presentation with John Hodgkiss.

a group of naked dinoflagellates with distinct characteristics from those of the old *Gymnodinium* complex. The *Young Scientist Award* was given to Rosa Figueroa. Rosa finished her PhD studies (IEO-Vigo, and ICM-Barcelona, Spain; University of Lund, Sweden 2001-2005)

Rosa Figueroa, Young Scientist Award.

three years ago, and has already made a substantial contribution to the description of life histories and survival strategies of a good list of dinoflagellate species.

Awards for the best oral presentations were given to Shi Hong[1] (University of Xiamen, China) and Iris Baula[2] (University of the Philippines), and for best posters to Laura Escalera[3] (IEO-Vigo, Spain) for work carried out at University of Hiroshima, and to Veronica Lundgren[4] (University of Kalmar, Sweden).



Veronica Lundgren, Honorable Mention Student Poster.

1. H. Shi & J. Zhang. *Clone and identify mazEF: a toxin-antitoxin module in cyanobabteria* Microcystis aeruginosa
2. I.U. Baula, R.V. Azanza & Y. Fukuyo. *Modern Dinoflagellate Cysts From a Mariculture Area in Pangasinan, Northwestern Philippines*
3. L. Escalera, S. Yoshimatsu, K. Takishita, K. Koike & K. Koike. *Cyanobacterial endosymbionts in the benthic Dinophysioid dinoflagellate* Sinophysis canaliculata*?*
4. V. Lundgren & E. Granéli. *Grazer induced colony formation in* Phaeocystis globosa *(Prymnesiophyceae): Influence of different nutrient conditions*

B. Reguera, ISSHA President.
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Future events

APRIL 2009

IPHAB meets in 2009

The IOC Intergovernmental Panel on HABs will meet 22-24 April 2009 at UNESCO Headquarters in Paris. The Panel is the forum to discuss and prioritise international activities and cooperation on HAB.

The 2009 meeting will in particular discuss capacity building; the GEOHAB Research Programme; biotoxin regulation and human health; the Harmful Algae Information System and the International Ocean Data Exchange; HAB observations and their inclusion in GOOS Regional Alliances; harmful algal events, coastal zone management and linkages with coastal eutrophication; and formulation/endorsement of specific objectives for regional activities.

Download invitation letter and more detail at www.ioc-unesco.org/hab

Erratum to 'Padmakumar, K.B. *et al.* 2008. *Harmful Algae News 27: 11-12'.*

In this article, authors' addresses have been incorrectly printed and should read as follows:

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The editor apologizes to authors and readers for the inconvenience caused by this error.

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HARMFUL ALGAE NEWS

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