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Photos by M. Lion (top) and K. Pagou (bottom).

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Tangles and Threads

Plate tectonics informs us that "Crete rides, as if on the back of a bull, at the point where Africa burrows under Europe."[1] The Dhikti Mountains which form the southern backdrop to Hersonissos are part of the bull's back. Zeus, head of the Olympian pantheon, was said to have been born in a Dhiktean cave. A local tradition had him buried under Mount Yioúhtas, casting doubt on his immortality. Some say this is the origin of Epimenides paradox, "All Cretans are liars"; he was himself a Cretan, hence the paradox. Zeus in the form of a bull carried the Phoenician goddess Europa off to Crete, whence the name of the western end of Eurasia. In Crete, Europa gave birth to Minos; those ICHA 14 participants who went to Knossos saw what remains of the palace named after him. It was in Knossos that Minos kept the bull-headed Minotaur in a labyrinth, and it was Minos' daughter Ariadne who showed Theseus how to escape from it, after killing the monster, by unravelling a *thread*.

Archaeologists think the Minoans may have reached Crete from Anatolia, present day Turkey. Whatever the truth, Cretan (and European) society was burrowed into from the east, in the ever ongoing process of cultural tectonics, as Europa's fate indicates. The music and dance at the conference dinner was one result of this hybridization. Inspiration for the Greek alphabet was Phoenician, and even the names of the Greek a-b-c-, alpha-beta-gamma-, are Semitic. By this route Pythagoras learned of the theorum we now know by his name, and we inherited the Babylonian sexagesimal base of their mathematics, which still survives in the degrees, minutes, and seconds of our circles and our time keeping.

With what threads can we navigate the labyrinthine imbroglio of ICHA 14, with its more than 500 contributions? **Linda Medlin** provided one thread, a review of the evolution of dinoflagellates, a dazzling cataract of erudition; she called them "kings of symbioses" (miniature minotaurs), spoke of their complex evolutionary history, of plastids gained and lost multiple times, of the phylogeny of peduncle feeding, and much more. Some details of plastid origins in *Dinophysis* were explored by **Nicolás Raho**; plastid maintainance following their acquisition by *D. acuminata* was addressed by **Jennifer Wisecaver**. Peduncle feeding, a trait shared with euglenids, was described in *Gymnodinium aureolum* by **Kyung Ha Lee**, and in *Karlodinium armiger* by **Terje Berge**. Like prokaryotes, dinoflagellate chromosomes are always condensed, their nuclear envelopes persist during mitosis, and they lack histones and nucleosomes; but their cell cycles are eukaryotic, as are the nucleus and nucleolus, the repetitive noncoding DNA sequences, the way ribosomal genes are arranged, and other features. To the outsider, navigating these giant genomes looks as perplexing as understanding turbulence. Genes are in a constant state of flux, from Barbara McClintock's jumping genes to unequal crossing over, DNA slippage, gene conversion, Gabriel Dover's molecular drive, evolution by genomic flux, and other dark matters. No wonder there is so often mismatch between the old names of classical taxonomy and the new trees of parsimony analysis. Add more genes and the trees change. Toxin profiles too might contribute to understanding phylogeny and distinguishing clones, suggested **Takeshi Yasumoto**. How long will the old names maintain their status as the *gold standard*? **Shauna Murray** provides an insiders view of some of the genetical perplexities unravelled here (see p. 10).

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Gustaaf Hallegraeff provided a second thread and summarized some anticipated responses of marine ecosystems to projected climate changes. He is well aware of the pitfalls of trying to discern the future of complex systems, for which he used the word *tangles* – an echo of Darwin's *tangled bank*? Some of his main points were, that if climate does change in the sense projected by IPCC models, we can expect phytoplankton to respond with changes in the ranges, abundance, and seasonal timing, that these changes will impact ecosystems through match-mismatch mechanisms, and that they will challenge our abilities to manage the harmful ones. A variety of contributions at the conference explored some of these expectations experimentally, but it is not clear so far whether what we may be seeing in field data are responses to *climate change* (in what now appears to be the canonical and, unfortunately, very politicized meaning of the phrase) or to *climate variability*. Or to neither! Several powerful voices attribute imputed trends in coastal phytoplankton ecology to eutrophication. Gustaaf's summary of conference contributions to the climate debate appears on page 11.

Protagoras asserted that there are two sides to every question. Thus **Barrie Dale** challenged us to view the high frequency fluctuations or trends we detect in monitoring data (with decadal to secular time scales) in the context of the *deep time* of geology. Whether we are in fact dealing with change or variation is of course a question of time scales, but the problems of even securely identifying trends in phytoplankton communities are not trivial[2]. In terms of management however, it would be Olympian indeed to think we could do anything about Barrie's larger scales. An alleged major cause of the destruction of Knossos in

the 12th century bce was a marked increase in aridity which persisted for some centuries; more recent droughts have impacted human history in regions around the world[3]. Some IPCC projections threaten some regions of the planet with a similar fate within the next few decades, and emphasize that the *rates* of likely change are unprecedented. In fact even higher rates of change in temperature have been identified …

To confound Protagoras, **Judit Padisak** took a third view, and reminded us that as oxygen breathers, we would not be here but for the labours of *harmful* cyanobacteria, partly responsible for oxygenating the atmosphere - the "Great Oxidation"[4]. But this change was inimical to organisms adapted to anoxic conditions. That was back in the Precambrian. Even today, prokaryotes are thought to represent about 70% of surface water planktonic biomass[5], and as Judit pointed out, they are "integral parts of healthy functioning ecosystems" and play essential biogeochemical rôles. "What strange creatures they are!", she said, quoting a Czech fairy tale. "Algae to the rescue" wrote David Swinbanks[6], of cures proposed by Tadashi Matsunaga and Shigetoh Miyachi to alleviate increasing atmospheric CO_2 concentrations.

Climate is always changing. If we only examine a brief period of warming, that warming is of course unprecedented. So, Gustaaf's editorial rule of thumb, that accounts of *change* based on time series shorter than 30 y should be rejected, is acceptable to a point. A longstanding and less arbitrary rule says that we need time series about 2 – 3 times as long as the signals we are seeking, so that a 30 y series might allow us to identify decadal signals like those related to sunspots, to ENSO or to the NAO, but is a little short to identify the 18.6 year tidal signal found by Alan White in Bay of Fundy PSP records[7]; the more extended data set now available might usefully be analysed to see if the signal found by White has persisted. Longer time-series are sometimes available but not used: *Phaeocystis* was considered a problem in the 1920s and 1930s in the North Sea, and there is quite an extensive literature on it from those decades; but many analyses of long-term trends in the species in the more recent literature use 1950s data as a base-line – a special issue of *Harmful Algae* (vol 4, issue 5) on *Phaeocystis* refers to the earlier work only once.

There is general agreement that climate has warmed a little (about 1°C) in the last 100 years (but not monotonically, and not by equal amounts in all regions), and that greenhouse gas concentrations in the atmosphere have risen, CO_2 for example from about 280 ppm in 1750 to 380 ppm at present. Agreement about what these facts mean is less widespread. It is often forgotten that the rate of temperature change in the period from the 1920s to 1940s was as high (in the North Atlantic) as it was after 1980, and that regional changes in species ranges in that earlier period were as extensive as those described more recently from CPR surveys (some of the latter presented at this conference by **Stephanie Hinder**, and by **Chris Reid**). Chris referred to the "*tangle* of feedback mechanisms" which make interpretation so difficult. Trends analogous to those in the Atlantic are hinted at by tropicalization of the East China Sea as indicated by increased occurrence of warm water dinoflagellates, fish, and macrophytes around Jeju Island, Korea, attributed to strengthening of the Tsushima Current (**Joon-Baek Lee**).

A few contributions based on multi-annual data sets identified changes in species abundance. Sediment trap results from the Santa Barbara Channel, NE Pacific, covering the years 1993 to 2007, indicate an increased frequency of *Pseudo-nitzschia* blooms after 1998 (**Emily Sekula-Wood**), attributed to changes in upwelling and in the chemistry of the California Undercurrent. A short time-series, 2000 to 2009, from lagoons in Texas seems to show that winter *Prymnesium parvum* blooms are strongly influenced by flushing rates there (**Daniel Roelke**), hence on varying rainfall. Flushing may be responsible too for the decline of *Karlodinium veneficum* blooms in the Canning estuary, Western Australia (**Alice Gedaria**). A comparison of early 20th century plankton records (1903-1911) with more recent ones (1993-2005) from the Baltic suggests there have been marked changes in the occurrence of *Skeletonema costatum* (more likely *S. marinoi*) and *Thalassiosira baltica*, that *Dinophysis* spp may have increased in abundance in Baltic coastal waters, while the bloom forming *Aphanizomenon flos-aquae* and *Nodularia spumigena* of open waters have not (**Heidi Hällfors**); an earlier comparison of Baltic ecology over the

same time period found that pelagic energy flow had increased by 30-70%, and pelagic fish catches more than ten times[8].

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Detailed attention to hydrographic data in short time-series can often unmask the unique conditions that promote blooms of selected species in particular years; **Beatriz Reguera** presented such an analysis for *Dinophysis acuta* in Galician coastal waters. A 20 y time-series off Aveiro, Portugal, yields evidence of a retention area for *Dinophysis*, focus of a project called HABSPOT (**Teresa Moita**), and potential source of the blooms farther north in Galicia. Conditions in the Yatsushiro Sea favour accumulation of *Chattonella* cysts (see below) and make it a "hot spot". The unique cysts of *G. catenatum* and its non-toxic congeners lead to some intriguing questions about the identity of subfossil deposits. It now appears that cysts of *G. catenatum* and *G. microreticulatum*, and possibly also *G.* cf *nolleri*, are found together in cores from the Portuguese shelf; *G. catenatum* cysts first appeared in southern Portuguese cores (off Mira) in the 1890s, farther north (off Douro) in the 1920s, and exhibited a major increase in abundance in the late 1960s (**Sofia Ribeiro**). A longer *G. catenatum* cyst record (~ 500 y), from the Gulf of California, published last year[9], shows a rather similar pattern for the 20th century, which the authors relate to upwelling rates and surface temperatures. Cyst counts from a core taken in Puget Sound, USA, have provided estimates of *Alexandrium catenella* abundance from 1878 to 2005 (**Kirsten Feifel**); counts were more closely related statistically to local conditions (SST and air T) than to large scale climatic indices (PDO, ENSO).

"Acidification" has provoked considerable attention. Seawater pH can vary from as high as 8.3 to as low as 7.8, daily in some coastal areas - so it is in fact always alkaline (pH > 7.0). Even the worst IPCC end-of-century scenario with pH ~ 7.6 does not forsee an acid ocean, only a less alkaline one. Experiments with bubbled cultures of *Lingulodinium* (**Christos Loukas**), *Karenia* (**Reagan Errera**), *Phaeocystis* (**Yan Wang**), *Alexandrium* (**Rhett Tabbada**), and mixed populations (**Lasse Nielsen, Edna Granéli**) have not yet provided any clearcut guides as to what might result from declining pH, even on the short time scales of these experiments. The well known impact of bubbling induced turbulence seems to have been ignored. Values of pH < 7.07 dissolve the spines of *Scrippsiella* cysts (**Hyeon Ho Shin**). Hallegraeff pointed out that physiological plasticity and strain diversity may significantly impact such experiments. As if in illustration, **Seung Ho Baek** reported highest growth rates of *Heterocapsa triquetra* in culture at 30‰/20°C; he nevertheless found blooms under ice in Lake Shihwa, Korea, and it blooms too in the highly eutrophic Golden Horn, Turkey, at a less extreme 13°C (**Seyfettin Tas**).

Most of us rarely face the real causes of the ecological changes we worry about, whether it be plankton communities or rain forests, namely our own increasing numbers, increasing expectations, and increasing wastes. Forests and swamps are destroyed by lumber companies, palm oil plantations, cattle ranching, marine ecosystems by overexploitation of various kinds. The corporate capitalist part of our nature is disembowelling the planet. Concern about overpopulation was already expressed in ancient times. In the Babylonian *Atrahasis*, Enlil asks for plague, famine and flood to control human numbers; and the same motif is found in the Greek *Cypria*. Fast forward to Malthus. But general concern about ecological change stems from the hypothesis that human activities have become so influential since the Industrial Revolution that they are now as effective as geological forces, and so have initiated a new geological era, the Anthropocene. In the sea, these new forces include the impacts of eutrophication, use of fresh water resources, dumping and dredging, fishing, aquaculture, as well as climate change. Some small scale instances reported at the conference relate the occurrence of blooms in response to changes in local flushing rates. Dams in Beijang River, China (**Fajin Chen**), spit growth at Juag Lagoon in the Philippines (**Joan Reotita**), construction of marinas along the Catalan coast, NE Spain (**Esther Garcés**) provide examples, and recall the changes at Alexandria Harbour, Egypt (Amany Ismael at 13th ICHA). Larger scale changes attributed to eutrophication were addressed by **Patricia Glibert**, who ascribes picoplankton blooms (*Aureococcus*, *Synechococcus*) to their competitive ability to thrive on reduced forms of nitrogen, as well as to live in anoxic conditions. She also pointed out that these picoplankton blooms favour dinoflagellates and raphidophytes over other grazers, and referred to such situations as *tangles*! The rôles of nutrients and their ratios were simulated in a box model of the Chesapeake (**Ji Li**), with uptake and assimilation rates derived from laboratory studies.

It is assumed that climate-linked rising surface temperatures will influence phytoplankton species composition. Higher temperatures reduce viscosity, which might select for smaller-celled more slowly sinking species, or for species able to increase viscosity by means of extracellular secretions. These matters come under the rubric of *thalassorheology* (**Ian Jenkinson**). The recent *Cochlodinium* blooms in NW Indian Ocean coastal waters produce some kind of froth, not yet characterized, and mucilage events of the kind familiar in the Adriatic and other parts of the Mediterranean (*mare sporco*) now occur in the Sea of Marmara, associated with *Fibrocapsa japonica* (**Yelda Aktan**).

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Some elementary models of phytoplankton population dynamics provide nutrients to allow growth, and control algal numbers by grazing. In slightly more complex models, nutrients are regenerated as a result of grazing. In multispecies models, some species become dominant as a result of reduced grazing pressure and exploitation of regenerated nutrients. **Hong Ying** suggested that dynamics of this kind lie behind *Cylindrospermopsis* blooms in reservoirs in Queensland, Australia. We usually think of nutrients supplied by upwelling and runoff, but groundwater and atmospheric inputs can also be important. Groundwater was earlier invoked to account for brown tides (*Aureococcus*) in Long Island (NY) lagoons[10], and now for *Pseudo-nitzschia* blooms in a lagoon in the northern Gulf of Mexico (**Justin Liefer**). Desert dust may supply essential iron to surface phytoplankton, and was proposed as a source of iron for *Cochlodinium* blooms in the Persian Gulf and Omani waters (**Cemal Saydam**); the key feature of Cemal's model is biological reduction of iron by atmospheric microorganisms. **Savvas Genitsaris** has identified 63 algal taxa in air samples from Thessalonika, Greece; curiously, *Dinophysis acuminata*, common in the local waters, was absent from the air samples. The notion that N:P ratios are a key factor in red tide occurrences in Tolo Harbour, Hong Kong, was originally based on an 8 year time series (1982-1989); **Paul Harrison** has extended the series another 19 years (to 2008) and shown that the hypothesis fails.

Access to nutrients can also be enhanced by attacking the competition. *Karenia* outcompetes (allelopathy?) *Prorocentrum micans* in mixed cultures of the two (**Ji Xiaoqing**). *Alexandrium minutum* secretes a product which targets photosystem-II of *Chaetoceros* and reduces its chlorophyll content, hence growth rate (**Aurélie Lelong**). This study as well as several other presentations, especially from the Alfred Wegener Institute, indicate that the suite of secondary metabolites available to *Alexandrium* (and presumably most phytoplankton species) is much more varied than the earlier focus on PSTs might suggest.

Grazing is not the automatic filtration of particles once imagined. Grazers have their likes and dislikes, and can select from mixtures of phytoplankton. In the Senegal River, mixed zooplankton avoid eating *Microcystis aeruginosa* but graze *Cylindrospermopsis raciborskii* and *Anabaena* spp in variable amounts (**Mireya Mendoza-Vera**); *Fragilidium duplocampanaeforme* feeds only on *Dinophysis* (but avoids the more toxic *D. fortii*) when offered a mixture of prey (**Miran Kim**); *Mytilus galloprovincialis* preferentially selects *Dinophysis* and *Prorocentrum* from mixed phytoplankton (**Živana Ninèeviæ-Gladan**). Toxins in food webs provide evidence of trophic relations as well as essential epidemiological information. Azaspiracids (**Joe Silke** summarized the history of their discovery) are found in *Favella ehrenbergii* and *Protoperidinium crassipes* revealing that they feed on *Azadinium spinosum* (**Phillip Messtorff**); PST of *Pyrodinium bahamense* in zooplankton indicates that grazing impacts bloom dynamics (**Joseph Palermo**).

The numerical effects of grazing are reduced by prey species in a variety of ways. *Heterosigma akashiwo* can avoid grazing by *Favella* and *Oxyrrhis* by seeking water of lower salinity (**Elizabeth Harvey**). Many species, *H. akashiwo* included, can transit metazoan guts unharmed; ascidians provide an example (**Sandra Shumway**). Allelopathy to deter grazers was demonstrated, by *A. tamarense* against *Polykrikos kofoidii* (**Uwe John**); it is not the PSTs but lytic compounds (partially characterized by **Haiyan Ma**) which are active in this context, more evidence of the diversity of secondary metabolites.

Population growth rates are also reduced by infections. We learned of a virus that infects *Prorocentrum minimum* (**JinJoo Kim**), several bacteria which attack *Microcystis aeruginosa* (**Myung-Soo Han**) and other cyanobacteria (**Shingo Hiroishi**), and a chytrid fungus which parasitizes recently excysted *A. tamarense* (**Mineo Yamaguchi**). Chytrid infections of phytoplankton are well known in freshwaters, but have not received much attention in the sea. Bacterial control of *Microcystis* blooms may be a management option (**Ichiro Imai**). Infection rates of various dinoflagellates with *Amoebophrya* in Monterey Bay, California, were described by **Fernanda Mazzillo**, and the demise of a *Prorocentrum micans* bloom due to this parasite in Reloncavífjord, Chile, by **Catharina Alves-de-Souza**; it also infects *Dinophysis acuminata* in Galician waters (**Lourdes Velo-Suárez**). A fascinating account of how the swimming patterns of *Karlodinium veneficum* (host), and *Amoebophrya* (parasite) can interact and hence control infection rates was given by **Allen Place**.

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The rôle of cysts in population dynamics has been debated since the first conference in this series in 1974. Some studies reveal more or less clear relations between excystment and bloom initiation, and between encystment and bloom termination. One link or both are illustrated by *Alexandrium minutum* in Cork Harbour, Ireland (**Sarah Cosgrove**), by the extensive data set on *A fundyense* from the Bay of Fundy (**Jennifer Martin**), by the same species in a Cape Cod salt pond (**Emil Vahtera**), and by *Chattonella* in the Yatsushiro Sea (**Mineo Yamaguchi**). These links are less clear in two other studies, of *A. catenella* in the Chilean inland sea (**Patricio Díaz**), and of *Pyrodinium bahamense* in various Philippine bays (**Elsa Furio**); in these cases, a relationship between cyst abundance and blooms may be obscured by the hydrodynamics. In contrast, Japanese (**Ken-Ichiro Ishii**) and Korean (**Myung-Soo Han**) studies of several species suggests that excystment and vegetative growth are largely uncoupled, so that resting stages are not necessarily bloom precursors. **Marta Estrada** presented a model of these aspects of population dynamics, and **Donald Anderson** brought us up to date on the sophisticated Gulf of Maine model for *Alexandrium* which is initialized with cyst counts. Cyst dynamics was a component of a model of the life history of *Pyrodinium bahamense* in Sorsogon Bay, Philippines (**Aletta Yñiguez**), in which transport, stratification, excystment and encystment, and grazing, each play their part in the generation and decline of blooms. Life cycle transitions and motility are also key components of a model of bloom dynamics presented by **Inga Hense**; the former are controlled externally, by nutrients, in Hense's model. A few contributions focussed on aspects of life cycle regulation – and hint at the existence of *chronogenes* whose transcription meters time. Internal control of life cycle transitions is suggested by reorganization of the transcriptome in *Karenia brevis* during the transition from logarithmic to stationary growth (**Jillian Johnson**).

Some important HAB topics received less attention than in earlier conferences. *Thin layers*, a core research area for GEOHAB, appeared only once, dealing with *Dinophysis* in the Galician rías (**Laura Escalera**); results like these have important consequences for sampling, modelling, and management. But some contributions on vertical migration relate to the theme. Distinct behaviour patterns of *Prorocentrum minimum* and *Heterocapsa triquetra* in different temperature and salinity gradients in the laboratory were reported (**Therese Jephson**), and, based on field data from Alfacs Bay in the NW Mediterranean, of *Pseudo-nitzschia* and *Karlodinium* in stratified and turbulent water columns (**Mireia Artigas**). Settlement patterns of *Heterosigma akashiwo* seem not to depend on changes in swimming behaviour during life history transitions (**Elizabeth Tobin**); their cysts apparently reach the sediment by passive sinking, so that their distribution there might depend on the local hydrodynamics.

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We end with a few further notes on some of the actors. The characterization of *Alexandrium tamarense* and its cousins continues to perplex. Toxic and nontoxic *A. tamarense* in Scottish waters appear to hybridize (**Jennifer Graham**), sequence data distinctions of *A. ostenfeldii* and *A. peruvianum* are blurred (**Anke Kremp**); within species variability is found wherever it is sought (**Pia Mäenpää**, **Daniel Varela**); all this is just as it should be in a Darwinian world. **Anna Godhe** presented a fascinating analysis of interactions between life histories and genetics in fjord and adjacent shelf populations of *Skeletonema marinoi*. The stx-genes are under scrutiny in cyanos and several dinoflagellates (see Murray's accompanying article), and the steps which lead from these genes to the toxins are being explored too (**Ralf Kellmann**; **Maria Wiese**).

Basic information on *Pseudo-nitzschia* was reported from Plymouth, UK (**Naomi Downes-Tettmar**), Atlantic Marocco (**Karima Chaira**), Lesvos, Greece (**Sofie Spatharis**) where there are large winter blooms, and from Nha Phu Bay, Vietnam (**Dao Viet Ha**), Sarawak (**S N-P Su**), Pacific Mexico (**David Hernández-Becerril**), and Uruguay (**Silvia Mendez**). Fourteen species of *Pseudo-nitzschia* occur together in Tongyeong waters (**Weol-Ae Lim**), a taxonomist's nightmare now being resolved with real-time PCR probes; similar species richness is found in Mexican Pacific waters (**Sonia Quijano-Scheggia**). Studies of the genetics of *Pseudo-nitzschia* from the South China Sea (**Peng Wang**, **Junrong Liang**), Malaysian waters (**Hong-Chang Lim**), and the Gulf of Naples (**Sylvie Tesson**) were also presented. Tesson's results indicate the existence of sympatric populations of genetically distinct but sexually compatible strains of *P. multistriata*.

Persistent high concentrations of *P. bahamense*, from November 2009 to May 2010, occurred about 60 km off the coast of El Salvador, with lower numbers inshore (**Sergio Licea**), and were associated with dead turtles (*Chelonia* and *Lepidochelys*). Blooms of this species were also described in the Gulf of California (**Lourdes Morquecho**), in Oaxaca (Mexico) waters in July 2010, with maximum numbers 3-5 m below the surface (**Esther Meave**). **Florence Onda** described conditions favouring pellicle cyst formation in culture.

In Manila Bay, we normally imagine *Pyrodinium bahamense* blooms (**Rhodora Azanza**), but *G. catenatum* was found there in February 2010, and *Noctiluca scintillans* too was widespread (**Teresa Escobar**, **Garry Benico**). *G. catenatum* and *N. scintillans* also occur together in the Gulf of California, where the latter grazes on the former (**Jose Bustillos-Guzmán**).

Extensive blooms of *Cochlodinium polykrikoides* now occur in the Northwest Indian Ocean, in the Persian Gulf, Gulf of Oman, with associated faunal mortalities (**Gilan Attaran-Fariman**, **Fereshteh Saraji**, **Anbiah Rajan**), and as far south as Masirah on the southern Oman coast (**Adnan Al-Azri**), and to the east in Karachi waters (**Sonia Munir**). In the Pacific, the species now blooms frequently in the Pearl River Estuary, China (**Yuzao Qi**). *Noctiluca scintillans* and other species accompanied the blooms in Omani waters (**Hamed Al Gheilani**). Experiments show that can control its competitors allelopathically, kill potential grazers, and acquire nitrogen in a variety of forms (**Christopher Gobler**). With such a well-equipped armoury, one must wonder why it waited until the 1980s before causing problems, or is our conceptual grasp of phytoplankton variability way off target? Are sporadic appearances and disappearances the norm?

Ostreopsis cf. *ovata* is attracting a lot of attention in Mediterranean laboratories (**Adriana Zingone**, **Cristina Ingarao**). It is found both in the plankton and on the surfaces of rocks and seaweeds (**Stefano Accoroni**, **Magda Vila**), and may move into the water column on a daily basis (**Rodolphe Lemée**). On the bottom it ejects thrycocyst nets (or tangles!) (**Giorgio Honsell**) and secretes mucilaginous material in which it sometimes attains attains very high cell concentrations (**Oriana Blasutto**), sharing its bioingeneered space with a variety of other organisms (**Roberta Congestri**). Mediterranean and Atlantic strains form a single panmictic population that differ from the Indo-Pacific one (**Antonella Penna**). A new genotype has recently been isolated from the Canaries and Eastern Mediterranean (**Katerina Aligizaki**). Some details of *Ostreopsis* life histories are emerging (**Isabel Bravo**). Several studies report the preferences of *O. ovata* in culture, for temperature, light, and nutrient conditions (**Marina Montresor**, **Rossella Pistocchi**, **Nayani Vidyarathna**), while other culture results are being used to interpret field data (**Veronique Sechet**). *Ostreopsis* cf. *siamensis* is recorded from Atlantic coasts, in Maroccan (**Asmae Bennouna**) and Portuguese waters (**Ana Amorin**), the latter in 38^{0}N, its most northerly occurrence so far known. Both *O. ovata* and *siamensis* are found along Japanese coasts, where ITS sequence analyses show that strains of Mediterranean-Atlantic populations of *O.* cf *ovata* are also found in those waters (**Shinya Sato**). Two new species of the related genus *Gambierdiscus* have been isolated from the Canaries and Eastern Mediterranean (**Santiago Fraga**), the former with both CTX-like and MTX-like toxicity, the latter lacking MTX-like toxicity (**Amandine Caillaud**).

Karenia mikimotoi practises phagotrophy when offered bacteria, *Isochrysis*, and even artificial microspheres (**Qingchun Zhang**) – so too does *Prorocentrum donghaiense* which can feed on *Skeletonema* (**Linjian Ou**). A suggestive correlation was found between *Karlodinium veneficum* and *Cryptomonas* in the Lesvos work mentioned earlier[11]. For many years, it has been assumed that *K. mikimotoi* was an introduction to European waters, since it was first reported in 1966. New evidence from genetic analysis of CPR silks now indicates that it was present in this region at least some years earlier (**Manal Al-Kandari**); *corrections* of this nature may appear more frequently in the future as such analyses become more widespread, and may need to be taken into account in time-series studies.

The most recently described harmful dinoflagellate, *Azadinium spinosum*, is now recorded in southwest Atlantic waters (**Rut Akselman**), and along Pacific Mexican coasts (**David Hernández-Becerril)**: there are now three known species, *Azadinium obesum*, which does not produce azaspiracid, another new non-toxic species under description (**Urban Tillman**), with new challenges for monitoring operations. The only toxic species in the genus, *A. spinosum*, is hardly distinguishable from its congeneric non-harmful species, despite the presence of a very small posterior spine. Molecular probes (**Kerstin Töbe**) are being developed that will help monitoring, and clarify the biogeography of these tiny species.

James Lovelock[12] introduces the Greek earth mother Gaia as a metaphor of the biosphere, atmosphere, oceans, and soil, "the totality constituting a feedback of cybernetic systems which seeks an optimal physical and chemical environment for life on this planet." The key feature of Gaia is a set of *negative* feedback mechanisms which give the system the ability to home in on a stable state, in a modelling idiom, to prevent the system from *blowing up*.

Peter Ward[13] adds Medea to the new pantheon of ecology. While Gaia nurtures her children, Medea consumes them; Ward's thesis is anti-Gaian, it does blow up. Medea is a metaphor of the dystopian scenarios provoked by life itself. The key feature here is *positive* feedback. The *great oxidation* already mentioned is an example. Aided by the evolution of the typical tubular guts of triploblastic animals, which package wastes so that they sink instead of floating around in the neighbourhood (like the invention of drains!), the oxygen produced by photosynthesis was able to accumulate in the upper water column of ancient seas - positive feedback. The use of clay to coagulate and precipitate blooms of noxious algae imitates the packaging process (**Xihua Cao**, **Paolo Rivera**, **Kevin Sellner**, **Hyun-Jae Shin**, **Ting Wu**, and others).

We might add Niobe to this pantheon[14]; she loses all her numerous children, and can stand for oligotrophy and the end state of thermodynamics, perfect entropy or energy death. Gaia is the middle path between Medean and Niobean extremes. Other gods, like Helios and Vulcan, play the rôles of boundary conditions[15]. It may be possible to correct small disturbances which move ecosystems away from the Gaian ideal by appropriate management strategies, but larger disturbances towards either Medea or Niobe may alter our life support systems in ways that we can neither anticipate nor reverse.

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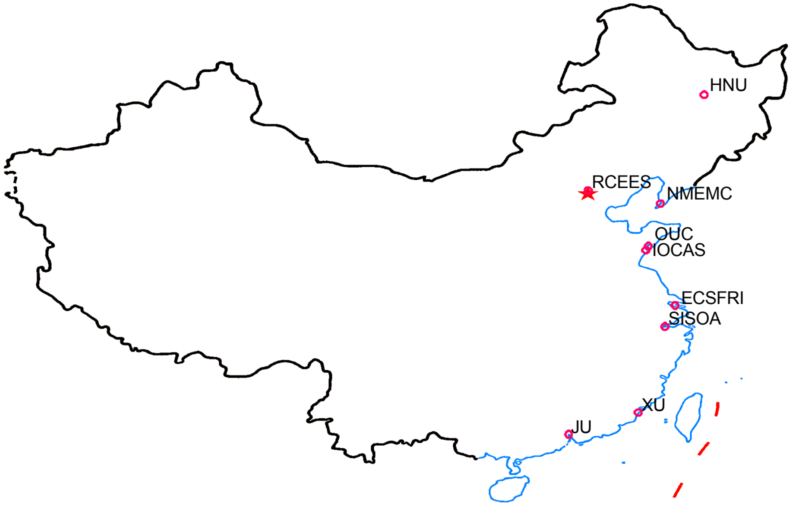
Chinese involvement in international HAB studies

14th International Conference on Harmful Algae

About 40 Chinese scientists and graduate students took part in the 14th International Conference of Harmful Algae held in Crete, Greece from November 1-5, 2010. They came from a variety of institutions and universities in China, including the Institute of Oceanology, Chinese Academy of Sciences (IOCAS) in Qingdao, Jinan University (JU) in Guangzhou, Ocean University of China (OUC) in Qingdao, Xiamen University (XU), Harbin Normal University (HNU), National Marine Environmental Monitoring Center (NMEMC) of the State Ocean Administration (SOA) in Dalian, The Second Institute of SOA in Hangzhou, East China Sea Fisheries Research Institute (ECSFRI) in Shanghai, Research Center for Eco-Environment Sciences, CAS (RCEES) in Beijing, as well as those working or studying abroad. Their study results on the genetics, biological interactions, population dynamics, impacts, management and mitigation of HABs were presented in oral or poster sessions.



China has experienced HAB problems in her coastal waters since the 1970s. Since then, many projects have been set up supported by the National Natural Science Foundation of China (NSFC), Ministry of Science and Technology (MoST) and Chinese Academy of Sciences (CAS). And a systematic HAB monitoring network has been established by the State Ocean Administration (SOA). After the beginning of the new century, an apparent "evolution" of HABs in coastal waters of China, with more harmful and extensive blooms, was observed. Large-scale dinoflagellate blooms of *Prorocentrum donghaiense* was first recorded in the sea area south to the Changjiang (Yangtze) River estuary, which became a recurrent phenomenon in this region in the last ten years. The extensive dinoflagellate blooms, sometimes affecting an area over 10,000 km^2, posed potent threats to the services and value of the local marine ecosystem including seafood safety. In the sea area north to the estuary of the Changjiang River, a bloom of green alga *Ulva* (*Enteromorpha*) *prolifera* first occurred in 2007 and then appeared every summer in the following years. The rapid expansion and evolution of HABs in coastal waters of China drew great attention from the Chinese government, scientific community and public. A group of research projects and monitoring programmes were launched, including a new national HAB research project - CEOHAB II under the support of MoST, focusing on the "evolution" of HABs along Chinese coasts. Chinese scientists are also actively involved in international HAB related research and management activities such as GEOHAB, EASTHAB, the ICHA conferences series and others.

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Genetics and genomics at ICHA 14

14th International Conference on Harmful Algae

For the first time, this conference included an expanded section on the genetics and genomics of HAB organisms, as a result of the exciting technological advances that now allow us to ask deeper questions, gain a new perspective on factors underlying bloom dynamics and toxin dynamics, and routinely use genetic tools for monitoring purposes. As a taste of what was to come, **Linda Medlin** provided a comprehensive overview of what is known of the molecular evolution of dinoflagellates and what is yet to be determined; the genetic tools that have been applied to study intraspecific and interspecific diversity; and a summary of studies in phylogeography, plastid and mitochondrial genetics and evolution; genomics and the evolution of toxicity in dinoflagellates.

Perhaps the most exciting developments were studies on the genetic basis of toxin production, particularly saxitoxin, as these open up the possibility of new methods of studying HAB dynamics. **Allan Cembella** discussed an EST* sequencing project on *Alexandrium minutum*, that was then used to construct a microarray to determine genes that were differentially regulated. **Jeremiah Hackett** presented a comprehensive data set of Illumina and 454 sequencing of EST libraries from *Alexandrium tamarense*, *Pyrodinium bahamense* and *Gymnodinium catenatum*. Using this approach, sequences homologous to fourteen *sxt* genes from cyanobacteria were found, several of which appeared to differentiate evolutionary histories from one another. **Anke Stüken** showed that saxitoxin in dinoflagellates is clearly autonomously produced, as transcripts for *sxtA* from *Alexandrium fundyense* had polyA tails on their 3' ends and dinoflagellate specific spliced leader sequences on their 5' ends, as deduced from EST sequencing and RACE* studies of *Alexandrium* species. **Shauna Murray** found that *sxtA4* existed in multiple copies in *Alexandrium catenella*, and used the sequence to design a qPCR* assay, specific to *Alexandrium* strains which contained this gene. Using this approach, they detected *sxtA4* in a bloom of *Alexandrium catenella* that resulted in toxin uptake in Sydney rock oysters.

The search for genetic markers of bloom formation and decline were the subject of several presentations. In studies of *Karenia brevis* bloom decline, **Jillian Johnson** found that 29% of the genes assessed changed in their transcription patterns during changes from logarithmic to stationary growth phases, based on microarray and qPCR studies. Fourfold changes in gene expression in another kareniaceaen, *Karlodinium veneficum*, related to the light and dark periods, were the subject of a study by **Holly Bowers**. The genetic basis of cell cycle regulation, and its role in population growth in *Alexandrium fundyense*, was examined by **Yunyun Zhuang**, who sequenced full length transcripts of mitotic cyclin and examined their expression throughout the cell cycle. A study by **Allen Place** of the prevalence of the replacement of thymine by 5-hydroxymethyluracil in the genomic DNA of dinoflagellates found that it appeared to be restricted to the core dinoflagellates, and was absent in the closely related genera *Amoebophyra, Oxyrrhis* and *Perkinsus*.

Our understanding of population structure and phylogeography of HAB taxa continues to improve as new comprehensive studies of large numbers of cultures are undertaken, using methods such as AFLPs*, microsatellite markers and fast evolving rDNA regions. **Mindy Richlen** showed that local populations of *Alexandrium fundyense* in the Nauset Marsh System in Massachusetts, USA, were genetically isolated from those in the Gulf of Maine. **Pia Mäenpää** used AFLP markers to analyse 180 strains of *Alexandrium ostenfeldii* from the Baltic and found high genetic diversity. **Karin Rengefors** used AFLP analyses to study genetic differences in *Scrippsiella hangoei* and *Polarella glacialis* in Antarctic saline lakes. A statistical parsimony analysis of rDNA sequences was used to determine that populations of *Ostreopsis* cf *ovata* appeared to be limited to particular geographical regions by **Antonella Penna**. **Karen Lebret** examined population structure using AFLPs in the raphidophyte *Gonyostomum semen*. Microsatellite markers were used by **Anna Godhe** to analyse population structure of *Skeletonema marinoi* and determine the degree of genetic differentiation between benthic resting stages inside a fjord and in the surrounding open sea. **Sylvie Tesson** used a combination of microsatellite markers and ITS* sequences to determine that 2 genetically distinct population of *Pseudo-nitzschia multistriata* occurred in the Gulf of Naples. In this context, the finding by **Senjie Lin** of extensive within genome genetic polymorphisms in rRNA genes of clonal strains of *Alexandrium fundyense* is a reminder of the complexity of studying dinoflagellate intraspecific diversity.

Phylogenetics, particularly of newly discovered toxic species and strains, was the subject of a large number of studies. In line with the strong emphasis on benthic HAB-causing dinoflagellates, these tended to be from benthic habitats. **Lesley Rhodes** described the relationships of the pinnatoxin-producing peridinioid dinoflagellate *Portodinium honu*. Several new lineages of toxic *Gambierdiscus* species were discussed (**Mahfuzur Shah**, **Santiago Fraga**), as well as new clades of *Ostreopsis* (**Shinya Sato**, **Mariangela Menezes**, **Atsushi Nakashima**) and *Bysmatrum* (**Cecilia Satta**). New insights into the evolution and phylogeny of *Dinophysis* species and their kleptoplastids were discussed in several studies (**Nicolás Raho**, **Katerina Aligizaki**, **Sara Handy**, **Jennifer Wisecaver**).

Newly developed qPCR detection tools were the subject of several studies, including for the detection of *Ostreopsis* cf *ovata* (**Cecilia Battocchi**), six *Gambierdiscus* species (**Wayne

Climate Change at ICHA14

Greek mythology delivered us the concepts of Chaos, Gaia (earth), Ouranus (sky), Oceanus and Tethys. The Creta Maris resort in Hersonissos provided the HAB community with the perfect "summer camp" theatre to play out our usual suspects.

While climate change had occasionally been raised in previous HAB meetings (eg. Fraga & Bakun commenting on *Gymnodinium catenatum* in relation to Iberian upwelling; Barrie Dale's long-term dinoflagellate cyst core records from the Kattegat; both at the Rhode Island 1991 meeting), the ICHA14 in Crete for the first time delivered a solid body of 50 papers and posters on this topic. Climate change was represented by a plenary talk, but also featured in sessions on Cyanobacterial Ecology, Time Series of Harmful Algae Bloom events, and Population Dynamics of HABs. **Gustaaf Hallegraeff** presented an overview on the formidable challenge of predicting behavior of HABs in response to multifactorial climate change: increased temperature, enhanced surface stratification, alteration of ocean currents, sealevel rise, extreme weather events of rainfall and dust storms, elevated CO_2 stimulating photosynthesis but also causing ocean acidification etc. We need to design realistic laboratory simulation experiments incorporating complex factor interactions and allowing for adequate acclimation. Organism responses will be species or even strain-specific, and there will be winners and losers from climate change.

Beatriz Reguera explored *Dinophysis acuminata/acuta* time series in relation to thermal stratification in Iberian waters. **Pat Tester** alerted the audience to the fact that range expansions of benthic HABS including *Gambierdiscus* and *Ostreopsis* are the ones to watch. *Karenia brevis* is predicted to produce larger biomass blooms under increased CO_2 (**Reagan Errera**). Increasingly we are discovering climate feedback mechanisms (e.g., Antarctic ozone-hole driving circumpolar westerly winds enhancing deep ocean CO_2 venting), never predicted from first order principles. We should never lose the perspective that climate change is a matter of scale and time. Cyanobacteria evolved on our planet at 500,000 ppm atmospheric CO_2; on a geological scale the last glacial period was nothing but a "cold weekend", and many gonyaulacoid and protoperidinioid cyst taxa survived the K/T climate catastrophe without a blink (**Barrie Dale**). HABs have been studied for 40 years only, and strictly speaking we need at least 100 yrs of data before we can confidently speak of climate change (Dale). Crying wolf does not serve our discipline and we need to refrain from making unsubstantiated climate predictions!

The best recent plankton archive available is that offered by the Plymouth based continuous plankton recorder (CPR) surveys (since the 1940s; **Chris Reid**). Even though initially focused on zooplankton, these formalin preserved plankton silks provide an unexpectedly well preserved phytoplankton record which can be interrogated using electron microscopy (Hallegraeff) and even molecular sequencing (**Rowena Stern**). **Stephanie Hinder** reported on changes in bloom window for *Dinophysis*, *Pseudo-nitzschia* and *Protoperidinium* in the North Atlantic which could lead to a mismatch with higher trophic levels. CPR records of calcareous coccolithophorids and

(Continued on p. 12)

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Litaker), and *Pseudo-nitzschia* species (**Karl Andree**). Allele specific qPCR was used to detect specific populations of *Alexandrium tamarense*, that differed in their production of potential allelochemicals (**Uwe John**). Allelochemicals were found to have strong negative impacts on grazing pressure but positive intra-specific impacts, based on this method.

The detection of toxic species using microarray approaches, as part of the large scale EU funded MIDTAL (MIcroarrays for the Detection of Toxic ALgae) project, were the subject of a series of presentations (**Katrina Campbell**, **Jixen Chen**, **Jane Lewis**, **Johannes Hagstrom**, **Gary McCoy**) describing preliminary results and methodological development and testing.

An exciting development was the first metagenomic analyses of HAB taxa based on 454 sequencing of environmental samples (**Satoshi Nagai**). This approach detected the presence of more than 1500 unique sequences of 18S rDNA in the samples, comprising 21 algal classes.

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[*] EST = expressed sequence tag
RACE = rapid amplification of c DNA ends
qPCR = quantitative real time polymerase chain reaction
AFLP = amplified fragment length polymorphism
ITS = internal transcribed spacer

(Continued from p. 12)

Foraminifera in the North Atlantic show increased abundance in the past decades, in apparent contradiction to expressed concerns on impacts from ocean acidification.

Edna Granéli and **Lasse Nielsen** demonstrated results from ocean acidification experiments in swimming pools and plankton wheels, respectively. Coastal plankton appears to tolerate well pH changes predicted by the end of the century (pH=7.6). Escalating interest in the phenomenon of ocean acidification and climate models has brought to light our poor understanding of ocean biogeochemistry. Climate change offers the opportunity of significant new investment in more work on carbon and nutrient cycling.

Paul Harrison reviewed the impact of sewage diversion on Hong Kong red tides, only to conclude that hydrodynamic forcing (low wind events) plays a greater role than N, P and Si nutrients, with nutrient concentrations rather than ratios most important. **Jennifer Martin** showed an association between *Alexandrium* blooms in the Bay of Fundy and long periods of fog. **Dedmer van de Waal** predicted impact from climate change on C:N stoichiometry and hence microcystin speciation in freshwater cyanobacteria. Climate change also can influence extreme weather events such as heavy rainfall and dust storms. Increased humics can reduce Fe availability (**Granéli**), while UV enhances N and P availability from humics (**Patricia Glibert**). **Cemal Saydam** sought to explain why Sahara dust is a more potent HAB fertilizer, based on complex interactions between Fe speciation, oxalic acid from fungi, solar intensity and cloud cover. Precipitation thresholds also drive Texas *Prymnesium parvum* blooms (**Daniel Roelke**). Only with significant new infrastructure investment in global ocean observation systems (e.g. IMOS in Australia, OOI in US, IOC-UNESCO's GEOHAB) can we hope to quantitatively forecast ocean-related risks to human health and safety, and shed light on the impact of climate variability on marine life and humans in general. Phytoplankton monitoring (continuous plankton recorder, flowcytobot, ecogenomics) provides a sensitive early warning for climate-driven perturbations to marine ecosystems and should play an important role in these endeavours.

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ASIMUTH

A collaborative project entitled Applied Simulations and Integrated Modeling for the Understanding of Toxic and Harmful Algal Blooms: "ASIMUTH" held its initial partner meeting in Cork Ireland on the 14 and 15 December 2010. This FP7 funded project has 11 research and SME partners from Ireland, France, Spain, UK and Portugal. Through the ASIMUTH project, scientists and industry from these countries along Europe's Atlantic Margin will form a network to produce the first realistic HAB advisory and forecasting capability to the European aquaculture industry. The project will be an applied downstream service of the MyOcean core project of Global Monitoring for Environment and Security (GMES) which is a joint initiative of the European Commission and European Space Agency, which aims at achieving an autonomous and operational Earth observation (EO) capacity. Using Satellite observations, a variety of model products and the outputs of core monitoring programmes an early warning of severe blooms will allow fish and shellfish farmers to adapt their culture and harvesting practices in time, in order to reduce potential losses.

In recent years there has been much discussion of satellites being able to track surface algal blooms. Understanding biological phenomena in the ocean requires a complex approach, though there is some merit in using satellite derived chlorophyll images to delineate high biomass near surface algal blooms. Much cutting edge HAB research work has focused on subsurface profiles, where certain HAB species are present in thin layers of limited geographical extent often associated with strong density interfaces. Clearly, in order for a toxic/harmful algal bloom forecast to be realistic, physical factors including changes in water column structure and transport pathways are necessary. ASIMUTH is the next step towards providing an operational advisory service by integrating these physical drivers (derived from GMES downstream services) with all available biotoxin, phytoplankton count and bioassay data. A distributed advisory service and thematic experts distributed across the participating countries will network to provide regular advisory products and forecasts of impending toxic and harmful algal events. ASIMUTH brings together experts in the areas of Modelling, Earth Observation, HAB monitoring programmes and end users to assemble a number of key data sets and explore forecasting options.

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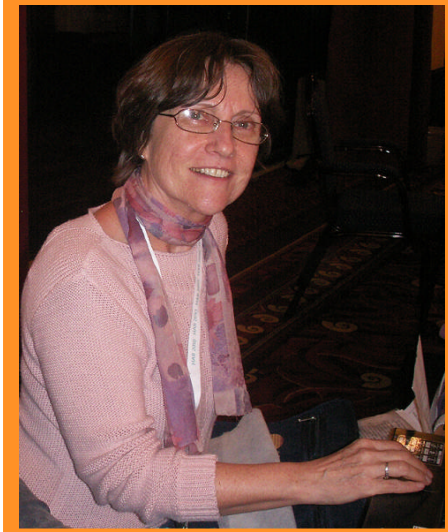


DEDMER
VAN DE WAAL


Parameters


HAB 2010

Fish kill by *Dictyocha californica* in Banderas Bay, Jalisco, México

Microscopic examination of phytoplankton samples in April 2009 from Banderas Bay revealed widespread abundance of silicoflagellates: dense patches lasted for 5 days. High densities of *Dictyocha californica* Schrader *et* Murray dominated the silicoflagellate assemblages in the discoloured area. Surface phytoplankton samples were collected from several sites in the discoloured area on April 16, 17 and 18, 2009, stored in 50 ml plastic bottles preserved with Lugol-acetate solution. Living and preserved material was used for identification of species, and morphological details were observed using scanning electron microscopy (SEM); fine structure information was needed to validate the identification of some species. Phytoplankton abundance was determined by standard Utermöhl technique [1], and counts made with 100x magnification in 10 ml aliquots using a 1mm^2 scale Whipple disc, with double cross pattern of 100 µm. Temperature was recorded with HOBO a temperature/light data logger.

Information on silicoflagellates in Banderas Bay is scarce [2, 3] and the studies are mainly concentrated on the Gulf of California and some areas of the Mexican Pacific Ocean [4, 5]. This is the first record of a Dictyochales bloom in Banderas Bay, and was associated with sardine mortalities. Satellite imagery shows increased chlorophyll *a* at the time of the dense algal bloom (Fig. 1). The mean temperature was 19.7 °C, and the chlorophyll *a* averaged 7.6 mg^{-3} (Table 1). No toxicity or human health problems have been reported in Banderas Bay linked to silicoflagellates, only hundreds of dead fish (this study).

Table 1. Data for each locality in the study area.

Station	Latitude	Longitude	Depth (m)	Temp °C	Chl *a*	Secchi (m)
Bucerías	20°40'06"	105°16'40"	6.50	17.5-19.9	7.6	6.50
Nuevo Vallarta	20°40'05"	105°14'55"	7.0	17.5-19.9	7.6	5.00

Fish mortalities related to plankton blooms have been observed before in Banderas Bay, associated with dinoflagellates such as *Cochlodinium catenatum* [6], and the euglenophyte *Eutreptiella marina* [7]. This is the first report of fish kills, of sardines, associated with *Dictyocha californica* in the Mexican Pacific. Dead fish were observed in the north part of bay, and washed onshore (16 April was the peak mortality day). Fish were observed gasping at the surface as well freshly killed. Hundreds of sardine were seen along the Nuevo Vallarta and Bucerías a few meters from the beach, where the high density of *Dictyocha californica* was found (Fig. 2). Toxin profiles were not measured, but the dead sardines were found free from infections.

Concentrations in the *Dictyocha californica* bloom reached 809 x 10^3 cell L^{-1} (Fig. 3A y C). *D. californica* skeletons are relatively large and elliptical with two longer radial spines in the mayor axis, and the two other spines in the minor axis; spines and axis are covered by clusters of small spines (Fig.3D). Living cells have a single flagellum and numerous chloroplasts (Figs. 3B). Other silicoflagellates identified in this study were *Dictyocha fibula*, *D. fibula* var. *robusta* and *D. octonaria*, but in minor abundance. Our observations agree with earlier records [2, 4] for the Mexican Pacific.

Abnormal production of *Dictyocha sp.* can clog fish gills and respiratory systems, causing suffocation. High densities of silicoflagellates can also cause hypoxia.

Acknowledgements

To Ph. E. Santamaría del Angel (FCM-UABC) for satellite imagery (MODIS-Aqua).

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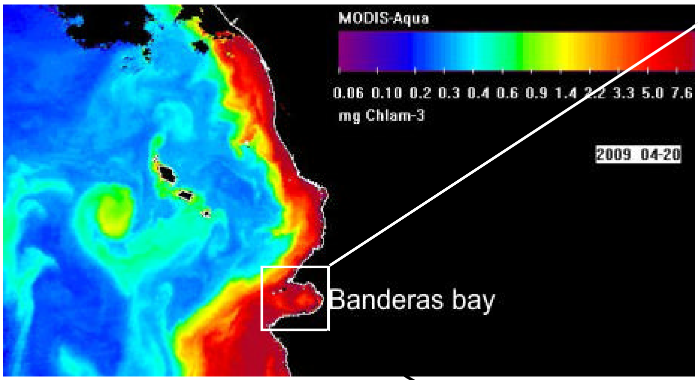

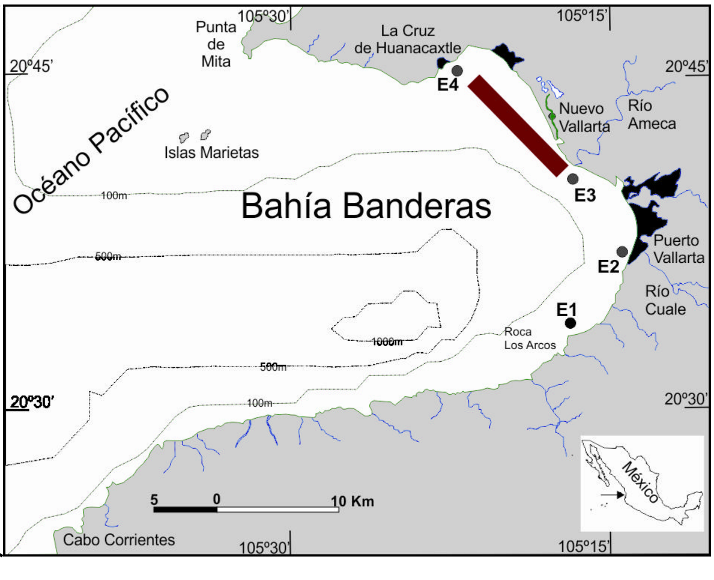

Fig. 1. Chlorophyll distribution a concentration, during the Dictyocha californica *bloom in Banderas Bay. Modis-Aqua satellite imagery (April 2009).*

Fig. 2. Location of the HAB event in Banderas Bay , Jalisco, México and sampling stations. Approximate site red bloom.

Heterocapsa triquetra bloom in Golden Horn, Turkey

A red tide of the dinoflagellate *Heterocapsa triquetra* in the shallow uppermost section of the Golden Horn Estuary (GHE) between January and April 2007 was investigated concurrently with physical and chemical variables. The red tide caused orange-brownish surface discoloration. We sampled monthly at selected stations from January to June 2007 (Figure 1). The lower estuary has a depth of 40 m and is strongly mixed. The upper estuary has a maximum depth of 5 m and the circulation is much weaker. Samples were collected using 5 L Niskin bottles. Inorganic nutrients, dissolved oxygen, chlorophyll *a* were measured. Physical data was recorded by a SBE-Sea Logger 25 CTD system. For phytoplankton analysis, 1 L water samples were taken, fixed in buffered formaldehyde, settled for at least 48 h, concentrated to 100 ml, and stored in dark colored glass bottles until examination. The phytoplankton cells were counted with a Sedgewick-Rafter chamber under a light microscope.

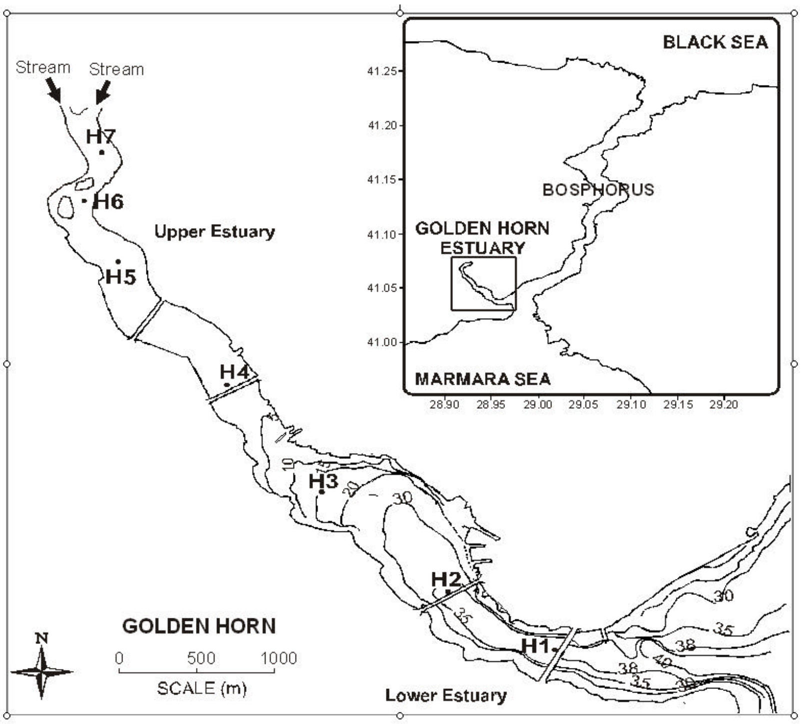

Fig. 1. Study area and sampling stations

During the red tide, temperature ranged from 9.1 ºC to 17.9 ºC and salinity from 18.8 to 19.7 psu in the lower estuary, and from 9.4 ºC to 24 ºC and from 15.2 to 17.2 psu in the shallow upper section. Secchi disc values were from 5 to 9 m in the lower estuary and between 0.2 and 1 m in the upper. *H. triquetra* appeared in the GHE between January and April 2007. Cell densities increased gradually from January, reached a peak in April, and decreased sharply in May; it was rarely detected in June (Fig. 2). *H. triquetra* concentrations were generally low in the lower estuary. Discolored water started in the upper estuary in mid-January 2007 when the water temperature was 9.5 °C and salinity 17.6 psu; at this time cell abundance was 2700 cell ml^{-1} and chlorophyll *a* concentrations exceeded 67 µg L^{-1}. In the upper estuary in February, *H. triquetra* cell densities reached 6000 cell ml^{-1} locally, and chlorophyll *a* 61 µg l^{-1}. In March, counts exceeded 10,000 cell ml^{-1} and chlorophyll *a* was 82 µg L^{-1}.

H. triquetra comprised 100% of the phytoplankton in the upper estuary during the red tide; surface densities there peaked at >19,000 cell ml^{-1} in April (Fig. 2). The highest chlorophyll *a* concentrations (104 µg L^{-1}) and supersaturated DO (20.4 mg L^{-1}) were recorded at this time (Figure 4). The secchi depth decreased to 0.1 m at

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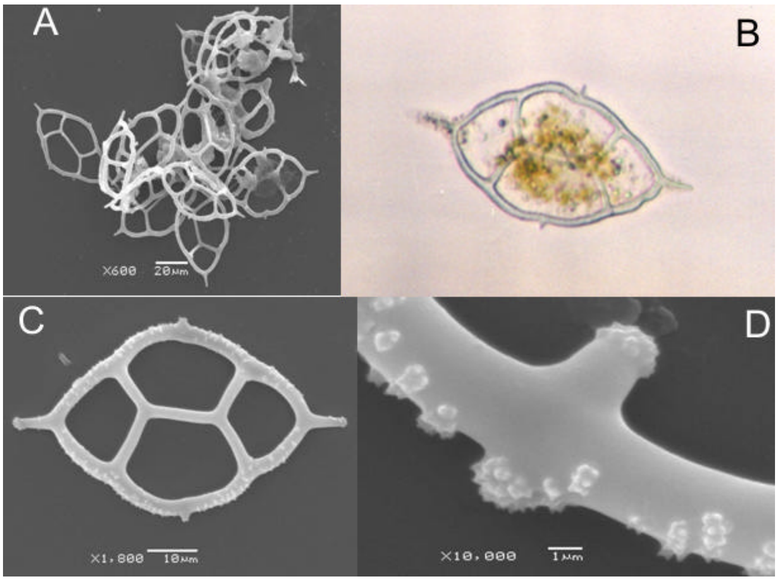

Fig. 3. Dictyocha californica *in Banderas Bay, México. A) Several specimens of the bloom. B) Specimen in vivo. C) Specimen in SEM . D) Detail of small spines.*

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Toxics blooms of *Microcystis aeruginosa* in three the Rio Negro reservoirs, Uruguay

Fig. 1. Map showing the study area with Bonete, Baygorria and Palmar reservoirs.

The Rio Negro is the most important internal river of Uruguay, it is 810 Km long and drains a basin of 69100 km^2 (Fig. 1). Along the river there is a system of three reservoirs constructed for hydropower generation and actually utilized for multiple uses. The main features of Bonete, Baygorria and Palmar reservoirs are shown in table 1.

The main activities at the Rio Negro basin are cattle breading, agriculture and forestation. These human activities can be considered as the main sources of nutrients to water ecosystems. Previous studies at this system revealed the eutrophic status of the reservoirs [1]. They have a dendritic shape with arms where the retention time is higher than in the main body, favouring the development of algal blooms. The cyanobacteria commonly occur in the phytoplankton of lake and reservoirs and sometime develop as blooms, cause deoxygenation, toxins production and nuisance odours [2]. For Uruguay they are reported since 1982 at various ecosystems such as, Salto Grande reservoir in the Uruguay river and in the La Plata river among others [3–6]. The presence of potentially toxic algae in the three reservoirs of the Rio Negro is frequent, especially in the summer months, though not always bloom events are generated, since they depend on particularly environmental and hydrological conditions.

Table 1. Hydrological caracteristics of the reservoirs

Parameter	Bonete	Baygorria	Palmar
Location	32º49'S 56º25'W	32º53' 56º48'W	33º03'S 57º27'W
Constructed (year)	1945	1960	1982
Area (km^2)	1070	100	320
Volume (km^3)	8.80	0.57	2.86
Max. Depth (m)	32	20	15
Residence time (d)	150	3	16

Many species are potential producers of cyanotoxins as (microcystin, saxitoxin, anatoxin, cylindrospermopcin), and constitute a threat to human and animal health.

Fig. 2. Aereal photographyes of Microcystis aeruginosa bloom (Palmar reservoir march 2010).

The main species of cyanobacteria potentially toxic reported in the three study reservoirs belong to the genus *Microcystis* and *Dolichospermum* being *Microcystis aeruginosa* the most common species founded.

This specie is distributed widely, and is the main microcystin producer in lakes [7, 8].

This study was conducted in summer, between december 2009 to march 2010 under the water quality monitoring program of the Rio Negro reservoirs carried out by the Limnology Section, Faculty of Sciences in partnership with the national energy agency (UTE). For this study Bonete, Palmar and Baygorria reservoirs were sampled monthly, in both a sampling station near the dam, and in a constrained arm of the main water body. Water samples for chemical analysis were taken at surface with a Ruttner bottle and kept cold until processing. There were recorded in situ the water temperature, dissolved oxygen, conductivity, pH, Secchi disc depth and the underwater photosynthetically available radiation (PAR), was measured with a Quantum Radiometer (Licor Instruments). Quantitative phytoplankton samples were collected from the surface and from the end of the euphotic zone (1% of subsurface light intensity) through a Ruttner bottle and integrated into a single sample. Quantitative samples were analyzed using the Uthermöhl method. Also qualitative phytoplankton samples were taken with a plankton net (20µm mesh size) for taxonomical identification. Samples for quantitative estimation of microcystin-LR were collected from areas of accumulation of cyanobacterial blooms. The microcystin-LR was

Table 2. Physics and chemicals condition during January 2010 in the three reservoirs

Parameter	Reservoirs					
	Bonete center	**Bonete arm**	**Baygorria center**	**Baygorria arm**	**Palmar center**	**Palmar arm**
Temperature (ºC)	27.3	27.2	28.5	28.6	28.1	28.9
pH	8.52	8.7	8.95	8.88	9.3	9.9
Secchi disc (mts.)	0.9	0.8	0.8	1	0.7	0.6
Kd (m^{-1})	0.35	0.31	0.31	0.43	0.7	0.26
OD ($mg.l^{-1}$)	8.1	8	9	8.7	8.8	9.6
Conductivity (μScm^{-1})	67.9	68.1	73.2	73.1	76.1	83
Ammonium ($\mu g.l^{-1}$)	0	0	0	0	0	0
Nitrate ($\mu g.l^{-1}$)	99.8	95.5	95.5	73.9	95.5	95.5
Nitrogen total ($\mu g.l^{-1}$)	446	392.5	481.7	562	695.9	945.8
Phosphate ($\mu g.l^{-1}$)	52.1	47.4	59.9	50.5	81.8	64.6
Phosphorus total ($\mu g.l^{-1}$)	178.11	164.69	198.24	225.06	202.70	263.07

determined by HPLC.

Dense *Microcystis* blooms were observed from January to March in the three reservoirs (Fig. 2).

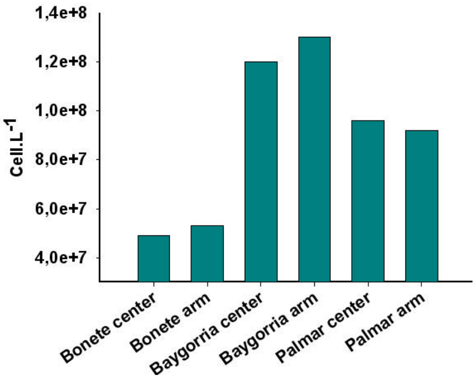

Fig. 3. Abundance (cells L^{-1}) of Microcystis aeruginosa *at six samples station in the Bonete, Baygorria and Palmar reservoirs in January*

Table 3. Microcystin-LR concentration for the 3 reservoirs during January- March 2010 (values, $\mu g.L^{-1}$)

Reservoir	**Microcystin-LR concentartion**		
	January	**February**	**March**
Bonete	294	197	2109
Baygorria	33	No	551
Palmar	34	2662	1478

The highest concentration occurred in January simultaneously in the three reservoirs. Baygorria reservoir showed the highest abundance of *M. aeruginosa* at arm station (1,3 x 10^8 cells.L^{-1}), while the minimum concentration was recorded in Bonete reservoir at the station near the dam (4,9 x 10^7 cells.L^{-1}), (Fig. 3). The environmental conditions recorded during January bloom are shown in (Table 2). The three reservoirs were characterized by high values of water temperature, transparency and nutrients concentration. These environmental conditions were maintained throughout the rest of study period.

While the primary function of dams is hydroelectric power generation they are also used for fishing, swimming and as a water source for animals, humans and irrigation. According to HPLC analysis of microcystin-LR, the three reservoirs showed toxicity during the summer months with an increase towards the end.

Only Baygorria reservoir in February was not toxic. The highest microcystin level was recorded in Palmar reservoir with 2662 mg L^{-1} of extracellular microcystin-LR in February (Table 3).

This study reaffirms the importance of continuous monitoring of water quality, and the importance of studies to determine the causes of *Microcystis* blooms in freshwater ecosystems. In the presence of blooms, extreme care is necessary regarding the uses of water for recreation, for direct consumption by animals or the purification treatment.

Acknowledgements

We appreciate the help of UTE staff. We were partially funded by the state-owned joint venture agreement under the UTE-Faculty of Sciences for the monitoring of the Rio Negro reservoirs.

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Cyanobacteria blooms in freshwater reservoirs of Central Cuba

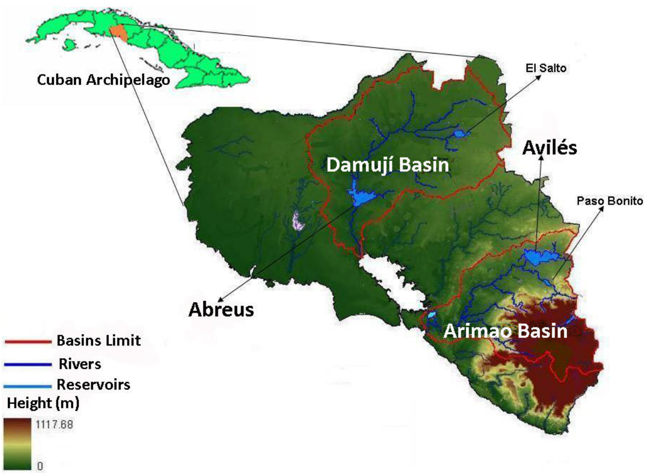


Fig. 1. Map showing Cienfuegos Province and its principal basins and reservoirs.

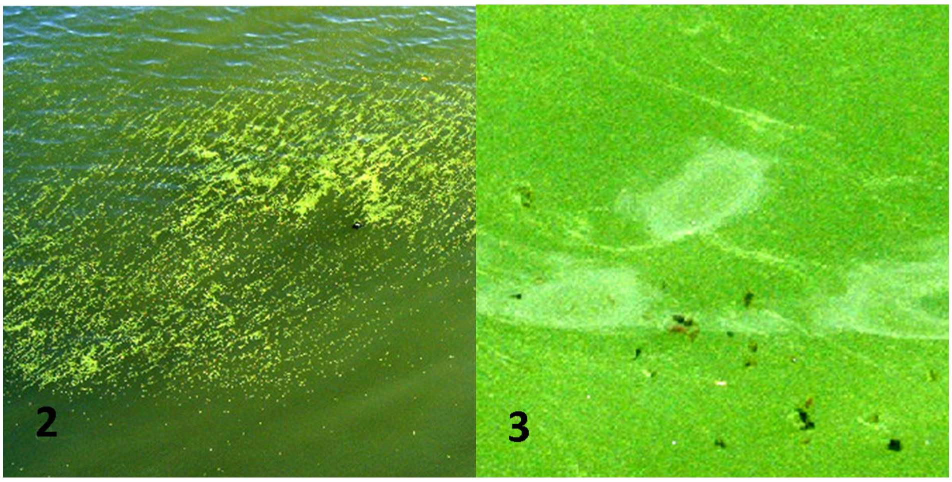
Water blooms were registered in Cuba by Komárek [1] in 16 localities distributed in several provinces, but not in the central part of Cuba. These communities were characterized by cyanobacterial taxa, among them a few *Microcystis* species (*M. aeruginosa* (Kütz.) Kütz, *M. flos-aquae* (Wittr.) Kirchner, *M. comperei* Kom. and *M. wesenbergii* (Kom.) Kom. No toxic events were reported.

Microcystis is morphologically very simple with wide infraspecific variation. Molecular analyses indicate genotype uniformity within this genus, so that species identification is difficult. However, the forms of colonies, cell size, and life cycle are different and characteristic in numerous natural populations and are used for their identification. Their phenotypic taxonomy is even important for investigations of the toxic effect of various *Microcystis* populations and cannot be underestimated.

In March 2009, typical water blooms were detected in two important reservoirs of the Province of Cienfuegos: "Embalse Abreus" and "Embalse Avilés" (Figs. 1-3). Chlorophyll *a* values were 33.52 and 48.92 µg/L respectively. The blooms were composed almost exclusively by two *Microcystis* species: *M. panniformis* Komárek *et al*. 2002 (Abreus), and *M. smithii* Kom. et Anagn. (Avilés) (Fig. 4). No toxic consequences were reported in either event.

M. panniformis forms micro- or macroscopic colonies, mainly irregular, rounded or elongated, but not clathrate, with cells densely aggregated in all the mucilage surface. Hyaline and inconspicuous mucilage does not overlap the cells agglomerations. Cells are 3-5 µm in diameter; cell content brownish green, with aerotopes. The species is common in plankton communities of eutrophic ponds, lakes and reservoirs, frequently forming blooms together with *M. aeruginosa* [2]. *M. panniformis* is frequently mentioned in the literature, especially in tropical freshwater bodies, but probably confused with *M. aeruginosa*, or also called *M. flos-aquae* (*M. aeruginosa* f. *flos-aquae* cited by Komárek [1] could be identical with *M. panniformis*). This species, which was involved in the Caruaru tragedy in Brazil in 1996 [3, 4], produces mycrocystins [5, 6].

The typical *M. smithii* forms colonies which are more or less spherical or slightly irregular, never clathrate, with scattered, rarely densely arranged cells. Cells 3-5 µm in diameter, blue-green, bright blue-green or olive-green, facultatively with one or several brownish aerotopes in each cell. According to Komárek & Anagnostidis [7] the taxon occurs in plankton of freshwater clear lakes. There are no available data about toxicity of this species. The Cuban population differs from the typical species by more irregular colonies, more densely arranged cells in the colonies, and also by its ecology.



Figs. 2-3. Microcystis *blooms in the Abreus (2) and Avilés (3) reservoirs.*

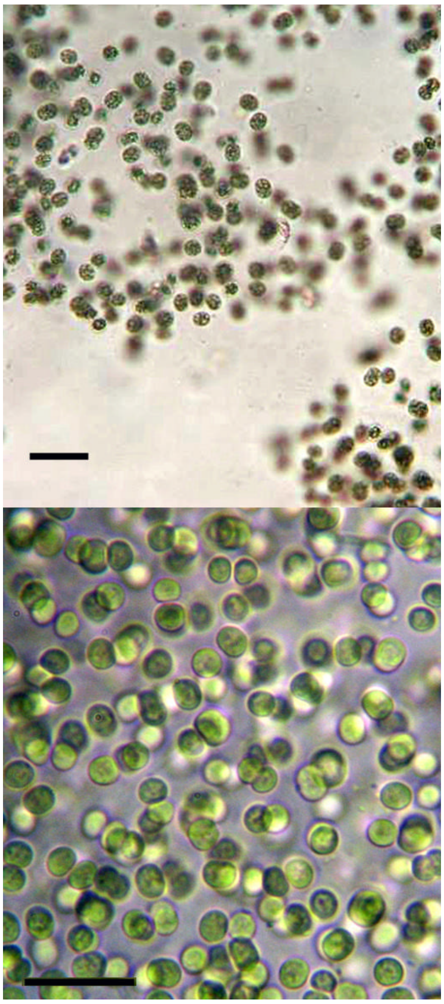


Fig. 4. Microcystis panniformis *above and* M. *cf.* smithii below. *Scales = 10 µm*

(continued from p. 15)

Station H7. High nitrate + nitrite and low phosphate concentrations, and very high TN:TP ratios were found in the lower estuary. Nutrient levels and the TN:TP ratio decreased gradually from the middle to upper estuary. Trophic index (TRIX) values ranged from 6.01 at H1 to 8.17 at H6 when *H. triquetra* cell densities were highest. *H. triquetra* was most abundant at 13.4 °C and 16.6 psu (Fig 3). The increase in DO concentrations from the lower to upper estuary indicated the magnitude of the *H. triquetra* red tide. DO values reached more than 2 x SDO (saturated dissolved oxygen) values (DO=20.4 mg L$^{"1}$, SDO=9.4 mg L$^{"1}$, 217% saturation) in April 2007; surface pH was high (8.5) in the upper estuary at the time of bloom.

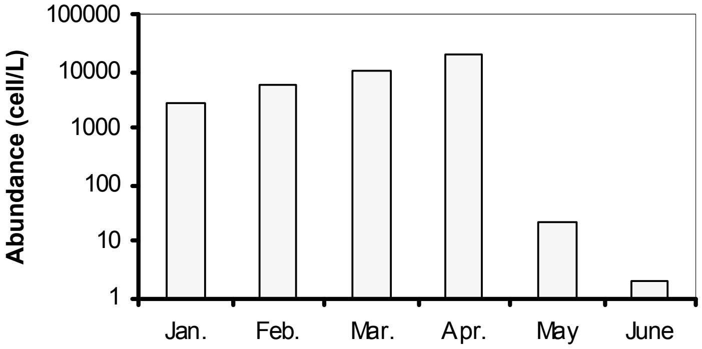


*Fig. 2. Monthly variations of*H. triquetra *abundance during the red tide.*

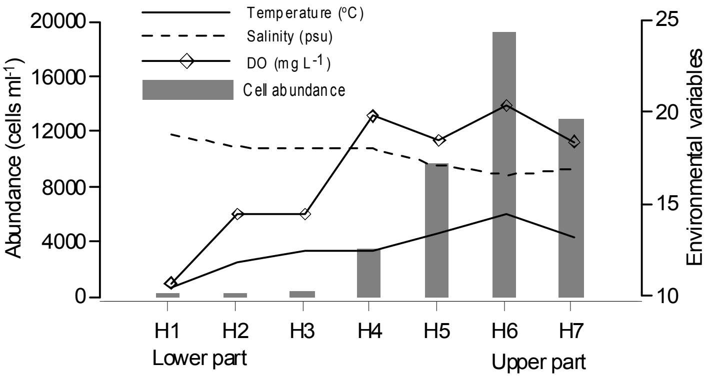


*Fig. 3. Abundance of*H. triquetra *and some environmental variables in April 2007.*

Two streams feed the GHE and cause natural eutrophication [1]. Runoff following rainfall in winter supplies inorganic and organic nutrients critical for phytoplankton growth. A mesohaline frontal zone in the upper estuaty with moderate salinity and the weak circulation created conditions for the *H. triquetra* bloom. Nutrient levels decreased sharply in the upper estuary during the bloom. Despite low inorganic nutrient levels, high TN and TP indicate that organic substances from two the streams influence particularly the upper estuary. *H. tnquetra* is capable of phagotrophy in nitrogen- and phosphorus-depleted media [2]. Thus, *H. triquetra* may feed mixotrophically on organic particles when inorganic nutrients are insufficient for growth. The TRIX values in April, between 6 and 8, indicate a eutrophic state but low water quality. The *H. triquetra* bloom may be a response to increasing eutrophication. Some *Heterocapsa* species may be harmful, but *H.triquetra* is non-toxic [3]. No toxic effects were associated with the *H.triquetra*bloom, but rapid oxygen depletion in the bottom waters, increasing pH, and low light transparancy can have negative effects on water quality.

Acknowledgements

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A dinoflagellate producer of pinnatoxins

A scrippsielloid dinoflagellate has been shown to be the producer of pinnatoxins (Fig. 1), members of the family of toxic cyclic imines [1]. Cells, mainly in the non-motile form (Fig. 2), have been cultured and tested for toxin production by LC-MS and, up to the present time, pinnatoxin-producing cells have been obtained from New Zealand, Australia and Japan. All are maintained in the Cawthron Institute Culture Collection of Micro-algae (CICCM).

The history of pinnatoxin research has been well documented [2-6], including the discovery of pinnatoxins E, F and G in New Zealand and Australia [7]. However, the dinoflagellate that produced these compounds remained unknown until 2008, when it was found as pitted but otherwise unornamented dark brown cysts (30 µm diam.) in surface sediment samples from the far north of New Zealand [1]. A full description of the new genus and species is in review [8].

Samples obtained from South Australia and positive for pinnatoxin (LC-MS) also contained scrippsielloid-like cells. Four cysts were successfully cultured and the toxicity of cell extracts determined [9]. A similar approach was employed with Japanese (Okinawa) samples resulting in two cysts being cultured. The cyst form is the most common in culture and it is relatively easy to produce mass cultures in a 10 litre plastic bag system. Motile cells (24-32 µm x 20-30 µm; Fig. 2) occur both in culture and in the 'wild', but the excystment trigger has not yet been determined and may involve circadian rhythms.

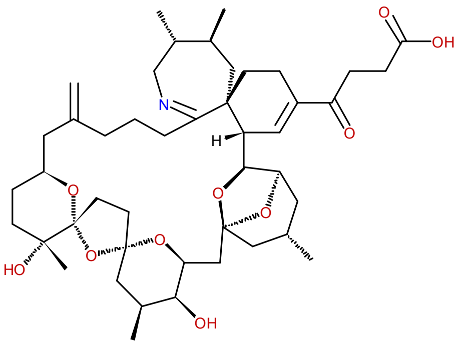

Fig. 1. The chemical structure of pinnatoxin D.

Eleven New Zealand isolates all produced pinnatoxin E and F, although at different concentrations, whereas South Australian isolates produced predominantly pinnatoxin G, with lower concentrations of D and E. One isolate also produced pinnatoxin F. Japanese isolates produced pinnatoxin G only.

Based on LSU rDNA and ITS sequence data, the New Zealand/South Australian isolates were found to be identical, but appear to differ from the two Japanese isolates. Further investigations are being conducted in order to determine whether the Japanese isolates belong to a different species.

The toxicity of extracts of the dinoflagellates to mice is of interest, since the LD_{50} by oral administration is very similar to that achieved by intraperitoneal injection. With other cyclic imines, such as gymnodimine and spirolides, toxicity by oral administration is 10 to 1000-fold lower than that by intraperitoneal injection.

Bioassays to test the effect of the dinoflagellate to invertebrate larvae resulted in the death of sea urchin and abalone larvae, and caused sea slug larvae to become moribund. Pacific oyster larvae were mainly impacted when the dinoflagellate cells were disrupted and Greenshell™ mussel larvae were unaffected.

The pinnatoxins are not regulated and only became a topic of interest in New Zealand and Australia when shellfish extracts killed mice in routine bioassays. However, now that the mouse bioassay has been dropped as a requirement by the European biotoxin regulators the closures enforced on the basis of the mouse bioassay no longer occur. No illnesses have ever been reported in Northland related to the consumption of Pacific oysters from areas regularly associated with pinnatoxin contamination, despite the consumption of shellfish gathered from such areas by locals throughout the last fifteen years.

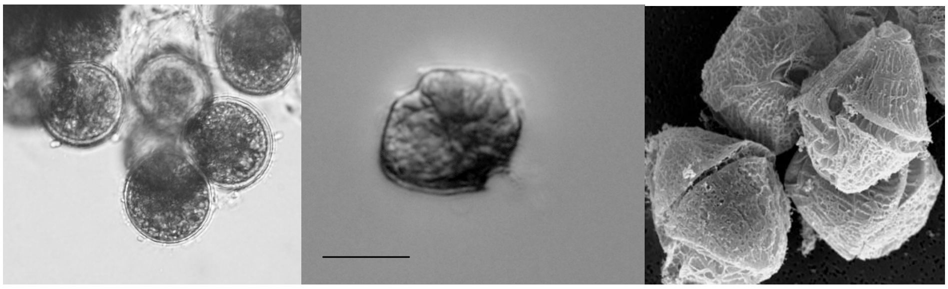

Fig. 2. Light micrographs of cultured non-motile cells (L; 30 µm diam.) and motile cell (centre; bar = 16 µm) of the pinnatoxin E and F-producing dinoflagellate from Rangaunu Harbour, Northland, New Zealand. Scanning electron micrographs (right) of motile cells (approx. 32 x 29 µm).

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A *Microcystis* bloom under the ice

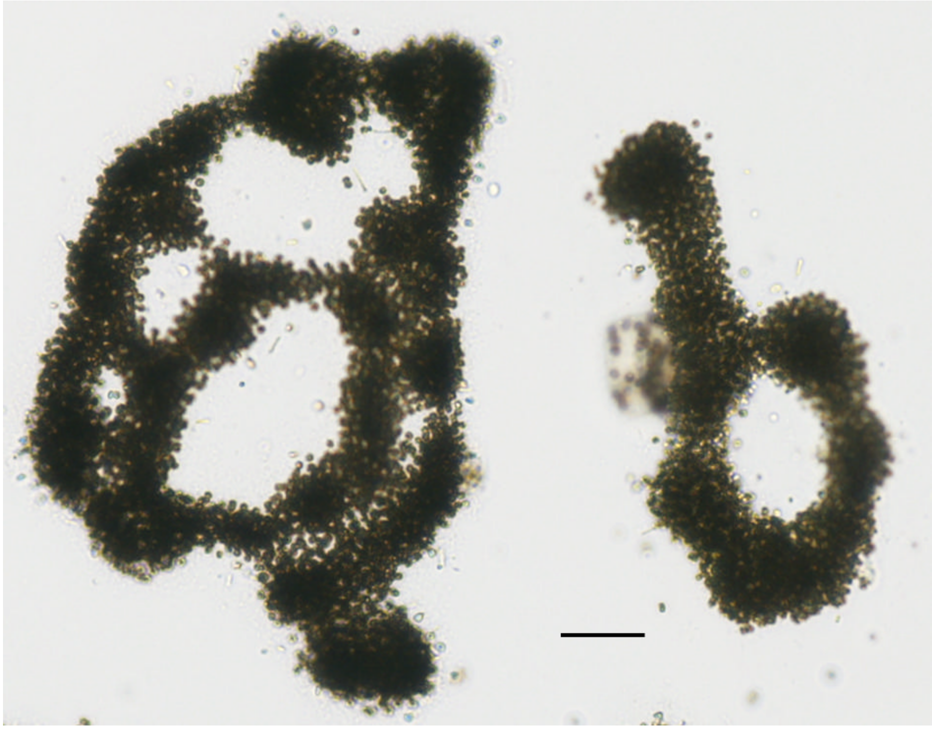

Fig. 1. Light micrograph of Microcystis aeruginosa *colonies collected from the water column of Lake Kastoria. Scale Bar: 50 ìm.*

Microcystis is one of the most common genera dominating the phytoplankton of eutrophic lakes worldwide while *M. aeruginosa* is the best known bloom forming species and a major cause of hepatotoxic blooms [1]. Cyanobacterial blooms are common in eutrophic freshwaters in Greece and cyanobacterial toxin-producing species have been found in all freshwaters studied [2].

Microcystis is known to overwinter on the sediment surface of lakes and re-inoculate the water column in spring from which the epilimnetic population develops in the following summer, as a life strategy [3]. However, it has been also reported that small populations of this cyanobacterium can overwinter as pelagic ones [4] but relevant data are limited [5].

Lake Kastoria is known to host toxic cyanobacterial blooms characterized by high microcystin (MC-LR) concentrations [6]. *Microcystis* morphospecies dominate in the late succesional stage of phytoplankton while during the winter a few colonies were observed on the sediment surface [7]. These morphospecies belong to phylotypes related to the toxin-producing *M. aeruginosa* [8].

A bloom of *Microcystis* morphospecies was recorded under the ice when the air temperature was below zero on 2 January 2009 in the eutrophic Lake Kastoria. During this winter bloom, very large viable colonies of *M. aeruginosa* (Fig. 1) were observed to be attached under the ice (Fig. 2) as well as in the water column. *M. aeruginosa* population density in the water column was high with 585 x 10^6 cells L^{-1} (or 11.7 mg L^{-1}w/w). At the same time, *M. wesenbergii* co-dominated the lake's phytoplankton with a population density of 34 x 10^6 cells L^{-1} (or 1.7 mg L^{-1}w/w). A large number of *Microcystis* single cells were also observed (25 x 10^6 cells L^{-1} or 0.43 mg L^{-1}w/w). Apart from cyanobacteria, cryptophytes were also present in the lake's phytoplankton in lower numbers (2.7 x 10^6 cells L^{-1} or 0.43 mg L^{-1}w/w).

Vasas *et al* [5] reported a large pelagic *Microcystis* (*M. viridis*) population frozen in the ice in a shallow pond near Debrecen, Hungary. Its cells were viable and toxin-producing providing inoculum for a strong toxic water bloom in the following summer. In Lake Kastoria, heavy blooms of *Microcystis* morphospecies were observed both in the summer of 2009 and 2010 (unpublished data).

These results may highlight the importance of the winter growing colonies besides the apparent role of the large sediment populations.

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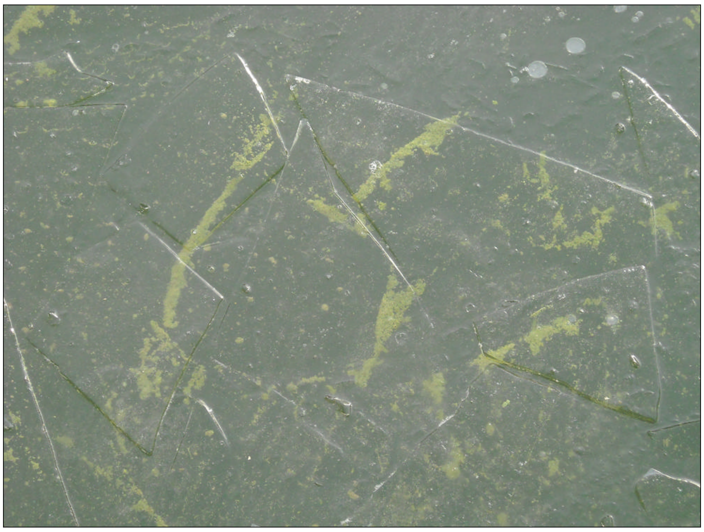

Fig. 2. Microcystis *colonies under the ice of Lake Kastoria.*

ISSHA's Corner

ISSHA
International Society for the Study of Harmful Algae

2010 Yasumoto Awards: Yasuwo Fukuto receives a Takayama carving (a pair of Dinophysis fortii*) with the smiling approval of Prof. Yasumoto (Photo Y. Fukuyo)*

The International Society for the Study of Harmful Algae (ISSHA) convened the 14th International Conference on Harmful Algae (ICHA14), held in Crete (Greece) (1-5 November 2010) and beautifully organized by the *Hellenic Centre for Marine Research* under the coordination of Dr Kalliopi Pagou. At the inauguration ceremony, a few minutes were dedicated to the memory of Patrick Gentien, who passed away last May.

On Thursday 4 November, the Seventh General Assembly of the Society was held. Beatriz Reguera (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: Karin Rengefors (Secretary) presented the new ISSHA website and invited ISSHA members to provide input and criticism; Nina Lundholm (Treasurer) presented the financial statement, covering the period September 2008 to October 2010, and detailed expenditures and funds raised from member's fees, book sales, and the auction; Clarisse Odebrecht (Travel Awards Committee) thanked the Society and the generous sponsors of the ICHA 14 (FAO, NOAA, IAEA, SCOR, UNEP-MAP, Black Sea Commission) for their contributions that allowed financial support to 56 predoctoral students and experts from developing countries and economies in transition to attend the conference. Jennifer Martin (Achievement Awards) summarized the procedure for the elections of Lifetime achievement awards, young scientist award and the Maureen Keller student presentations awards. She announced the decision of the Council to rename the Young Scientist Awards the *Patrick Gentien Young Scientist Awards*.

Don Anderson with the Korean jewellery box won at the ISSHA Auction raffle. (Photo D. Anderson)

Gustaaf Hallegraeff (Committee on Publications and Dissemination) presented new material uploaded to the webpage and plans for the future. The publication of the proceedings from the previous conference (ICHA13, Hong Kong 2008) was announced by Prof. Zhou (coeditor) on behalf of the main editor, Prof. K.C. Ho.

Representatives from Mexico, New Zealand and Turkey presented the bids from their countries to host the ICHA 16 Conference in 2016. The three venues were voted by ISSHA members in the following hours, and for the first time, members who were not able to attend the conference were able to vote online. New Zealand was elected as the venue for the ICHA16. ISSHA acknowledges the three countries which bid for their willingness to undertake the laborious task of organizing ICHA conferences. Prof. H.G. Kim, acoompanied by local authorities from his home town, enthusiastically presented ongoing activities for the organization of ICHA 15, to be held in Korea in autumn 2010.

The General Assembly was followed by the ISSHA Auction (which finished at midnight!). The compilation of donations was organized by Anke Kremp, and once more, the auction was a success thanks to the invaluable help of Barrie Dale. Over 11000 $ were collected, to be used mainly for student travel awards for the next conference. Some very valuable donations, such as the hand-

2010 Yasumoto Awards. Barrie Dale receives a Takayama carving of an Alexandrium tamarense *motile cell and its cyst form. (Photo M. Lion)* made marine tapestry by Esther Garces' mother, and the beautiful mother of pearl and lacquer jewelery boxes donated by the Korean delegates were raffled. The ISSHA gods blessed Barrie by letting him win the tapestry. Don Anderson was the lucky winner of an exquisite Korean jewelery box.

Achievement awards were announced at the conference banquet.

The ***Yasumoto Lifetime Achievement Award* 2010** was given to Profs. **Yasuwo Fukuyo** and **Barrie Dale**. Short biographies of these two inspiring scientists and great communicators can be found at the *HAB Trail Blazers* section on the ISSHA website (www.issha.org).

Yasuwo Fukuyo was the taxonomist behind the breakthrough discoveries of the causative agents of Diarrhetic Shellfish Poisoning and Ciguatera in the late 1970's. He was a driving force in the promotion of HAB Studies in the WESTPAC region, and probably the taxonomist that has best contributed to the popularization of HABs worldwide with his beautiful plates of microalgae taxonomy and the impacts of HAB events. He felt extremely pleased to receive this award, and a massive carving of a dividing pair of *Dinophysis fortii* (from Prof.Takayama), in front of a smiling Prof. Yasumoto, and said he considered himself such a lucky man because he had the privilege of working with him.

Barrie Dale is "The Geologist" of our HAB community, always putting us back into the right perspective. He made key contributions in the field of dinoflagellate cyst biology and ecology, and in the applications of this research to fossil records. His communication skills excelled in his hilarious performances at the 2006, 2008 and 2010 ISSHA auctions. The Society is deeply indebted to him for them. When Barrie received his prize, and a beautiful carving of an *Alexandrium tamarense* vegetative cell and cyst, he expressed with emotion his view that the greatest thing a scientist can receive is the recognition of his colleagues.

Over 90 PhD students participated in the contest for student presentation awards. Awards for the best oral presentations were given to **Jillian Johnson** (*Global analysis of growth phase-associated transcriptomes in the toxic dinoflagellate, Karenia brevis)* from NOAA (South Carolina, USA) and **Lasse Tor Nielsen** (*Coastal plankton communities appear resilient to year 2100 CO2 and pH changes: evidence from microcosm studies*) from the Marine Biological Laboratory in Helsingor (Denmark). Awards for best posters were given to **Victoria Hewlett** (*A comparison of nutrient effect on haemolytic activity produced by two fish killing species: Gymnodinium mikimotoi and Heterosigma akashiwo*) from the University of Western Ontario (Canada) and to **Heidi Hällfors** (*The Baltic Sea phytoplankton community at the beginning and end of the 20th century–a comparison of historical and modern species data*) from the Finnish Environmental Institute.

2010 Maureen Keller student Awarsd: Top left, Jillian Johnson (Best oral); top right, Lasse Tor Nielsen (second best oral); bottom left, Victoria Hewlett (best poster); bottom right, Heidi Hällfors (second best poster). (Photos by M. Lion)

A beautiful carving of *Alexandrium minutum*, made by Prof. Takayama, was given by the Society to Dr Kalliopi Pagou (Popi) in recognition of the tremendous amount of work she invested to make ICHA 14 a success.

B. Reguera, ISSHA President.
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Future events

APRIL 2011

I ICOD - Ist International Conference on *Ostreopsis* Development

6-8 April 2011, Villefranche-sur-Mer, France

ICOD aims to bring together and synthesize knowledge on ecological, chemical and toxicological aspects of *Ostreopsis* species and the different methods of ecological, economic and public health management of the problem. The meeting will promote exchange between scientists, policy makers and managers of Mediterranean and other temperate countries, in order to optimize the knowledge transfer and reduce the risks linked to *Ostreopsis* development.

More info at: www.obs-vlfr.fr/ICOD.

IPHAB-X 10th Session of the IOC Intergovernmental Panel on Harmful Algal Blooms

12-14 April 2011, Paris, France

IPHAB aims to improve the managerial, scientific and financial resources available for implementation of a global HAB Programme. A primary task is still to identify the required resources, so that we, the international community jointly, can continue to implement activities addressing capacity building, international cooperative research, and communication networks.

More info at: ioc-unesco.org/hab/

MAY 2011

Marine and Freshwater Toxins Analysis - 2nd Joint Symposium and AOAC Task Force Meeting

1-5 May 2011, Baiona, Spain

The symposium will address new developments and methods for the analysis of marine and freshwater toxins, as a joint meeting with the AOAC Task Force on Marine and Freshwater Toxins. Presentations and discussions will deal with needs for detecting STXs, DAs, OAs, AZPs and other seafood toxins, as well as cyanobacterial toxins. In spite of recent progress, many methodological needs remain, ranging from emerging toxins to the ongoing replacement of mouse bioassays with modern and fully validated chemical methods.

Deadline for Abstract submission: 15 February.

For further information please contact: biotoxins.meeting@uvigo.es

JUNE 2011

1st International Conference on "The Molecular Life of Diatoms"

5-9 June 2011, Atlanta, USA

This conference aims to bring together a cross-disciplinary research community that is dedicated to studying the molecular foundations of all aspects of diatom biology and technology

Please register on the website as early as possible to take advantage of the reduced "early birds" registration fee. The deadline for abstract submission is February 28th.

More info at: www.lifeofdiatoms.org

8 ICMSS - 8th International Conference on Molluscan Shellfish Safety

12-17 June 2011, Charlottetown, Prince Edward Island, Canada.

Experts from around the world will discuss the latest scientific advances and their impact on molluscan shellfish safety.

Deadline for abstracts submission: February 7. Early Bird Registration: March 31.

More info at: www.gov.pe.ca/icmss2011/

XII Course COI-AECID-IEO: Monitoring programs for biotoxins according to European regulations

June, Vigo, Spain

The course will be held at the Centro Oceanográfico de Vigo (IEO) in June 2011 (Tentative dates: 8-24). It is organised by the "IOC-IEO Science and Communication Centre on Harmful Algae" and has been designed for Latin American and African university graduates having experience in the analysis of marine biotoxins, which are responsible for starting the regional or national monitoring programs or for strengthening the existing ones.

The language of the course is Spanish.

Further info: vigohab@vi.ieo.es

AUGUST 2011

IOC Identification Qualification in Harmful Marine Microalgae

August, Copenhagen, Denmark

The course will be held at the University of Copenhagen organised by the IOC Science and Communication Centre on Harmful Algae.

The course has two components: a short mandatory preparatory theoretical part provided over the Internet in June followed by a practical laboratory course.

Dates:

Mandatory E-learning part: Over 4-5 weeks in the period May-July.

Practical course at Univ.Copenhagen. Tentative dates: 15-25 August 2011. Optional extension on enumeration techniques from 26-27 August.

Course open for applications.

More info at: ioc-unesco.org/hab/

Harmful Algae News

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