REPORT OF MARINE ENVIRONMENTAL QUALITY COMMITTEE

The meeting of the Marine Environmental Quality Committee (MEQ) was held from 14:30-18:30 hours on October 12, 2003. The Chairman, Dr. John E. Stein, called the meeting to order and welcomed the participants (*MEQ Endnote 1*). The Committee reviewed the draft agenda (*MEQ Endnote 2*), and it was adopted.

Business from last year's meeting (Agenda Item 3)

The special issue of *Marine Environmental Research* (Vol. 57, Nos. 1-2) was presented to members of the Committee. The issue includes 9 papers by authors from 6 PICES member countries, and this publication brings to closure a major project by MEQ to hold a practical workshop involving scientists from all PICES member countries working collaboratively on assessment of marine environmental quality. Although not present, the Committee thanked Dr. Richard F. Addison (Canada), past member and Chairman of MEQ, for his efforts in serving as Guest Editor for the special issue.

Membership and chairmanship of MEQ (Agenda item 4)

Dr. Stein informed the Committee that Dr. Joan Kean-Howie has replaced Mr. Steve Samis as a Canadian member to MEQ; unfortunately at the last minute she was not able to attend PICES XII.

The Committee expressed again its concern that there was no participation in MEQ from China this year, nor has there been for the last few years. There continues to be an overall issue of recruiting full participation in MEQ by all PICES member countries.

This was the third year of Dr. Stein's chairmanship of MEQ, and normally there would be a change in chairmanship. At present there is no candidate to assume chairmanship of MEQ. The Committee requested Dr. Stein to serve for an additional year, and he agreed to do so while the Committee identifies a candidate from the western Pacific. A potential candidate to be the next Chairman of MEQ is Dr. Hideaki Nakata (Japan).

Report from WG 15 on *Ecology of harmful algal blooms in the North Pacific* (Agenda Item 5)

The Acting Chairman of WG 15, Dr. Vera L. Trainer, presented a report of Working Group activities since PICES XI, including their workshop on "Harmful algal blooms – harmonization of data" held October 10-11, 2003, and their meeting on October 11, 2003 (see *MEQ Endnote 3* for details).

At the close of this Annual Meeting, WG 15 will have completed its Terms of Reference. At the request of Science Board, MEQ led an effort to develop a proposal for establishing a Section on *Harmful algal blooms* (see Agenda Item 7).

MEQ inter-sessional activities in 2003 (Agenda Item 6)

Dr. F.J.R. (Max) Taylor (WG 15 Co-Chairman) attended the annual meeting of the ICES/IOC/IMO Study Group on *Ballast waters and other ship vectors* (SGBOSV), and Dr. Stein participated in the annual meeting of the ICES Working Group on *Introductions and transfers of marine organisms* (WGITMO). Both meetings were held in March 2003, in Vancouver, Canada. The purpose was to explore areas of cooperation between ICES and PICES on non-indigenous species. Drs. Taylor and Stein gave presentations on activities of Working Group 15 and the MEQ Committee, respectively. It was agreed that the following are options for initiating collaborative activities on introduced species between the two organizations. To foster exchange of information, members of WGITMO and SGBOSV could participate in scientific sessions

or workshops at PICES Annual Meetings, and representatives of MEQ and WG 15 could attend future meetings of ICES groups. The two organizations could also consider holding a joint workshop or scientific session and discuss whether it would be beneficial to establish a joint Working Group. Specifically, Dr. Stein requested PICES to extend an invitation for a representative of SGBOSV and WGITMO to present a scientific paper at PICES XII in Seoul, Korea. In addition, it was agreed to explore the possibility of developing a joint ICES/PICES session on harmful introductions of phytoplankton at PICES XIII in Honolulu, in 2004 (see *MEQ Endnote 7* below).

MEQ proposals for new subsidiary bodies (Agenda Item 7)

There are proposals for establishing a Section and two new Working Groups.

MEQ Section on *Harmful algal blooms*
The Science Board requested MEQ to develop a proposal describing the roles and responsibilities for a potential MEQ Section on HABs. Inter-sessionally, the Committee developed and reviewed a draft proposal and sought comments on the proposal from scientists involved with HAB activities in other international organizations. At PICES XII, the proposal was revised by Working Group 15 at their workshop. MEQ discussed and accepted the revised proposal (*MEQ Endnote 4*). The Committee strongly endorsed establishing a Section on HABs and requested Science Board to support the proposal.

MEQ/FIS Working Group on *Ecosystem-based management*
Last year, both MEQ and FIS reviewed a proposal for establishing a joint Working Group on ecosystem-based management (see *MEQ Endnote 4* in the 2002 PICES Annual Report, pp. 107-108). Inter-sessionally, the proposal was revised and submitted to both Committees for discussion. At PICES XII, FIS concluded that the current draft Terms of Reference should be less broad and focus more on fisheries management if FIS was to co-sponsor the Working Group. MEQ suggested that there should be further discussion and potential revisions of the Terms of Reference following the Topic Session on "Ecosystem-based management science and its application to the North Pacific" at PICES XII. MEQ recommended that a Working Group should be established, and that the first task should be to review existing information on the subject and use the review to refine and focus the Terms of Reference (*MEQ Endnote 5*).

MEQ/FIS Working Group on *Aquaculture*
At the 2003 interim Science Board/Governing Council meeting, MEQ and FIS were asked to lead a discussion on forming a Working Group on the scientific issues of aquaculture. An initial proposal was developed and discussed in both Committees at PICES XII (*MEQ Endnote 6*).

Proposed Topic Sessions and Workshops for PICES XIII (Agenda Item 8)

The Committee proposed two Topic Sessions and a workshop for PICES XIII:

- A 1-day Topic Session on "Natural and anthropogenic introduction of marine species" (*MEQ Endnote 7*); recommended convenors: William P. Cochlan (U.S.A.) Yasuwo Fukuyo (Japan) and Julia Parrish (U.S.A.). ICES is to be approached to co-sponsor the session.
- A ½-day Topic Session on "Marine Protected Areas" (*MEQ Endnote 8*); recommended convenors: Glen Jamieson (Canada) and a scientist from the western Pacific to be decided.
- A 1-day MEQ Workshop on "Developing a North Pacific HAB data resource II" (*MEQ Endnote 9*); recommended convenors: Vera L. Trainer (U.S.A.) and Hak-Gyoon Kim (Korea). IOC and ICES are to be approached to co-sponsor the workshop.

Theme for PICES XIV (Agenda Item 9)

The Committee suggested that the theme for PICES XIV be "Sustainable use of ocean resources and coastal ecosystems: Land – sea - ocean interactions". This theme seems particularly appropriate for an Annual Meeting in the Russian Far East.

The Committee also noted that at PICES XIV, it would be timely to re-visit the topic of "Ecological effects of oil and gas development". Other potential themes for the MEQ Session are: coastal eutrophication, sediment contamination, and loss and degradation of marine habitat.

MEQ Strategic Plan (Agenda Item 11)

The Committee briefly re-visited changes made to the MEQ Strategic Plan at PICES XI, and agreed that no further changes were needed, particularly since the PICES Strategic Plan was undergoing a major revision.

TCODE meta-database thesaurus (Agenda Item 12)

Committee members had no substantive comments on the list of keywords for the North Pacific Ecosystem Metadatabase assembled by TCODE, but continue to support the efforts to develop a metadatabase.

Report from Study Group on *PICES Strategic Issues* (Agenda Item 13)

The Committee commended the work of the Study Group in producing the draft PICES Strategic Plan (Vision Statement). While MEQ supported themes and goals outlined in the draft, it was concerned that if PICES cannot increase participation by all member countries and the level of funding, progress in implementing all aspects of the plan maybe slow. MEQ and other Committees have been requested to provide their comments by November 30, 2003.

Discussion of *North Pacific Ecosystem Status Report* (Agenda Item 14)

Committee members were requested to review the North Pacific Ecosystem Status Report (NPESR) with particular attention to the *Synthesis* chapter and send comments to the MEQ Chairman by mid-November. The Committee noted that there are many gaps related to MEQ issues, and that as a Committee we need to develop mechanisms to identify the high priority gaps and then find individuals to draft sections for inclusion in the NPSER.

Report from Study Group on *PICES Capacity Building* (Agenda Item 15)

The Committee agreed in general with the recommendations of the report, but was concerned that their effective implementation was dependent on finding additional financial resources. Comments to Science Board are requested by November 30, 2003.

Next major PICES scientific program(s) (Agenda Item 16)

The Committee suggested that the broader ecological issues of harmful algal blooms is a good candidate for being a major scientific program in PICES. HABs are a concern for all PICES countries, and each country has national scientific programs on HABs. There are other international scientific organizations initiating programs on HABs. Both coastal pollution and oceanographic features appear to influence the initiation and progression of HABs but the interaction between anthropogenic and natural factors are not well understood. Coordinated efforts to conduct comparative studies of the ecology and oceanography of HABs could be very useful in understanding processes and mechanisms regulating the initiation and progression of toxic phytoplankton blooms, which is needed to develop models to improve the ability and capacity to forecast HAB events. Ultimately, this would substantively improve the ability of PICES to provide scientific advice to member countries on the trends, prediction, and mitigation of HABs.

ICES Symposium on "Marine bioinvasions" (Agenda Item 17)

ICES has requested PICES to consider co-sponsoring a major 3-day symposium on "Marine bioinvasions" to be held in spring 2006, at a location to be decided on the east coast of the United States (*SB Endnote 9*). MEQ endorses PICES co-sponsorship of the symposium. Bioinvasions is a high priority ecological risk in the North Pacific that has received limited attention by PICES.

PICES web site revisions (Agenda Item 18)

Ms. Julia Yazvenko (PICES Secretariat) demonstrated the features of the new PICES web site. The Committee nominated Dr. Alexander Tkalin to be the point of contact on scientific content for the MEQ page.

Relations with other international organizations (Agenda Item 19)

MEQ requested Ms. Keiko Ide, Deputy Director of the UNEP Northwest Pacific Action Plan (NOWPAP) Special Monitoring and Coastal Environmental Assessment Regional Activity Center (CEARAC), to provide information on NOWPAP/CEARAC activities. She reviewed the structure and goals of NOWPAP and focused on the objectives of the Working Groups to develop assessment tools. Of particular interest was the CEARAC Working Group 3, which is focusing on developing a harmful algal bloom database. MEQ noted that cooperation with NOWPAP would be beneficial to the coordination of efforts to harmonize data on harmful algal blooms.

Items with financial implications (Agenda Item 20)

MEQ requests travel support from the PICES Trust Fund for 1 Russian and 1 Chinese scientist to attend the proposed MEQ Workshop on "Developing a North Pacific HAB data resource – II", and the normal allocation (CND$5,000) for invited speakers for MEQ Topic Sessions.

Best Presentation Award (Agenda Item 21)

Dr. Alexander Tkalin (Russia) agreed to assess the presentations and recommended that the MEQ Best Presentation Award be given to Sung Il Lee (Pukyong National University, Korea) for his paper (co-authored by C.-I. Zhang and J.-M. Kim) entitled "Ecosystem-based management of fisheries resources in the Tongyeong marine ranching area in Korea" at the MEQ/BIO/FIS Session on "Ecosystem-based management science and its application to the North Pacific".

Other items

Request for advice from the United States

This is the first request for scientific advice by a member country to PICES. This request is seeking review of the evidence for, and ecological consequences of, observed climate-ocean changes in the North Pacific in 1999. MEQ agreed that this is an appropriate request and suggested that PICES should provide scientific advice on issues that are of an intermediate temporal nature, such as climate-ocean changes, but should not accept requests for advice that address management issues that are of an annual nature. MEQ also agreed with the process proposed by Science Board to address the request. Although not explicitly stated, MEQ expects that developing the advice, seeking peer review, finalizing and approving the final advice, and publishing the resulting document will be solely the responsibility of Science Board. The Committee recommends Dr. Julia Parrish for the group that will address this issue.

MEQ Endnote 1

Participation List

Members

Tatyana Belan (Russia)
Glen Jamieson (Canada)
Hideaki Nakata (Japan)
Alexander Tkalin (Russia)
John E. Stein (U.S.A., Chairman)
C. Michael Watson (U.S.A.)
Dong-Beom Yang (Korea)

Observers

Vladimir Shulkin (Russia)
Elena Latkovsjaya (Russia)
Keiko Ida (Japan)
Sook Yang Kim (Korea)

MEQ Endnote 2

MEQ Meeting Agenda

1. Welcome and introductions
2. Approval of agenda
3. Business from last year's meeting
4. Membership and chairmanship of MEQ
5. Report from WG 15 on *Ecology of harmful algal blooms in the North Pacific*
6. 2003 inter-sessional activities – Attendance at ICES Working Group meetings
7. Proposals for new subsidiary bodies
   a. Section on *Harmful algal blooms*
   b. Joint FIS/MEQ Working Group on *Ecosystem-based management*
   c. Joint MEQ/FIS Working Group on *Marine aquaculture*
8. Topic session proposals for PICES XIII
9. Theme for PICES XIV
10. Proposal for a joint PICES/ICES workshop on "harmful bio-invasions"
11. MEQ Strategic Plan
12. TCODE – Discussion of metadatabase thesaurus
13. Discussion of report from Study Group on *PICES Strategic Issues*
14. Discussion of *North Pacific Ecosystem Status Report*
15. Discussion of report from Study Group on *PICES Capacity Building*
16. Discussion of steps towards next major PICES scientific program(s)
17. Discussion of co-sponsoring with ICES a symposium on "Marine bioinvasions"
18. PICES web site revisions – MEQ content
19. Relation with other international organizations/programs
20. Items with financial implications
21. 2003 MEQ Best Presentation Award
22. Preparation of report and recommendations to Science Board

MEQ Endnote 3

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

The Working Group 15 met from 14:30-18:00 hours on October 11, 2003. The meeting was attended by 20 participants representing all PICES member countries (*WG 15 Endnote 1*). The agenda was approved as presented (*WG 15 Endnote 2*).

Dr. Vera Trainer reported on the successful joint PICES/IOC workshop on "Harmful algal blooms - harmonization of data", held on October 10-11, 2003, in conjunction with PICES XII. The main goal of the workshop was to determine how harmful algal bloom and red tide data could be shared among PICES member countries. The agenda included 11 presentations and an extensive discussion of the benefits and challenges of sharing HAB data. The summary of the workshop can be found elsewhere in this Annual Report. All PICES member countries unanimously decided to adopt the IOC/ICES HAB Metadatabase (HAE-DAT) for a 1-year trial period to further explore the strengths and limitations of this approach. It was agreed that:

- Each country will enter one year's HAB data in the database using a year of their choice;
- Each country will decide which data to enter, or in other words, will decide what constitutes a "problem" HAB in their country;
- Each country will define "regions" for their data entry that could include exact locations or more general areas (*e.g.* prefectures in Japan). This will allow issues of data sensitivity to be overcome;
- Each country will decide on a point person to oversee data entry into HAE-DAT during the next year (a point person was chosen for each country but Canada); and
- For the next PICES Annual Meeting (October 2004, Honolulu, U.S.A.), each country will complete a "report card" describing what worked within the database, types of data that were difficult to deliver (data access issues, etc.), and the overall usefulness of the database.

It was highly recommended that a 1-day follow-up workshop on "Developing a North Pacific HAB data resource - II" be convened at PICES XIII (see *MEQ Endnote 9* for description). IOC and ICES are to be approached to co-sponsor the workshop. The interaction with IOC looks essential to foster PICES/ICES coordination on HAB data harmonization, and Dr. Henrik Enevoldsen should be invited to speak again about improvements to HAE-DAT database at the next meeting. Travel funds are requested for 1 Russian and 1 Chinese scientist who might not otherwise be able to attend the workshop.

It was also recommended that MEQ sponsor a 1-day Topic Session at PICES XIII on "Natural and anthropogenic introduction of marine species" (*MEQ Endnote 7*). ICES is to be approached to co-sponsor the session through the ICES/IOC/IMO Study Group on *Ballast waters and other ship vectors* (SGBOSV) and the ICES Working Group on *Introductions and transfers of marine organisms* (WGITMO). Travel funds are requested from PICES for 2 invited speakers, one to speak about natural introductions and another person to speak about anthropogenic introductions.

Participants discussed the lack of non-"Topic Sessions" at PICES. With the proliferation of topic sessions we may be discouraging the submission of excellent papers to PICES Annual Meetings only because they are outside the topic areas. Rather than having Paper Sessions sponsored by a Committee, it was suggested that a "Hot" Topics/Breakthrough Science" session be held at each annual meeting.

Members of WG 15 continue to strongly endorse the proposal to establish a Harmful Algal Blooms Section under MEQ. The proposal and draft terms of reference for the HAB Section were reviewed, revised and recommended to MEQ for acceptance (*MEQ Endnote 4*). Potential Co-Chairmen for the Section were suggested.

WG 15 Endnote 1

Participation List

Members

William P. Cochlan (U.S.A.)
Yasuwo Fukuyo (Japan)
Paul J. Harrison (Canada)
Ichiro Imai (Japan)
Hak-Gyoon Kim (Korea)
Tatiana Orlova (Russia, Co-Chairman))
Vera L. Trainer (U.S.A., Acting Co-Chairman)
Mark L. Wells (U.S.A.)

Observers

Robin Brown (Canada)
Ming-Yuan Zhu (China)
Henrik Enevoldsen (IOC)
Hee Dong Jeong (Korea)
Sung-Dae Kim (Korea)
Keiko Ide (Japan, NOWPAP/CEARAC)
Muneharu Tokimura (Japan)
Georgiy Meiseenko (Russia)
Igor Shevchenko (Russia)
Nicolaus G. Adams (U.S.A.)
Kimberly Bahl (U.S.A.)
John E. Stein (U.S.A.)

WG 15 Endnote 2

WG 15 Meeting Agenda

1. Welcome and introductions
2. Approval of agenda
3. HAB scientific presentations:
   - Utilization of inorganic and organic nitrogen by harmful algae: A case study of *Heterosigma Akashiwo* blooms in San

Francisco Bay – by William P. Cochlan and Julian Herndon
    - Iron limitation of natural phytoplankton assemblages associated with the Pacific Northwest ECOHAB *Pseudo-nitzschia* blooms – by Mark J. Wells, William P. Cochlan and Charles G. Trick
4. National reports on harmful algal blooms
5. Summary of the joint WG 15/TCODE workshop on "Harmful algal blooms - harmonization of data"
6. Discussion on the future of harmful algal bloom issues within PICES (stay with modified TOR? new WG under MEQ? become a HAB Section under MEQ?)
7. Interactions with other international organizations/programs (GEOHAB, ICES, IOC, NOWPAP, SCOR)
8. Specific funding requests for 2004-2005
9. Adoption of report and recommendations to MEQ Committee

MEQ Endnote 4

Proposal for a Section on *Harmful algal blooms and their impacts*

Background

Harmful algal blooms (HABs) are a global issue, believed to be increasing in magnitude, frequency, and duration. Presently, most coastal countries are influenced by HABs, many with multiple species affecting multiple fisheries and coastal resources. Both toxin-producing and non-toxic algae are known to have harmful effects in PICES member countries. The historical record of events, the discovery of new algal toxins, the transport of toxic phytoplankton to new areas, the apparent relationship of some blooms with human activities, and the increase in economic cost of HABs to coastal regions, all are strong indicators that these events are a systemic ecological phenomenon that may become more severe as coastal human population continues to increase.

Recently, several international efforts have been initiated, highlighting the interest of many nations in increasing their understanding of the ecology and oceanography of HABs and in mitigating the effects of serious events. PICES is the organization that should facilitate and coordinate international efforts on HABs in the North Pacific. In this regard, the Scientific Committee for Ocean Research (SCOR) and the Global Ecology and Oceanography of Harmful Algal Bloom (GEOHAB) programs have recently approved a project on "*HABs in upwelling systems*" and will have an open science meeting on the subject in Lisbon, Portugal, in November 2003. This is an example of the types of meetings that are now occurring, and where representation or co-sponsorship by PICES would be beneficial in facilitating cooperation among scientists of PICES member countries and interactions with these other international scientific programs.

The Ecology and Oceanography of Harmful Algal Blooms (ECOHAB) and Monitoring and Event Response to Harmful Algal Blooms (MERHAB) programs are currently funding research and monitoring projects on the U.S. west coast. This critical mass of research activity in the northeastern Pacific as well as a recent strong interest in HAB programs in other Pacific nations (for example, CEOHAB in China and a Japanese project investigating the use of satellite remote sensing for detection and tracking of HABs in Asia, commonly called the "Red Tide Watcher" project) are motivations for coordinated research efforts in PICES member nations. Funding for international activities is becoming increasingly available. Therefore, one important activity for a proposed HAB Section is to position member nations for research collaborations that can take advantage of infra-structural funding that is developing in each country. PICES activities will be critical in positioning the Pacific HAB community for mainstream research support.

The ecology and oceanography of HABs is a topic where there is also strong mutual interest between PICES and ICES. Currently, ICES has a standing working group dealing with HAB issues, therefore, it would be advantageous to

have a similar group in PICES. Having a standing group in PICES would make collaboration between the two organizations more straightforward and more likely to be sustained and productive.

PICES Working Group 15 on *Ecology of harmful algal blooms in the North Pacific* has identified a number of areas where sustained efforts are needed:

- *The fostering of international collaboration to assist in investigating HABs in ecosystems with common features.* For example, there is a current effort through GEOHAB to support meetings on ecosystem-based subjects. PICES investigators could propose a GEOHAB core project that incorporates systems of interest to their member countries, leading to open science meetings and coordinated research activities within the region.

  SCOR and the GEOHAB Scientific Steering Committee have approved a project on "*HABs in upwelling systems*" (as well as other ecosystems) and are convening Open Science Meetings [OSM] on the subject. Terms of reference for this steering committee, as well as the final document have been developed. The purpose of the OSM will be to review our knowledge of HABs in upwelling systems and to plan a comparative study between the Californian, Iberian and Benguela systems. SCOR will fund the participation of 15 individuals at the OSM, 5 from each of the regions. Because the Californian system is part of the study, PICES could and should be represented at the OSM, and information collected at that meeting should be reported back to the HAB section members. In a similar manner, open science meetings are planned for two other GEOHAB core projects, "*HABs in fjords and enclosed embayments*" and "High biomass HABs in atrophic systems", each of which has great relevance to PICES member countries.

- *The development of interactions between ICES and PICES HAB working groups will take some time to become effective*. Examples of the beginnings of a strong collaboration are:

  Henrik Enevoldsen, from IOC (UNESCO) and ICES HAB working group, requested the PICES Scientific Report No. 23 for inclusion in ICES training courses. This demonstrates the level of maturity of the scientific collaboration in PICES on HABs, and demand for truly global perspectives in addressing the ecological effects, human health risks and prospects for mitigation of HABs.

  The building of a global database on HAB occurrences and impacts is challenging but an extremely important task that will allow a GIS-referenced comparison of HAB problems in similar ecological regions around the world. IOC and ICES are much more advanced in this direction, and their knowledge and experience is valuable to PICES. The workshop on "Harmonization of HAB Data", convened in conjunction with PICES XII, was declared a joint PICES and IOC meeting. Again, this demonstrates the expanding international and global nature of HAB research, and why PICES can serve as the coordinating entity for the North Pacific.

- *Collaboration is required to understand timely the urgent problems in the HAB field*.

  Max Taylor, Co-Chairman of WG 15, attended the annual meeting of the ICES/IOC/IMO Study Group on *Ballast waters and other ship vectors* (SGBOSV) held in March 2003, in Vancouver, Canada. Although PICES has not yet focused on the ballast water question, it is an important and pressing issue that should be a future activity in PICES. Again this is not an issue that can be addressed in the short time frame of a PICES working group; it will require a sustained effort of synthesis and coordination among PICES member countries and with other international organizations. A particularly attractive suggestion was for a joint PICES/ICES

workshop/session on the problem of HAB introductions (*e.g.* ballast water), to be held in conjunction with the next PICES Annual Meeting in Honolulu in 2004. An invitation was extended to the Chairman of the ICES/IOC/IMO Study Group, Stefan Gollasch, to participate as a convenor and/or an invited speaker. This was in accordance with several recommendations by ICES and PICES Executives to encourage interaction between appropriate groups from each organization. WG 15 had also expressed a desire for more interaction in its annual reports.

- *Data harmonization is a long-term problem that cannot be resolved in 1-3 years*.

  There is a strong interest among PICES and ICES member countries to join databases that will help investigators study HAB trends and commonalities among nations. This effort was begun at the WG 15 workshop in October 2001, in Vancouver, Canada. The next step was the workshop on "Harmful algal blooms - harmonization of data", held in October 2003, in Seoul, Korea, in conjunction with PICES XII. The energy and interest in this subject should be supported through continued efforts in the future to harmonize HAB data. Because each country records data in a different way, this problem will take many years to resolve and establish effective data sharing protocols. Without this we will be limited in our ability to discern common elements of HAB event initiation, propagation, and to what extent human activities and climate variability are altering the dynamics of HABs.

- *Funding for international collaboration could be leveraged through PICES support*.

  There are examples of international collaborations in HAB research that are currently being funded. For example, the ECOHAB program is funding Canadian collaborators through the US program in the Pacific Northwest. These Canadian scientists are recognized as specialists in their field who are required for the completion of a comprehensive US research project that affects both member countries, and is most effectively studied in such a collaborative effort.

  A US-EU request for HAB proposals will be released at the end of 2003, jointly by the United States and European Union. This is an exciting opportunity that will fund (through the EU and US National Science Foundation) scientists on the respective sides of the Atlantic to collaborate with scientists researching similar problems. The realization of similar funding for international study across the Pacific could become possible through PICES support.

  Mexico has shown a strong interest in joining PICES in order to collaborate on a number of issues, including HABs. Their participation in a permanent HAB Section in PICES may facilitate their acquisition of internal funds for travel, etc.

In conclusion, WG 15 has made substantive progress in identifying the science needs related to HAB issues that are both common and unique to individual PICES member countries (see PICES Scientific Report No. 23). All PICES member countries and Mexico have significant HAB problems, and similar levels of scientific uncertainty in regard to HABs that are severely limiting the ability to forecast and mitigate HAB events. For these reasons there is keen interest in sharing information from active science and management programs in each PICES member country. In addition, some nations may be able to expand or re-define their research and management programs as a direct result of PICES support and interest. This is the critical time for PICES to begin active participation in the international collaborations that are currently underway. To name a few, IOC, SCOR, ICES and GEOHAB are sponsoring open science forums or workshops on HAB related topics. An international effort through APEC is currently underway to harmonize seafood safety regulations. A proposed MEQ Section on *Harmful algal blooms and their impacts* could effectively join these efforts by co-sponsoring

workshops and conferences on specific topics and by helping to support research collaboration among PICES member countries. This level of coordination and collaboration would be very difficult to achieve and maintain through short-lived working groups. PICES needs a more "visible" and interactive long-term HAB program, and that vehicle is a HAB Section.

Proposed Terms of Reference

1. To develop and implement annual bloom reporting procedures that can be consistent with ICES procedures, and therefore incorporated into HAE-DAT and used to update the North Pacific Ecosystem Status Report. This will be important in assessing impacts of HAB events and as a research tool to understand patterns that will eventually lead to an increased prediction capability.
2. To exchange national reports of HAB incidents and development in order to inform PICES of new toxins, new developments, and new approaches. Both toxin producing and non-toxic (but harmful) algal species should be included.
3. To focus on specific needs for scientific advice among PICES member countries by identifying topics of interest, and providing syntheses of the available scientific information on those selected topics. Example topics for discussion and syntheses might include:
    a. Mitigation practices to reduce the impact of HABs;
    b. Numerical model development of harmful algal bloom initiation and transport for predictions and forecasts;
    c. Relationship between oceanographic processes and HAB formation (*e.g.*, how the physics of nutrients, trace metals tie into bloom formation);
    d. Organism identification using molecular biological techniques;
    e. Discussion of possible changes to certain monitoring techniques (for example, cell numbers vs. toxin levels);
    f. Species introductions including issues of anthropogenic sources (e.g. ballast water) or natural systems (e.g. species range extension).
4. Together with TCODE, to develop a meta-database that describes HAB monitoring and research efforts in each PICES member country.
5. Support the harmonization of methods for identifying HAB species. This could include inter-calibration workshops co-sponsored by PICES and ICES.
6. Development of early warning systems for the detection of HABs. This could include discussion of ocean observing systems and techniques.
7. To educate the community (managers, students) about biology and ecology of HAB organisms. For example, an in-depth study and documentation of selected HAB species ("top ten") could include information about physiology, taxonomy, etc. of each of the species.

Recommended Co-Chairmen: Hak-Gyoon Kim (Korea) and Vera L. Trainer (U.S.A.)

MEQ Endnote 5

Proposal for an MEQ/FIS Working Group on
Ecosystem-based management science and its application to the North Pacific

Proposal: Working Group under MEQ and FIS
Title: Ecosystem-based management science and its application to the North Pacific

Background

Under the overarching objective of conservation of species and habitat, ecosystem-based management (EBM) is the implementation of defined objectives related to maintaining and monitoring the ecosystem features of biodiversity, productivity, and the physical and chemical properties of an ecosystem. EBM is now timely and necessary because *(i)* in many environments, individual ecosystem components

are presently being utilized, harvested or impacted with limited attention to the maintenance of the integrity of the overall ecosystem, and *(ii)* the scale of these impacts is now such that there is real possibility of overall negative ecosystem change to the detriment of human society. This Working Group will develop a synthesis of how PICES member countries are currently addressing the issue of EBM, and make recommendations on how PICES could improve the state of the science that provides the framework for EBM initiatives in PICES countries. This goal for the Working Group is consistent with the actions being currently undertaken by other national and international agencies.

The term 'marine environmental quality' generally refers to an assessment of the state of the marine environment, including conditions resulting from human activities. Both biotic and abiotic environmental impacts thus need to be considered in the context of natural variation in the ecosystem, and where appropriate, management objectives need to be proposed that address defined biological, social and economic EBM objectives. To date within PICES, the Marine Environmental Quality Committee has largely focused on contaminant issues. This proposal would address more completely MEQ's existing mandate, to promote and co-ordinate marine environmental quality and interdisciplinary research in the North Pacific. However, since fishing activities are one of the major human activities occurring in marine ecosystems, co-sponsorship of this Working Group by the FIS Committee would be appropriate and desirable.

In 2001, a Working Group on *Ecosystem considerations in fisheries management* was proposed by FIS (but not established). This Working Group was to incorporate new information on decadal scale shifts in ocean condition, and re-examine interpretations of fishing effects in light of this information. Developing an understanding of both natural variability and the changes arising from fishing on ecosystem characteristics would be part of the proposed Working Group's task, but the task would be broader. The Working Group would focus on how such variability and impacts could be monitored, and would also consider impacts arising from activities other than fishing. Consideration of how biological community organization is being, and can be, effectively and relevantly measured and monitored, is a necessary prerequisite to the meaningful assessment of how organization of a community might be altered by any proposed human activity.

It is suggested that MEQ and FIS are the appropriate leads of the proposed Working Group because of their mandates to investigate marine environmental quality and fisheries issues, respectively. The suggested approach to evaluate EBM will require coordination with a proposed MEQ/FIS Working Group on *Marine aquaculture*, if formed, with potential benefits from close interaction because of the significant scale of aquaculture and its impacts on coastal waters, notably in Asian countries.

<u>Proposed Terms of Reference</u>

1. Provide a summary of EBM definitions and national initiatives to implement or address EBM, and progress that has been achieved in pilot initiatives to date. Describe how each nation is working towards integrating environmental management and fisheries management from a policy/legislative point of view.
2. Briefly summarize EBM initiatives being undertaken elsewhere in the world, and in particular in the North Atlantic and around Australia and the Antarctic. Evaluate the indicators from the 2004 Symposium on "Quantative ecosystem indicators for fisheries management" for usefulness and application to the North Pacific.
3. Describe the ecological boundaries ("eco-regions", "large marine ecosystems") recognized by each PICES member country in which EBM is being, or could be, implemented, including a description of the relationship between these ecological boundaries, existing PICES regions, and national and international management jurisdiction boundaries. Identification of the major impacts and/or threats in each eco-region should be done in order to provide a

basis for the selection of appropriate indicators.

4. Provide recommendations on the science needed to enable EBM initiatives to be more fully implemented by PICES member countries. Recommendations might address, for example, the scientific merits of a common case study site for pilot EBM study; opportunities on how adjacent countries might explore common initiatives in trans-boundary; commonly-defined, eco-region areas; and the organization of topic sessions or workshops to broaden discussion around this complex overall topic.

The Terms of Reference listed above were prepared following a discussion at the MEQ/FIS/BIO Topic Session at PICES XII on "Ecosystem-based management science and its application to the North Pacific". The summary of the session is presented elsewhere in this Annual Report.

Recommended Co-Chairmen: Drs. Glen Jamison (Canada) and Chang-Ik Zhang (Korea).

MEQ Endnote 6

Proposal for an MEQ/FIS Working Group on
Mariculture in the 21st century – The intersection between ecology, socio-economics and production

Proposal: Working Group under MEQ and FIS
Title: Mariculture in the 21st century – The Intersection between ecology, socio-economics and production

Background

Globally the demand for seafood is increasing with projections that aquaculture in the marine environment will provide a steadily increasing proportion of the supply of seafood for human consumption. With this likely growth, aquaculture operations, including ocean ranching, are predicted to expand to additional coastal areas and most probably into the exclusive economic zones (EEZ) of several countries. Scientific progress has been made in: 1) developing standards for conduct of aquaculture operations (environmentally sound aquaculture); 2) exploratory research on the feasibility of offshore mariculture operations; and 3) evaluating the ecological risk and economic benefits from aquaculture in coastal areas and the EEZ. Less attention has been devoted to evaluating aquaculture from an ecosystem perspective. From an ecosystem perspective the questions might be – How should captive and capture fisheries be simultaneously evaluated in the context of fisheries management? What is the energy mass-balance in growth of piscivorous fish in captivity or in the wild? What are the risks and benefits of aquaculture in different marine systems (*e.g.*, coastal zone or EEZ)? What are emerging species for captive culture and what issues do they potentially represent? Another area of interest is the science underpinning harmonization/integration of aquaculture activities with other human activities that occur in the coastal zone under the concept of integrated coastal zone management. For example – What are appropriate analytical approaches to evaluate the siting of aquaculture operations related to other coastal zone management objectives?

Recent publications have called into question the merits of aquaculture, suggesting that there may be ecological or environmental trade-offs. Aquaculture itself is facing some serious problems, such as declining productivity and product quality, as well as ecosystem changes. It is time for PICES to pro-actively review the status and future of aquaculture, bring together what is known, and provide an opportunity for expert opinion on achieving sustainability in this increasingly important segment of world fisheries. The scientific activities in PICES should be on the environmental and ecosystem function, sustainability of production (e.g., carrying capacity of ecosystems), and socio-economics, and not on the technology of aquaculture or specific aspects of nutrition of cultured species. Coordination with the World Aquaculture Society is one avenue to gain

access to that expertise. Coordination with other relevant organizations (*e.g.*, NPAFC) and programs and participation in relevant meetings should be considered as appropriate to avoid duplication.

The suggested approach to evaluate the scientific issues of aquaculture from an ecosystem perspective will require interactions from all standing Scientific Committees in PICES. It is suggested, however, that MEQ and FIS are the appropriate leads of this proposed Working Group with input and advice, and participation by members, if warranted, of BIO and POC.

Additionally, because of the importance of aquaculture to China, Japan and Korea, and the level of scientific research on aquaculture in these countries, PICES scientists from these countries should have a substantive role in the proposed Working Group.

Proposed Terms of Reference

1. Develop an overview of current status and projected trends in aquaculture in marine and estuarine regions of PICES and non-PICES Pacific Rim countries (*e.g.*, India) that substantively contribute to world aquaculture.
2. Compile a list of current and emerging issues with respect to environmental and ecosystem function, sustainability of production (*e.g.*, carrying capacity of ecosystems), and socio-economics.
3. Explore coordination with the World Aquaculture Society and other relevant organizations and programs and participation in relevant meetings as appropriate.
4. Produce an outline for a volume on "Scientific issues for sustainable aquaculture in the PICES region".
5. Convene a workshop, perhaps jointly with the World Aquaculture Society, to explore these issues in detail.
6. Complete report of the results of the workshop as a PICES Scientific Report or "special issue" in a scientific journal or other accepted publication venue.

The Terms of Reference listed above were prepared following recommendations from the MEQ/BIO Topic Session at PICES XII on "Aquaculture in the ocean ecosystem". Discussion at this session also identified scientific issues to be considered in carrying out the Terms of Reference. These scientific issues are included in the summary of the session that is presented elsewhere in this Annual Report.

Recommended Co-Chairmen: Drs. Ik Kyo Chung (Korea), Carolyn Friedman (U.S.A.) and a Chinese scientist (TBD).

MEQ Endnote 7

Proposal for a ½-day MEQ Topic Session at PICES XIII on "Natural and anthropogenic introductions of marine species"

Justification

The Hawaiian Island chain ranks among the richest in flora and fauna, and among the most highly invaded of any archipelago in the world. Because PICES is meeting in Hawaii in 2004, it is appropriate to sponsor a session on species introductions in the marine environment. Further, ICES has recognized the potential serious consequences of species introductions in the marine environment, and has established two Working Groups to address both intentional and unintentional introductions, and is very interested in coordination with PICES. We propose a broad-based session, ranging from phytoplankton to fish, from the tropics to polar systems, and from the estuarine environment to the open ocean. Presentations will include broad overviews, as well as case studies from PICES countries.

Session description

Species introductions are among the most prevalent of human activities affecting natural ecosystems. In the marine environment, introductions, including most aquaculture initiatives, have resulted in both positive and

negative effects. The transport of invasive species such as phytoplankton, is thought to stem from range extensions associated with fluctuating oceanographic conditions (*e.g.*, El Niño), severe storm events (*e.g.*, typhoons), and human activities (*e.g.*, ballast water). The impact of transport processes on species distributional changes in North Pacific waters is not fully understood. Relative to the terrestrial environment, the study of introductions, and the potential for new species to become invasive, is in its infancy in marine systems. Emerging work includes introduction vectors, life history characteristics of invasive species, ocean conditions responsible for invasions, ecosystem resistance to invasion, and potential for eradication or mitigation of introductions once established. This session will seek to answer three fundamental questions: 1) What is known about different transport mechanisms? 2) What is the magnitude of ecological and economic effects arising from the transport of species? and 3) What steps can be taken to minimize real or potential effects of existent and future invasive species ?

Recommended convenors: William P. Cochlan (U.S.A.) Yasuwo Fukuyo (Japan) and Julia Parrish (U.S.A.).

Recommended co-sponsoring organization: ICES

Potential topics for presentations:

- Unintended consequences of aquaculture introductions
- When introductions become invasions: Case studies of aquatic vegetation (Spartina, Caulerpa)
- Re-introduction for restoration – helpful or harmful?
- The introduction of disease
- Influence of ocean conditions and environmental stress on the establishment of introduced species
- Atlantic salmon in Canada: Economic benefit or ecological disaster?
- Life history characteristics of invasive invertebrates

MEQ Endnote 8

Proposal for a ½-day MEQ Topic Session at PICES XIII on "Marine Protected Areas"

Justification

Many marine-focused organizations are considering the implications of marine protected areas (MPAs), and it would seem appropriate that PICES initiate a program that brings together relevant studies in PICES member countries. Hawaii, the site of the next PICES Annual Meeting, has a relatively extensive area protected through MPAs, and a session on MPAs there could be expected to encourage extensive participation by many academic and non-government organizations not presently involved with PICES.

Session description

Marine protected areas (MPAs) are increasingly being recognized as both a fishery management tool and as means to re-establish reference areas of relatively undisturbed biodiversity and productivity. There are proposals to declare substantial (20-30%) portions of all habitats as fully protected as is possible, and some studies suggest that this action may enhance local fisheries. The goals of this session are: *(i)* to review the nature and characteristics of existing and proposed MPAs in PICES countries; *(ii)* to review scientific data as to the utility of MPAs in improving our understanding of marine ecosystems and in fishery enhancement; and *(iii)* to compare experiences with MPAs in both tropical and temperate waters.

Potential convenors: Glen Jamieson (Canada) and a scientist from the western Pacific (TBD)

MEQ Endnote 9

Proposal for a 1-day MEQ Workshop on PICES XIII on "Developing a North Pacific HAB data resource – II"

Harmful Algal Blooms (HABs) are comprised of rapidly growing toxic and non-toxic species, and affect the marine ecology and economy of coastal nations. Monitoring and research activities aimed towards achieving effective predictive and mitigative strategies are underway in each PICES member nation, in many cases dealing with similar organisms or problems. These efforts will benefit from building a common data resource among PICES nations that allow inter-comparison of HAB species composition and the magnitude of environmental and economic impacts. At the joint PICES/IOC Workshop on "Harmful algal blooms – Harmonization of data" (October 2003, Seoul, Korea), representatives from PICES member countries accepted an offer from IOC/ICES to utilize their successful harmful algal event meta-database (HAE-DAT) format on a trial basis. The goal of this workshop is to provide an interim "report card" on the use of this database. The central tasks are: *(i)* to ascertain how well the database process worked; *(ii)* to identify any difficulties in data delivery from member nations; *(iii)* to assess the effectiveness of the interactive web-based window to the developing resource; and *(iv)* to determine if further modifications are needed to encompass unique aspects of Pacific Rim marine resources.

Recommended co-sponsoring organizations: IOC and ICES

Recommended convenors: Hak-Gyoon Kim (Korea) and Vera Trainer (U.S.A.)