

REPORT OF MARINE ENVIRONMENTAL QUALITY COMMITTEE

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The meeting of the Marine Environmental Quality Committee was held from 1330-1730 hours on October 10, 2001. The Chairman, Dr. John E. Stein, called the meeting to order and welcomed the participants (*MEQ Endnote 1*). The Committee reviewed the draft agenda and it was adopted after revision (*MEQ Endnote 2*).

Practical Workshop Data Report (Agenda Item 2)

The Vancouver Harbour Practical Workshop Data Report was published this year as PICES Scientific Report No. 16. In the near future the report will also be available on the PICES web site.

Special issue in *Marine Environmental Research* – status report (Agenda Item 3)

Dr. Richard F. Addison summarized the publication status of the Vancouver Harbour Practical Workshop proceedings. A special issue of *Marine Environmental Research* will contain seven technical papers based on the results of the workshop. In addition, there will be an introductory paper which “sets the scene” for the workshop, and an overview paper which synthesizes the general workshop results. All papers except the overview had been received; four of the technical papers had been sent out for refereeing, and the remaining three will be sent out in early November 2001. Revised manuscripts, which have addressed referees’ comments, should be in Dr. Addison’s hands by mid-January 2002, so that a final package ready for production can be sent to the journal before the end of January. There was some discussion about the “overview” paper, and Dr. Michael Watson, who had been involved with the planning of the workshop but had not participated directly in the data collection and analysis, and was therefore well placed to step back and take a broad overview of the results, agreed to lead the writing of this paper. Dr.

Watson will invite Profs. Makoto Shimizu and Ming-Jiang Zhou to collaborate in preparing this overview.

Sessions at future Annual Meetings (Agenda Item 6)

The Committee recommended convening two half-day MEQ Topic Sessions and one half-day MEQ Paper Session at the PICES Eleventh Annual Meeting in Qingdao¹:

Advances in HAB monitoring and mitigation. Conveners: Tian Yan (China) and Vera Trainer (U.S.A.)

Effect of environmental changes on harmful algal bloom events. Conveners: Edward Black (Canada) and Ming-Jiang Zhou (China)

MEQ Paper Session. Convener: John E. Stein (U.S.A.)

Contributed papers for the MEQ Paper Session are encouraged to address scientific and technological advances in the assessment of marine environmental quality. Areas of interest are in new techniques to measure levels, transport and effects of chemical contaminants; approaches to environmentally sound mariculture, and development of science based criteria for protection of marine ecosystems (e.g., criteria for contaminated sediments, thresholds for biological effects, etc.).

The following possible themes for future PICES meetings were considered:

1. Ecological interactions between mariculture and indigenous species and habitat.

¹ After the Annual Meeting, PICES learned of a conflict between the dates proposed for PICES XI (October 18-25, 2002) and those of a Tenth International Harmful Algal Blooms meeting in Florida. This required some adjustment to activities planned by MEQ in Qingdao.

2. Emerging chemicals of concern: What is the risk of biological effects?
3. Sentinel species of marine environmental quality in the North Pacific.

Progress report of WG 15 on *Ecology of harmful algal blooms in the North Pacific* (Agenda Item 4)

The WG 15 progress report was presented by Dr. Vera L. Trainer (see *MEQ Endnote 3* for details). Recommendations to MEQ are as follows:

1. More interaction and collaboration between adjacent/contiguous countries is desired. For example, *Pseudo-nitzschia* and *Heterosigma* projects between the United States and Canada could be encouraged by PICES.
2. Monitoring of both shellfish and plankton is desired by all countries. There are serious limitations and problems in comparison among countries when only a single sentinel shellfish species is used for monitoring.
3. Information needs are identified, especially from Russia, the northern B.C. coast, and northern Alaska. Monitoring projects are required in these areas that are generally lacking in HAB data.
4. Mexico should be included in the database project and has expressed a desire to do so.
5. There is the need for a basic taxonomy class, especially for young U.S. and Canadian scientists (there are taxonomy classes that are offered, but these are focused towards scientists from 3rd world countries). This basic taxonomy class could be sponsored by ICES and/or PICES (perhaps jointly).
6. Convene a 2-day workshop on *Development of common standards for HAB data* prior to PICES XI. A possibility to conduct this workshop jointly with TCODE should be pursued.

Science Board issues (Agenda Item 7)

North Pacific Ecosystem Status Report

MEQ reviewed recommendations of the Study Group on *North Pacific Ecosystem Status Report*

and *Regional Analysis Center* (*SB Endnote 7*) and supported the development of the North Pacific Ecosystem Status Report. However, the lack of Committee members from the western Pacific limited discussion of this topic.

Annual Meeting theme at PICES XII

MEQ endorsed the proposed theme of *Human dimensions of ecosystem variability* (*SB Endnote 10*).

Symposium on North Pacific transitional areas

The MEQ supports holding this symposium (*SB Endnote 6*), however, participation by MEQ members is unlikely.

Documenting PICES science

MEQ had a lengthy discussion of this proposal (*SB Endnote 11*). It was endorsed with the following considerations. Several members did not see the value in documenting the discussions from Contributed Paper Sessions, because these sessions do not have a coherent scientific theme. However, it was agreed that there is value to PICES and to the respective Committee in documenting the content, discussions and recommendations that arise from sessions that have focused scientific themes.

Requests for funding

1. WG 15 requests the publication of their report in the PICES Scientific Report Series. The report will include an introduction (background), national reports on HAB events in the PICES region (these will detail types of HAB events, seasonality, earliest dates recorded, highest toxin levels, general environmental information, comprehensive literature, causative organisms, bloom reports with maps, unanswered questions, and research and monitoring needs), summary, and appendices (images, scanning electron micrographs, and maps).
2. Travel support for two scientists to attend a workshop (2 days) on *Development of common standards for HAB data* to be held prior to PICES XI. The participants are Ms. Michelle Tomlinson (U.S.A.), who is crucial to database development, and Dr. Tatiana Orlova (Russia), Co-Chairman of WG 15.

Relations with other organizations, programs and projects (Agenda Item 8)

ICES: An issue of high priority to the MEQ is the interaction of mariculture operations with local ecosystems. The Committee will seek to build a stronger relationship with ICES through its Working Group on *Environmental interactions of aquaculture*. This will be pursued through Dr Edward Black (Canada) who is currently the Chairman of the ICES Working Group.

GEOHAB: Dr. Max Taylor, Co-Chairman of WG 15, will attend the upcoming Canadian GEOHAB meeting and will represent interests of MEQ and WG 15 at this meeting.

APEC: There was a strong interest among Committee members to identify avenues for interaction of MEQ with various APEC Committees. An area of interest to MEQ is in training a new generation of systematists for identification of harmful algal species. Internationally there is great concern that we will lose this scientific expertise, which would severely impact our ability to investigate HAB events.

GOOS: There is interest in pursuing a relationship with the Health of The Oceans (HOTO) component of GOOS. However, presently the Committee is putting a higher priority on establishing relationships with GEOHAB and APEC.

MEQ Strategic Plan (Agenda Item 9)

Because of the low attendance by Committee members at this year's meeting, it was agreed that an update of the MEQ Strategic Plan (*MEQ Endnote 4*) would be postponed. The Committee will consider reviewing and revising the plan inter-sessionally.

Report on MEQ Scientific Sessions at PICES IX (Agenda Item 12)

Sediment contamination - the science behind remediation standards (MEQ Topic Session, S6). Convenors: Steve C. Samis (Canada) and Dong-Boem Yang (Korea).

Scientific criteria for the regulatory management of contaminated aquatic sediments are being developed in various jurisdictions around the North Pacific. Approaches to criteria setting for sediment quality evaluation and protection vary based on the legislative regime, the contamination history of regions, aquatic life at risk, human use of fish and economic factors. A number of other factors need to be defined, such as: appropriate thresholds for triggering remedial actions, dealing with mixtures of contaminants while using numeric criteria, definition of baseline or background conditions, importance of bioavailability, inter-calibration of bioassay test organisms and the use of risk assessment in lieu of numeric sediment criteria. Risk assessment is driven in part by socio-economic factors, but from a scientific perspective, contaminants that cause endocrine disruption in fish or that bioaccumulate in tissues will also drive regulatory decision making. From an ecological standpoint no observable effects in receptor biota is a reference point that can be implemented through the regulatory application of the lowest observable response level in carefully selected species. These and other factors will form the crux of a debate that this session and others that follow will need to foster.

Co-convenor Dong-Boem Yang (Korea) and presenters Peter Grevatt (U.S.A.), Ming-Jiang Zhou (China) and Mike Macfarlane (Canada) were unable to attend the meeting this year. Notwithstanding, a new presenter, Lee Nikl (Canada) accepted the challenge and filled a major gap in the program.

List of authors and titles of presented papers:

1. Peter M. Chapman (Canada). The Utility and use of Sediment Quality Values (SQVs).

2. James Meador (U.S.A.). Tissue and sediment concentrations of TBT and PCBs to protect juvenile salmonids under the *Endangered Species Act*.
3. Lee Nikl (Canada). History of contaminated sediment management in Canada's Pacific Region.
4. Vladimir M. Shulkin (Russia). Metal concentrations in mussels and oysters in relation to contamination of ambient sediments.
5. Evgueni Shumilin (Mexico). Heavy metals and metalloids from mining operations in coastal marine sediments of the peninsula of Baja California.
6. Doug Spry (Canada). Canadian sediment quality assessment tools.
7. Galina V. Moiseychenko (Russia). Heavy metals environmental contamination while offshore oil and gas deposits development. (poster)
8. Galina V. Moiseychenko (Russia). The contents of radionuclides in offshore bottom sediments of northeast Sakhalin in the area of oil and gas deposits. (poster)
9. Galina V. Moiseychenko (Russia). Methodical aspects and evaluation of bottom sediments contamination level. (poster)
10. Tatiana Konovalova (Russia). Results of environmental monitoring of the Piltun-Astokhskoye oil and gas field (northeast shelf of Sakhalin Island). (poster)

Common themes running through the oral presentations and brought out in the free-flowing discussion period were as follows:

- Clean up goals (e.g., restore ecosystem services) need to be enunciated in advance for each project.
- Numeric chemical criteria are not stand-alone tools. They are only one part of the arsenal.
- Biological criteria also may not stand alone – they do not necessarily show the cause of the impacts.
- Biological criteria need to be based on relevant species.
- One size does not fit all when it comes to clean up criteria.

- Focused international (e.g., Canada-US) workshops on the matter of regulatory clean-up criteria for aquatic sediments need to be held soon.

Physical oceanography to societal evaluation: Assessing the factors affecting coastal environments (MEQ Topic Session, S7).
 Convenors: Julia K. Parrish and John E. Stein (U.S.A.).

Ten papers were presented during this session that ranged from the physical oceanography of the coastal ocean off of Washington and Oregon, U.S.A., to the status of the human residents living near coastal estuaries. This was the first session at PICES to explicitly consider how humans respond to ecosystem variation; as such this session is an introduction to the proposed theme of PICES XII - *Human dimension of ecosystem variability*.

The introductory paper (J. Parrish) set the stage for subsequent papers by introducing the objectives of the overall project, and provided an overview of an approach for developing a set of indicators of estuarine structure and function that are science-based but also can be easily understood by the general public. The subsequent papers presented the science that will underpin the development of the indicators, and that are establishing a mechanistic basis for the selection of indicators. New findings on the physical oceanography of the coastal ecosystem in the study area show that ocean processes influence estuaries in a way that is markedly different from conventional wisdom (B. Hickey). Several papers demonstrated how biota are responding to ocean features and to intrusions of the Columbia River plume into coastal estuaries. Changes in the distribution and productivity of plankton, bivalves, crustaceans, and fish were presented (G. Swartzman, C. Roegner, J. Ruesnik, D. Armstrong). A new model was also presented that links oceanic environmental variables to returns of adult hatchery coho through a generalized additive model (E. Logerwell). The model was robust and was able to explain a substantial amount of the variability in the Oregon Production Index time-series, thus

providing support to the underlying conceptual model where survival during the first winter in the ocean is a critical period affecting recruitment.

The following presenter showed that in Pacific Northwest estuaries marshes and seagrasses, are key habitat features for many marine species. Retrospective studies demonstrated that in estuaries along the coast there have been significant changes in seagrass distribution and abundance. However, there is also significant inter-annual variation in densities of seagrasses, although the mechanisms for this variation remain to be fully elucidated (R. Thom).

The final two presentations discussed the human component of coastal ecosystems. Data has been collected to assess the economic status of several communities, the public's perception of the major ecological threats and what ecosystem components humans most value (D. Huppert). This information in conjunction with US Census data is being used to develop a times series of changes in socio-economic conditions of several communities. In addition, survey data are being collected from resource managers to better understand how scientific information can be used in environmental management (T. Leschine). This is important information in selecting environmental indicators that have the greatest potential to influence decision-making in natural resource management.

Emerging issues for MEQ: A ten-year perspective (MEQ Topic Session, S8).
Convenors: Richard F. Addison (Canada) and Ming-Jiang Zhou (China).

This session contained nine papers, six of which were invited. One invited paper (M.-J. Zhou) was withdrawn late in the planning process, and a former MEQ member Dr. Lee Harding, presented a paper in its place entitled "Threats to the marine environment from sea-based activities in Canada". Drs. M.Y. Zhu and R. Li were also unable to attend and their paper was presented by their colleague Mr. Shang Chen.

The papers covered a range of topics. It was obvious from the invited introductory paper (R.

W. Macdonald) and from later papers by M.Y. Zhu and R. Li, by S. Bertold and A. van Roodselaar, and by P.S. Ross, that our approaches to defining and assessing the impact of marine pollution go much further than simply recording chemical contaminants; various biological assessments are becoming increasingly important and may even be considered in regulatory processes. Chemical pollution is, of course, by no means the only "stress" on marine systems and even apparently "environmentally friendly" activities like eco-tourism may present threats to ecosystem stability that are difficult to quantify and assess (L. Harding). Even though "classical" chemical pollutants like PCBs have been controlled (and their environmental concentrations may be falling) hitherto unrecognized chemicals, such as polybrominated diphenyl ether flame-retardants, are actually increasing in concentration in various environmental reservoirs. (M. Ikonomou). Concentrations of persistent organic pollutants ("POPs") are high enough in some high trophic level biota such as mammals and birds to cause measurable deleterious effects (J. Elliott, P. Ross). Processes of contaminant transport continue to be of concern and trans-Pacific transport of dust and other particulate material may be a vector for wide distribution of POPs and other particle-associated chemicals (D. Jaffe). Modeling of chemical distribution from point source discharges (e.g., offshore drilling operations) continues to be developed as a predictive tool (I. Kochergin).

Physical, chemical and biological interactions during harmful algal blooms (MEQ/BIO/POC Topic Session, S9).
Convenors: Hak-Gyoon Kim (Korea), F.J.R. (Max) Taylor (Canada) and Vera L. Trainer (U.S.A.)

Dr. Kim was unable to attend the session because he needed to be present at an emergency harmful algal bloom (*Cochlodinium* bloom) in his country. He sent his regrets.

The following papers were presented:

1. Barbara M. Hickey (U.S.A.). Biological/physical connections of harmful algal blooms in the eastern Pacific Ocean. (invited)

2. Hee-Dong Jeong (Korea). The prediction and movement of the harmful algal blooms in Korean waters. (invited)
3. Adrian Marchetti (Canada). Evidence of toxin production by the oceanic diatom, *Pseudo-nitzschia* during Fe stimulated growth in an HNLC region.
4. Juliette Fauchot (Canada). Study of *Alexandrium tamarense* bloom dynamics in the St. Lawrence Estuary (Canada): A modeling approach.
5. Shang Chen (China). Study on the HAB biological model in China.
6. Mark Wells (U.S.A.). Iron regulation of domoic acid production by toxigenic *Pseudo-nitzschia* spp.

A common thread through several of the talks was the influence of nutrients, both macro and micro, on the development of harmful algal blooms (HABs), especially blooms of toxic *Pseudo-nitzschia*. There is a strong interest in understanding the role of iron on the initiation and proliferation of these blooms. It is currently believed that domoic acid (the toxin produced by *Pseudo-nitzschia* species) acts as a chelator, much like bacterial siderophores. The role of domoic acid as an iron chelator is currently being researched in the laboratory using cultured phytoplankton (Wells), and with *in situ* samples in shipboard studies (Marchetti). Another common subject of several talks in the session was the development of models describing HAB development and delivery to coastal regions. Fauchot (Canada) and Cheng (China) presented

their work on development of HAB models in their respective countries using retrospective data from shellfish and phytoplankton monitoring efforts. Both Hickey (US) and Jeong (Korea) focused their presentations on the physical oceanographic conditions that advect HABs to coastal regions, but also described their initial work on model development using data from cruises and coastal monitoring.

Best Presentation Award

Dr. Watson agreed to assess the presentations and recommended that the MEQ Best Presentation Award be given to Mr. Adrian Marchetti (Canada) for presentation of the paper entitled “Evidence of toxin production by the oceanic diatom *Pseudo-nitzschia* during iron stimulated growth during iron stimulated growth in an HNLC region”. His co-authors were: Paul J. Harrison and Vera L. Trainer. The Committee accepted this recommendation.

Other matters (Agenda Item 10)

The Chairman noted that this meeting would be the last meeting for Dr. Richard Addison as a Canadian member of MEQ. Members acknowledged Dr. Addison’s significant role in MEQ since PICES II in guiding the Committee’s activities as a previous Chairman of MEQ, and as key member in organizing and executing the Vancouver Harbour Practical Workshop.

MEQ Endnote 1

Participation List

Members:

Richard F. Addison (Canada)
 Hideaki Nakata (Japan)
 Steve C. Samis (Canada)
 John E. Stein (U.S.A., Chairman)
 C. Michael Watson (U.S.A.)

Observers:

Sam Geum Lee (Korea)
 Won Chan Lee (Korea)
 Lee Harding, (Canada)
 Vera L. Trainer (U.S.A., WG 15)
 Igor Kochergin (Russia)
 Evgueni Shumilin (Mexico)

MEQ Endnote 2

MEQ Meeting Agenda

1. Opening, introduction of members, and adoption of the agenda
2. Practical Workshop Data Report
3. Status report on publication of Practical Workshop papers in *Marine Environmental Research*
4. Progress report by WG 15 on *Ecology of harmful algal blooms in the North Pacific*
5. MEQ scientific sessions at PICES X
6. Topics for MEQ scientific sessions at PICES XI
7. Science Board issues and proposal on documenting PICES science
8. Relations with other organizations, programs and projects
9. MEQ Strategic Plan
10. Other matters
11. Draft report to Science Board

MEQ Endnote 3

Report of Working Group 15 on *Ecology of Harmful Algal Blooms (HABs) in the North Pacific*

Accomplishments in 2000 – 2001

1. Accomplishments include more complete and uniform country reports from China, Japan, Korea, Russia, western USA and western Canada. Mexico would also like to contribute their report to this publication. The WG 15 requests that national reports be published in the PICES Scientific Report Series. The report will include an introduction/background (Dr. Max Taylor), country reports (these will detail types of HAB events, seasonality, earliest dates recorded, highest toxin levels, general environmental information, comprehensive literature, causative organisms, bloom reports including maps, unanswered questions, and hopes for future work), summary (Dr. Max Taylor), and appendices (to include images, scanning electron micrographs, and maps).

2. A workshop on *Taxonomy and identification of HAB species and data management* was held at the University of British Columbia, October 4-5, 2001, hosted by Dr. Max Taylor. Guest speakers included Dr. Laurie Connell from University of Maine (molecular probes) and Ms. Michelle Tomlinson from the National Ocean Data Center (HAB database). Dr. Connell presented a session on gene probes that are currently being used and/or development for automated HAB species detection. She gave a demonstration of this technique and described the pros and cons of its use. Ms. Tomlinson gave a web-based demonstration of the HAB

database that is currently being developed for the entry of biological HAB data. To date, shellfish toxin data from Washington State has been entered. Alaska and British Columbia shellfish monitoring data will be entered by December 2001. These data can be accessed on the web and maps of HAB events can be created. (This work was also presented at the TCODE Electronic Poster Session). The intent of the WG 15 is to add HAB information into this database from as many PICES countries as possible (also including Mexico).

3. General recommendations to MEQ
 - a. More interaction and collaboration between adjacent/contiguous countries is desired. For example, *Pseudo-nitzschia* and *Heterosigma* projects between the United States and Canada could be encouraged by PICES.
 - b. Monitoring of both shellfish and plankton is desired of all countries. There are serious limitations and problems in comparison among countries when only a single sentinel shellfish species is used for monitoring.
 - c. Information needs are identified, especially from Russia, the northern B.C. coast, and northern Alaska. Monitoring projects are required in these areas that are generally lacking in HAB data.

- d. Mexico should be included in the database project and has expressed a desire to do so.
- e. There is the need for a basic taxonomy class, especially for young U.S. and Canadian scientists (there are taxonomy classes that are offered, but these are focused towards scientists from 3rd world countries). This basic taxonomy class could be sponsored by ICES and/or PICES (perhaps jointly).
- f. Convene a 2-day workshop on *Development of common standards for HAB data* prior to PICES XI. A possibility to conduct this workshop jointly with TCODE should be pursued.

Report of WG 15 Workshop on *Taxonomy and identification of HAB species and data management*

Introduction

The workshop was held over one and a half days prior to PICES X, at a venue provided by the Botany Department at UBC. After welcoming the 23 participants, the convenor, Dr. Max Taylor, stated the goals of the workshop, reminding them that it was not a training workshop but rather an opportunity for analysts to discuss problems related to the accurate identification of harmful species, uniformity of taxonomy and data reporting, management and usage. The agenda included presentations by Drs. F.J.R. "Max" Taylor, Yasuwo Fukuyo, Rita Horner, Laurie Connell and Ms. Michelle (Shelly) Tomlinson (in order of appearance), but provided as much time in the laboratory as possible to observe practical demonstrations and to microscopically examine material brought by the participants.

Presentations

Dr. Taylor used a brief summary of problems with fish- and shellfish-killing flagellate species to introduce taxonomic difficulties with HABs. These include misidentification (*Heterosigma* as *Olisthodiscus* in much earlier literature), taxonomic priority and usage (*H. carterae* vs. *H. akashiwo*), recent name changes (*Karenia*,

Karlodinium, *Akashiwo*), species recognition (within *Chattonella*) and the need for infraspecific levels of discrimination. Problems arising from the complex putative life-cycle stages and modes of nutrition in *Pfiesteria*, plus difficulty in distinguishing it from "*Pfiesteria-like organisms*" which may not be closely related (e.g. *Karlodinium galatheanum*), as well as toxin type and source were briefly mentioned. It is suspected that some common (psammophilic) sand dinoflagellates having a similar mode of feeding, currently attributed to *Katodinium*, may be closely related (Taylor, unpubl.).

It was noted that almost any bloom-forming phytoplankter can kill marine fauna if locally over-concentrated, leading to plankton death and oxygen depletion. Members of *Gonyaulax* have been commonly involved in this type of HAB phenomenon. The special case of *Noctiluca*, a microzooplankter often included in HABs because of numerous kills of fish and shrimp, especially in China, was illustrated and discussed. Only one species, *N. scintillans* (syn. *N. miliaris*) has been morphologically discriminated but more may exist and there is a need for genetic studies. The mechanism(s) of death due to *Noctiluca* blooms is unclear although high ammonia levels may be involved. It usually occurs in confined bodies of water, such as shrimp ponds. In passing it can be noted that this common, cosmopolitan species is often treated in ecological studies as if it was a phytoplankter, with possible links to inorganic nutrients being sought, but such links can only be indirect since its blooms have to follow those of a prey species.

The HAB biogeographic picture shows extraordinary latitudinal cosmopolitanism, including bihemispherism and a general lack of true endemism (except in polar regions) is the norm. This is generally not appreciated by non-phytoplanktological taxonomists and has an important bearing on the significance of supposed ballast water introductions. It is to be expected from general dinoflagellate biogeography that, for example, it is highly likely that species of *Pfiesteria* will be found in shallow estuaries in other countries with similar

coastal temperature ranges such as Brazil or southern Africa or Australia. Given the present climate of interpretation, artificial introduction would almost certainly be invoked as an explanation.

Dr. Fukuyo began by illustrating the seven orders of dinoflagellates involved in HABS, with most HAB species being found in the Prorocentrales (e.g. okadaic acid-producing *Prorocentrum* spp.), Dinophysiales (DSP-associated *Dinophysis* spp.), Gonyaulacales (several genera including *Alexandrium*, *Pyrodinium*, *Gambierdiscus*, *Ostreopsis*) and Gymnodiniales (*Karenia*, *Karlodinium* etc.). He provided plentiful excellent identificatory aid material to the participants, including publications and a CD produced in Japan. In the Peridinales, the recently described *Heterocapsa circularisquama* requires electron microscopy of its scales in order to identify it, but it has a characteristic movement when seen alive. It has killed oysters and other bivalves in Japan but fish in Hong Kong. The toxin of this economically important, recently described species is unknown.

Dr. Fukuyo then focussed on the PSP-producing genus *Alexandrium* with more than 20 species implicated in this widespread phenomenon as well as fish killers. He used it to illustrate the criteria employed in identification (tabulational features revealed by calcofluor or iodine staining) and visual aids to the identification of the species, including a manuscript by M. Yoshida prepared for a recent IOC-DANIDA training workshop. It was noted here, as seen earlier by Dr. Taylor, that the shape of cells and number of plates change in culture. In particular, chain formation is often reduced in culture, resulting in cells more rounded in shape.

This was followed, after laboratory material examination of dinoflagellates, by Dr. Horner who gave a talk on HAB diatoms, focussing on domoic acid-producing species of *Amphora*, *Nitzschia* (a recently-described benthic species from Vietnam) and *Pseudo-nitzschia* (six species so far). After a brief history of HAB diatom studies on the west coast of North America, noting that it is almost certain that records of

Pseudo-nitzschia seriata (= *Nitzschia seriata*) before the late 1990's are actually of *Ps. australis*, focus turned to the problems of visually discriminating between various toxic and non-toxic species of *Pseudo-nitzschia*. Electron microscopy, SEM or TEM, is needed to observe the fine details of valve structure needed to discriminate the species. Examples of local representatives of well-known toxic species were illustrated, including *Ps. australis*, *Ps. multiseries* and *Ps. Pseudodelicatissima*. *Ps. granii* has been isolated recently from the open North Pacific Ocean by researchers from UBC. Problems of overlap in descriptions and arising from different views (valve, girdle) were discussed. As toxicity varies with strains or physiological state within known toxic species their mere presence cannot be taken as evidence of the presence of toxins in shellfish. This is also found in culture. Even the type of chain formation can vary, including the formation of *Fragilariopsis*-like chains. A fungal parasite is commonly seen in wild coastal N.E. Pacific populations.

Another problem associated with diatoms in the PICES region is the death of farmed fish due to physical gill damage by *Chaetoceros concavicornis* and, possibly, *Ch. convolutes*. Earlier records referred only to the latter species but Taylor and co-workers have concluded that the former is the greater threat, having more developed spinulae on the setae. It is interesting that this species does not seem to be a problem, or is unrecognized, in other temperate fish farming areas.

In the laboratory, Dr. Connell gave a talk and demonstration of a commercially available LSU RNA sequence quantitative technique for HAB species identification (Saigene). It is almost fully automated and can handle large numbers of samples. It is in current use for identifying species of *Chattonella*, *Heterosigma*, *Alexandrium* and *Pseudo-nitzschia* (there are outstanding difficulties with *Ps. Pseudodelicatissima*). In the future, based on complete sequences of rRNA, it is likely that microchip probes will be developed. A very recent presentation at the 7th International Physiological Congress by Linda Medlin and

European colleagues showed excellent promise for discriminating species of *Alexandrium*.

Other fluorescent probes are used for toxins, using labelled antibodies. ELISA and other antibody methods for toxin detection in cells or shellfish were not discussed here since this workshop dealt with species recognition, but the need for a workshop on recent developments in these techniques was recognized as a need.

Ms. Tomlinson gave a web-based demonstration of an online HAB Data Management System (HAB-DMS), which is now available through the National Oceanographic Data Center (NODC, U.S.A.) at www.nodc.noaa.gov/cgi-bin/hab/hab.pl. A Pacific region website has been created and can be found at www.nodc.noaa.gov/col/projects/habs/pacindex.html. The FGDC record for the Washington State Department of Health PSP and Domoic Acid 1998-2000 (NODC #0000559) has been completed. The online linkage can be found at www.doh.wa.gov/ehp/sf/.

The Northwest Fisheries Science Center (NWFSC, NMFS, USA) has supplied harmful algal bloom datasets to the NODC. These include data from Washington State Department of Health, the Alaska Department of Fisheries. These data have been archived and documented using the FGDC format and are available in the originator's format through the NODC Direct system (www.nodc.noaa.gov/col/project/access/nodcdir.html). The FGDC metadata descriptions will be provided to the Howard Diamond by NODC, as a part of a routine transfer of metadata. These HAB data sets have been reformatted, and are in the process of being loaded into the HAB Data Management System (HAB-DMS). Currently, the HAB-DMS and web-based interface are being migrated to an operational mode. Therefore, sample data, which was loaded into the database for testing, are being removed and replaced by the current Washington State data sets archived at NODC.

In collaboration with Michelle Tomlinson, the NWFSC has developed a web-based form to facilitate the acquisition of information

regarding Harmful Algal Bloom reports in Pacific Rim countries. These will be linked to the HAB database as another source of HAB data and information. A statement of work is being written to describe additional enhancements to the system, as well as requirements for linking these HAB reports, as well as other sources of coastal data sets which reside within NODC, to the system.

Conclusion and recommendations

1. There is a need for at least one training workshop in which inexperienced PICES phytoplankton analysts become familiar with a wide range of HAB species potentially harmful in their waters (both Dr. Fukuyo and Dr. Taylor have taught several of these before, mostly in S.E. Asia). A special workshop to be convened in Japan, next October, immediately prior to PICES XI, was recommended, and would focus on antibody-based toxin detection techniques.
2. The initial entry of HAB shellfish data from the western US into the NODC database has been successful. The goals for the upcoming year include entry of data from western Canada and Asian Pacific countries. It was recommended that Asian Pacific country representatives make available their historical shellfish toxin data for entry into the database. There is concern that these data may be of a sensitive nature, and not desirable for general release to the public. This concern can be circumvented by focusing on historical data that is at least two years old. Additional funding should be sought to continue collaboration of PICES with NODC.
3. There is a need to continue the development of possibly the most useful PICES HAB database. Much further discussion of HAB databases is required to deal with design and standardization issues. A further workshop on the latter seems to be essential.
4. Participation by more PICES countries at future workshops, especially countries not present at this workshop (e.g., China, Korea, Russia) has to be encouraged.

Workshop agenda

October 5, 2001 (Friday):

- 0900 Gather at main entrance to Biosciences Bldg.
0915 Opening remarks, introductions, objectives, schedule
0930 *F.J.R. Taylor*. Fish-killing flagellates
0950 *Y. Fukuyo*. Dinoflagellate identification
1010 Coffee break
1030 Sample examination (lab.)
1200 Lunch break
1300 *R. Horner*. Diatom identification
1330 Sample examination/discussion (lab.)
1500 Coffee break
1520 *L. Connell*. Molecular identification aids demo
1700 Close Day 1

October 6, 2001 (Saturday):

- 0900 *M. Tomlinson*. Web access and HAB data handling
0930 Discussion
1030 Coffee break
1050 Sample examination/discussion (lab)
1200 Workshop conclusion

Participation list

Canada:

Alexander Culley, Helen Drost, Nicky Haigh, Lawrence, Adrian Marchetti, F.J.R. (Max) Taylor (Convenor), and J.N.C. (Ian) Whyte

Colombia:

Juan Saldarriaga

France:

Pascale Loret

Indonesia:

Gabriel Wagey

Japan:

Yasuwo Fukuyo, Yuichi Kotami

U.S.A.:

Brian D. Bill, William Cochlan, Laurie Connell, David Garrison, Julian Herndon, Rita Horner, Racheal Howard, James Postel, Michelle Tomlinson, Vera L. Trainer

MEQ Endnote 4

MEQ Strategic Plan

The MEQ Committee's area of responsibility is to promote and coordinate marine environmental quality and interdisciplinary research in the North Pacific. Marine environmental quality has an interactive role with the other PICES Committees to assess status and trends in environmental and biological conditions as affected by human activities. The coordination and research includes: understanding the sources, transport, and fates of contaminants found in the marine environment; the ecology and oceanography of harmful algal blooms; the biological effects of natural and anthropogenic toxic substances; the effects of mariculture on coastal environment; and the transport, introduction, and ecological effects of non-indigenous species and stocks.

Review of activities

The first MEQ meetings at Victoria, Canada (1992) and Seattle, U.S.A. (1993), were largely focused on identifying common problems of marine pollution in the North Pacific. It was decided that MEQ should concentrate its efforts on coastal pollution problems (instead of open ocean processes). The preliminary focus was on "Interdisciplinary methodology to better assess and predict the impacts of pollutants on structure and function of marine ecosystems". Two areas were mentioned as particularly important: algal blooms and chemical and biological contaminants. In 1992, Working Group 2 (WG 2) on *Development of common assessment methodology for marine pollution* was established under the leadership of Dr. Richard F. Addison (Canada) and Prof. Ming-Jiang Zhou

(China). Prof. Jia-Yi Zhou (China) was elected MEQ Chairman in 1992.

At PICES III in Nemuro, Japan (1994), MEQ held a symposium on *Interdisciplinary methodology to better assess and predict the impact of pollutants on structure and function of marine ecosystems*. It was decided also to organize a Practical Workshop at one of the impacted coastal ecosystems of the western North Pacific to work on common methodology of marine environment quality assessment. The proposed preliminary workshop site was the Yangtze estuary, East China Sea. After the meeting, Working Group 2 was disbanded and Working Group 8 was established to prepare and organize the Practical Workshop.

At PICES IV in Qingdao, China (1995), MEQ held a symposium on *Sources, transport, and impact of chemical contaminants*. WG 8 recommended organizing the Practical Workshop in Jiaozhou Bay, China (instead of Yangtze estuary) to trace the ecological impacts along the gradient of chemical contamination. Dr. Richard F. Addison was elected the new MEQ Chairman.

At PICES V in Nanaimo, Canada (1996), MEQ held a session on *Processes of contaminant cycling*. WG 8 developed a Scientific Workplan to hold the Practical Workshop in Qingdao, China, in 1997. Harmful algal blooms and environmental impacts of aquaculture were considered as possible topics for future MEQ sessions.

At PICES VI in Pusan, Korea (1997), MEQ held a session on *Processes of contaminant cycling*. Three priority areas were identified for inter-session activities: (i) Environmentally sound mariculture: Status and technology needs; (ii) Harmful algal blooms; and (iii) MEQ/PICES interactions with GIWA (Global Assessment of International Waters): a feasibility study. The WG 8 report on preparation of the Practical Workshop in Jiaozhou Bay, China, was also approved. Following the WG 8 meeting, the Chinese authorities informed PICES that "...the present situation in Jiaozhou Bay is not suitable to hold the workshop...", and after some

discussion within MEQ, the proposed site was moved to Vancouver Harbour.

At PICES VII in Fairbanks, U.S.A. (1998), MEQ discussed the report of WG 8 on preparation for the Practical Workshop in Vancouver Harbour in May-June 1999. MEQ held a topic session on "Science and technology for environmentally-sustainable mariculture" and a joint session with BIO on "Contaminants in high trophic level biota – linkages between individual and population responses". Dr. Alexander V. Tkalin was elected the new MEQ Chairman.

At PICES VIII in Vladivostok, Russia (1999), MEQ convened a Topic Session on *Ecological impacts of oil spills, oil exploration, land reclamation and other man-made activities* and a joint session with BIO on *Coastal pollution: Eutrophication, phytoplankton dynamics and harmful algal events*. The WG 8 Practical Workshop was held from May 24-June 7, 1999, in Vancouver Harbour.

At PICES IX in Hakodate, Japan (2000), MEQ held topic sessions on *Science and technology for environmentally sustainable mariculture: Impacts and mitigation in coastal areas* and on *Environmental assessment of Vancouver Harbour: Results of an international workshop*. Dr. John E. Stein was elected the new MEQ Chairman. WG 8 was dissolved after developing plans for publication of a data report and peer-reviewed articles concerning the results of the Practical Workshop.

In summary, over the past years, the Marine Environment Quality Committee of PICES has focused its activities on coastal pollution problems and common methodology to estimate the state of marine ecosystems under anthropogenic pressure. Closer links between marine chemists and marine biologists working on pollution problems in PICES member countries have been established.

The future

The main goal of MEQ, as part of PICES, is to improve "scientific knowledge about the ocean

environment, global weather and climate change, living resources and their ecosystems, and the impacts of human activities”. Increasing information exchange and collaboration between scientists of PICES countries will be of mutual benefit to their people and will help to sustainable development of these countries.

For the coming years, the following scientific themes are considered of high priority to MEQ:

- Impacts of climate change on coastal ecosystems;
- Ecological and environmental impacts of mariculture;
- Impacts of trawling of benthic habitat;
- Emerging of chemical contaminants of concern;
- Biogeochemical processes regulating contaminant dynamics in sediment;
- Biological and physical transport of anthropogenic substances in the North Pacific;

- Diseases in marine species: population level effects and the role of human activities in their occurrence;
- Harmonization of existing methodologies used in PICES countries;
- Scientific criteria for protection of marine ecosystems from contaminant impacts.

MEQ will work in establishing links with international organizations/programs (e.g., SCOR, ICES, GIWA, TRAP) that will improve coordination of multidisciplinary research to better understand the structure, function, and health of North Pacific marine ecosystems under anthropogenic pressure. The MEQ will also pursue building relationships with other international organizations that will broaden interest in MEQ activities within PICES countries, and will bring scientists from disciplines not currently represented in MEQ to PICES meetings and workshops.

