

2007 Harmful Algal Bloom Section annual workshop events

by Charles G. Trick

Background

The workshop was the third of an annual series of workshops organized by the PICES Section on *Ecology of harmful algal blooms in the North Pacific* to document the existing knowledge on the eco-physiology of harmful algal bloom species (HABs) that impact all, or most, countries in the North Pacific. The series began in 2005 at PICES XIV (Vladivostok, Russia) with *Pseudo-nitzschia* and *Alexandrium*, and then continued in 2006 at PICES XV (Yokohama, Japan) with *Dinophysis* and *Cochlodinium*. In 2007 at PICES XVI (Victoria, Canada), we reviewed the abundance, distribution and harmful ecological affects of *Heterosigma*, *Chattonella* and other raphidophytes. *Heterosigma* is the representative species of marine flagellates that are associated with extensive fin-fish losses after local or regional blooms. This genus is cosmopolitan and represents a problem in many of the PICES countries, and its occurrence results in a significant loss to coastal aquaculture facilities. Topics included detection methods for each species and toxic activities, ecosystem comparisons, and new advancements in physiology and ecology from each of the PICES member countries. In particular, we stressed those factors that need additional study in order to develop a predictive capacity for these HABs. The workshop was held at the Victoria Conference Centre and included a half-day laboratory demonstration on classical and automated methods of detection (October 26), and a one-day scientific session (October 27).

Laboratory demonstration

The demonstration was organized by Drs. Charles Trick (University of Western Ontario, Canada) and Vera Trainer (Northwest Fisheries Science Center, U.S.A.), and was well attended by 28 participants from Canada, China, Denmark, Japan, Korea, Philippines, Russia, Spain, and U.S.A.

The first demonstration, “*Using DNA probes to determine raphidophyte taxonomy*”, was conducted by Roman Marin (Monterey Bay Aquarium Research Institute, U.S.A.). He illustrated the importance of this sandwich hybridization technique in the quantification of raphidophyte species in natural waters, and provided both detailed theory and a precise and complete demonstration of the methodology. We challenged his procedures with two unknown samples from Spain, which were confirmed to be *Heterosigma*.

In the second demonstration, “*Microscopic observations and detailed analysis of raphidophyte taxonomy*”, Dr. Carmelo Tomas (University of North Carolina–Wilmington, U.S.A.) presented the audience with a detailed and effective microscopic survey of all the raphidophytes. He educated each of us on the fine details of taxonomic

differentiation and provided a theoretical analysis of the taxonomic position of the raphidophytes within the Kingdom Protist. We were given practical assistance through Louise Tieman of Saigene Corporation (Gig Harbor, WA, U.S.A.) and excellent microscopes through Dennis Tanji of Tanji Consultants (Sammamish, WA, U.S.A.).



Dr. Carmelo Tomas preparing materials for the practical laboratory demonstration on harmful raphidophytes.

The two demonstrations illustrated that there is a balanced need between the automated sandwich hybridization techniques and the experienced microscopy. It is very easy to misidentify the different species and genera within the raphidophytes given that some of the characters that we commonly rely on, such as number of chloroplasts, are variable within a species and certainly among genera. Misidentification at the early stages of a study may result in molecular probes being created that are not clearly associated with the desired HAB species.

Scientific session

The scientific session was convened by Drs. Charles Trick and Ichiro Imai (Kyoto University, Japan). There were more than 30 scientists in attendance from 9 nations (Canada, China, Denmark, Japan, Korea, Philippines, Russia, Spain, and U.S.A.). Three experts were invited: Drs. Ichiro Imai, Tatsuya Oda (Nagasaki University, Japan) and Carmelo Tomas (U.S.A.). Traveling expenses for these invited speakers were provided by PICES and the Fisheries Research Agency of Japan.

Dr. Tomas gave an in depth and detailed presentation, “*The Raphidophyceae: Enigmas in taxonomy, identification and morphology*”, that outlined the taxonomic position of both *Chattonella* and *Heterosigma* with regard to the general group of raphidophytes and illustrated the complex position these genera have among other, presumably unrelated,



Some participants of the 2007 HAB annual workshop at PICES XVI (Victoria, Canada, October 2007).

protist taxa. One conclusion is that while raphidophytes have common physical, photosynthetic and toxicological characteristics, which we exploit in our microscope observations, they do not comprise a monophyletic group and thus, have nucleic acid sequences more similar to other marine phytoplankton. This knowledge has little impact on our monitoring programs but does influence strategies for the creation of molecular probes. It also implies that the toxicological attributes aligned to these raphidophytes may be expressed in non-raphidophytes as well.

In his talk on “*Life cycle strategies and occurrences of red tides of Heterosigma akashiwo and Chattonella spp. in temperate coastal sea*”, Dr. Ichiro Imai carefully outlined the maintenance and inter-annual variation of established populations of *Heterosigma* and *Chattonella* in coastal waters of Japan. His presentation indicated the importance of the different life stages of these raphidophyte species. Cysts and resting cells are essential components of maintaining a bloom in a region, and indicate that once blooms occur locally, the sediment phase cells of the life cycle may ensure a long-term repetition of these blooms.

In his presentation entitled “*Generation of ROS (reactive oxygen species) by Chattonella marina as a possible factor responsible for the fish-killing mechanism*”, Dr. Tatsuya Oda gave a greatly detailed analysis of the environmental factors that influence reactive oxygen species production in *Chattonella*. Through the use of published and recent research, he made a strong case concerning the important role that ROS has on the toxicological attributes of the fish-killing raphidophytes (*Heterosigma* and *Chattonella*). He provided some brilliant experiments to illustrate the

important role that the extracellular matrix (glycocalyx) plays on the expression of toxicity.

The invited presentations generated considerable discussion focused on two major themes: (1) What are the common factors that limit the distribution and toxicity of these two genera in PICES countries? and (2) What is the actual mechanism of fish kill?

The invited lectures were complemented by a series of presentations concerning these genera in individual PICES countries. Dr. Jack Rensel (U.S.A.) reviewed the local dynamics of *Heterosigma* in Puget Sound and associated waters. His perspective was unique and valuable since he has a close working association with local aquaculture industries that are directly influenced by *Heterosigma*. Bloom dynamics in PICES countries with distinct historical *Heterosigma* populations were reviewed by Dr. Hakgyoon Kim (Korea), Dr. Takashi Kamiyama (Japan), Dr. Jinhui Wang (China) and Julian Herndon and Roman Marin (U.S.A.). These talks illustrated the common features of a bloom. Dr. Charles Trick, Desmond Johns (U.S.A.) and William Bjornsson (Canada) reviewed their work on laboratory-based studies on toxicity and other unique metabolites that may provide an ecological advantage for the producing species.

The next workshop of this series will be held in October 2008 at PICES XVII in Dalian, China, and will focus on *Karenia* and *Prorocentrum*. The workshop will be co-convoked by Drs. Ming-Yuan Zhu (China) and Vera Trainer (U.S.A.), and will have the same format as the previous workshops.



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