REPORT OF WORKING GROUP 19 ON ECOSYSTEM-BASED MANAGEMENT SCIENCE

Working Group (WG 18) on *Ecosystem-based management science and its application to the North Pacific* held its first meeting from September 28-30, 2005. The WG 19 Co-Chairmen, Drs. Glen Jamieson and Chang-Ik Zhang, welcomed the participants (*WG 19 Endnote 1*) and reviewed the agenda for the meeting (*WG 19 Endnote 2*). Ms. Patricia Livingston, the third WG 19 Co-Chairman, was unable to attend due to travel interruptions enroute to Vladivostok.

Making terms of reference useful to PICES (Agenda Item 2)

There seems to be a significant difference between regions: Japan, China, and Korea have relatively perturbed ecosystems, and much of the national emphasis is on fisheries and aquaculture; on the other hand, Russia, Canada, and the United States seem to emphasize maintaining less-impacted, historical ecosystem characteristics. Valuable perspectives were offered from other parts of the world (*e.g.*, ICES, Australia).

WG 19 proposes to produce a brochure on ecosystem-based management (EBM), following the template of the well-received approach used by the PICES Study Group on *Fisheries and Ecosystem Responses to Recent Regime Shifts.* The brochure would be an executive summary of the final report of the Working Group and would focus on (1) the need for EBM, (2) objectives for EBM, (3) consequences of not moving to EBM, and (4) research that is needed to move towards EBM.

Revision of ocean management reporting format (Agenda Item 3)

The draft management plan was reviewed and streamlined to increase the focus on the general characteristics at the eco-region level. For each section, a list of questions was prepared for members from each country to answer about the status of management in their respective jurisdictions (*WG 19 Endnote 3*).

National marine ecosystem monitoring approaches, plans and issues (Agenda Item 4)

All member countries represented at Vladivostok gave overviews of their existing ecosystem monitoring approaches (neither China nor Japan sent Working Group members to the meeting). Monitoring approaches exist in each country, although each identified many data gaps, difficulty with data accessibility, and a lack of integration among monitoring programs. Dr. Elizabeth Fulton summarized the Australian approach to EBM-based monitoring. Some member nations have monitoring programs, though not necessarily organized in an EBM conceptual framework.

WG 19 proposes to establish a standardized format for reporting monitoring in each country, focusing on biological monitoring, physical monitoring, human influences, modeling, and ecosystem status reporting (*WG 19 Endnote 4*).

Overview of the 2004 IOC/SCOR symposium on "*Quantitative ecosystem indicators for fisheries management*" (Agenda Item 5)

Dr. Ian Perry provided a summary of a symposium that was held from March 31 – April 3, 2004, in Paris, France. Selected papers from the symposium were published in the *ICES Journal of Marine Science* (2005, Vol. 62, No. 3). The symposium had two major themes: (1) to provide an overview of the range of indicators of exploitation and state of ecosystems developed for fisheries management; and (2) to examine scientific basis for incorporating indicators into ecosystem-based fisheries management (EBFM). Over 100

indicators were proposed, and some included reference points or reference directions. All papers advocated multiple indicators, and most indicators were derived from fisheries-independent surveys. The symposium did not achieve consensus on which indicators to use, but the general consensus was that the identification of indicators is an important task but it is work in progress.

Dr. Perry described the properties of good indicators, an eight-step procedure for identifying them, how to determine screening criteria, and the general approaches used in applying them (empirical *vs*. theoretical, which seem to converge on which indicators are strongest, according to ICES symposium papers by Drs. Jason Link and Elizabeth Fulton).

Dr. Fulton noted that indicators based on data from fishery-independent surveys are not available in all parts of the world because countries cannot afford them. Models and empirical studies suggest that restricting the choice of indicators to fishery-dependent data can result in incorrect conclusions being drawn from the indicator data. Therefore, priority should be placed on the use of fishery-independent data. There is optimism that this can be done, even in developing countries and new fisheries, because of increased capabilities of remote sensing and the power of coarse scale indicators (*e.g.*, body size, abundance of all individuals in a particular functional group) that may be relatively easy to monitor.

Discussion on eco-regions (Agenda Item 6)

WG 19 discussed how to define eco-regions, based largely on the Canadian experience. The "eco-region" definition includes a mixture of geological, biological and physical parameters. Eco-region boundaries tend to be fuzzy, not sharp, and indicate areas of commonality.

All countries reported on progress with eco-regional delineation. Canada has progressed farthest. Delineation of eco-regions is in progress in the United States and Russia. Korea has begun consideration of formal eco-regional delineation. All participants agreed that it would be beneficial to have regional plans that span national boundaries because many of the eco-regions in the North Pacific are trans-boundary or in international waters.

Dr. Fulton discussed the Australian approach to bio-regionalization, a hierarchical approach that is defined at large scale by information on circulation and temperature, and adds in finer scale, ecological processes as you move down the 5-level hierarchy.

To consider the scientific requirements for eco-region identification and review the existing Large Marine Ecosystem boundaries in the PICES area, WG 19 proposes to convene a 1-day MEQ/FIS Topic Session on "*Criteria relevant to the determination of unit eco-regions for ecosystem-based management in the PICES area*" at PICES XV. Travel funds are requested for 1 invited speaker to attend the session.

NPRB/PICES Workshop on ecosystem indicators for the Bering Sea (Agenda Item 7)

Dr. Perry informed about a project that was funded by the North Pacific Research Board to integrate ecological indicators in the North Pacific, with an emphasis on the Bering Sea. Four activities were identified for a workshop to be held May 31 – June 2, 2006, in Seattle:

1. Involve Bering Sea and international communities in developing a set of operational objectives for southeastern Bering Sea ecosystem;
2. Evaluate the NOAA/Fisheries "*Ecosystem Considerations*" chapter that is prepared annually for the North Pacific Fishery Management Council and the PICES North Pacific Ecosystem Status Report, with the goal of integrating the results;
3. Investigate methodologies to monitor system-wide structural ecosystem changes within the marine ecosystem;
4. Identify steps in valuating indicator performance that improve the monitoring network, and integration into predictive models.

Findings from this workshop are important for identifying criteria for ecosystem indicators.

Action items to be completed prior to the next WG 19 meeting (Agenda Item 8)

1. Compile national and international (*e.g.*, PICES, LMEs, "Sea Around Us" project (D. Pauly), Longhurst) approaches (maps, processes used to identify area) to establishing science-based eco-regions, and compare these to existing or planned "management" regions. Gather together all delineated areas (*e.g.*, fishery statistical areas, LOMAS, management areas, *etc*.) and digitize for GIS display. Identify areas of cooperation/collaboration between adjacent countries to jointly evaluate cross-jurisdictional areas with the goal of trying to establish common eco-regions. These deliberations may be useful in updates of the North pacific Ecosystem Status Report.
   - Lead – all countries
   - Submission deadline – January 1, 2006
   - Product – summary GIS chart and report; G. Jamieson and I. Perry for Canada; D. Fluharty and J. Stein for US; by July 1, 2006.

2. Consider a theoretical evaluation of the consequences of an artificial boundary that splits an ecological process and how that could affect management.
   - Lead – C. Harvey and E. Fulton (ghost collaborator)
   - Deadline – July 1, 2006
   - Product – report and presentation at next meeting, as well as a paper to be published in peer-reviewed literature.

3. Each country will complete at least one Ocean management activity report. The intent is to show the process and framework that each country is using to implement an ecosystem approach to management. In selecting a region, consider regions where there is more than one significant management issue (*e.g.*, fishing and oil and gas exploration).
   a. Leads – All WG members
   b. Deadline – June 1, 2006
   c. Product – reports

4. Describe national ecosystem monitoring approaches relevant to the eco-regions considered in #3 (above). Monitoring activities should be grouped by category.
   - Lead – all countries
   - Deadline – June 1 2006
   - Product – reports

5. Summarize the findings from the 2004 symposium on "*Quantitative ecosystem indicators for fisheries management*"
   - Lead – I. Perry and P. Livingston (with assistance from E. Fulton)
   - Deadline – January 1, 2006
   - Product – reports

6. Summarize findings from the upcoming PICES/NPRB workshop on the framework and criteria for identifying ecosystem indicators. Invite members of MONITOR to WG 19 meetings.
   - Lead – WG members that participate in the workshop
   - Deadline – October 2006, next WG 19 meeting
   - Product – preliminary report

7. Hold a mini-symposium at PICES XVI on "*Comparative analysis of frameworks to develop EBM and research needed to move towards implementation of EBM*" to build on products arising from the PICES/NPRB Bering Sea Indicators workshop. Each country would present their perspective. Invited speakers will address issues such as case studies, lessons learned, indicators, *etc*. WG 19 should invite participation by other PICES Committees (*e.g.*, MONITOR) and WGs/Sections. Consider "over-arching" questions such as the following (also proposed bases for a brochure-type publication):
   - scientific need for EBM and consequences of not moving to EBM,
   - objectives for EBM,
   - ways to move towards EBM,
   - research needs to move towards EBM.

   Co-Chairmen to present brochure concept to parent PICES Committees in 2006.

8. Next meetings:
   - A 3-day PICES/NPRB Workshop on "*Integration of ecological indicators for the North Pacific with emphasis on the Bering Sea*" to be held May 31-June 2, 2006, in Seattle, U.S.A.;
   - A 3-day WG 19 meeting prior to PICES XV (October 2006, Yokohama, Japan);
   - A 1-day MEQ/FIS Topic Session on "*Criteria relevant to the determination of unit eco-regions for ecosystem-based management in the PICES area*" at PICES XV.

WG 19 Endnote 1

Participation list

Members

Elena Dulepova (Russia)
David Fluharty (U.S.A.)
Christopher Harvey (U.S.A.)
Glen Jamieson (Canada, Co-Chairman)
Jae-Bong Lee (Korea)
R. Ian Perry (Canada)
Vladimir Radchenko (Russia)
Inja Yeon (Korea)
Chang-Ik Zhang (Korea, Co-Chairman)

Observers

Vladimir Belyaev (Russia)
Robin Brown (Canada)
Elizabeth Fulton (Australia)
Melissa Haltuch (U.S.A.)
Yukimasa Ishida (Japan)
Tokimasa Kobayashi (Japan)
Phillip Mundy (U.S.A.)
Hak-Gyoon Kim (Korea)
Darlene L. Smith (Canada)
John E. Stein (U.S.A.)

WG 19 Endnote 2

WG 19 meeting agenda

Wednesday, September 28

1. Welcome and introductions
2. Review terms of reference
3. Revision of ocean management reporting format
4. National marine ecosystem monitoring approaches, plans, and issues

Thursday, September 29

5. Continue descriptions of relevant national marine ecosystem monitoring approaches, plans and issues
6. Overview of the 2004 IOC/SCOR symposium on "*Quantitative ecosystem indicators for fisheries management*"
7. Review existing definitions of "eco-regions" and identify criteria that could be used for defining ecological boundaries in the PICES area

Friday, September 30

8. Discuss ideas for a PICES/NPRB workshop on ecosystem indicators for the Bering Sea planned (May-June 2006) and an inter-sessional workshop to be held in Year 2 or 3 of the WG's mandate
9. Discuss objectives, site and date for the next WG 19 meeting

WG 19 Endnote 3

Revised ocean management reporting format

Ocean management activities

- Eco-region where defined or geographic location (*e.g.*, Korean portion of Yellow Sea);
- General description of oceanographic and biological setting; if appropriate, start with PICES North Pacific Ecosystem Status Report for the description of regions;
- Relevant management plan, policy, legislation (please provide copies of these or a source, such as a website or a contact point, so that we can obtain copies);
- General form of management or any other general comments on the management regime;
- What are overall ecosystem-based management objectives?
- How will these objectives be achieved?
- What is the timeframe to implement these objectives and meet goals?

Fishery management

- Management objectives for targeted and non-targeted species in fisheries;
- How is the ecosystem taken into consideration when managing fisheries?
- How selective is the gear (*e.g.*, bottom trawl; mid water trawl; purse seine; other gear, such as long line and trap; gillnet) for the target species?
- Fishery gear targets certain sizes or life-history stage(s);
- Is fishery spatially concentrated, or not?
- Is fishery year round, or not?
- Are certain geographic areas excluded from the fishery? Explain reason for the exclusion.
- Are there catch limits on non-target species?
- Is the catch of non-target species recorded and accounted for?
- What is the environmental variability (*e.g.*, physical disturbance regime; El Niño, typhoon, changes in strength of currents) and how do species respond, if known?
- What is the spatial distribution of the fishery compared to the distribution of the target species?

Management of threatened or protected species and communities

- General approach to designation (legal/regulatory framework), management and recovery of threatened or protected species/communities (describe ecological properties of the species or groups that makes them vulnerable and needing protection);
- Is there legislation for designating species at risk?
- How are threatened species identified, and are there timeframes for developing recovery plans?
- Are recovery thresholds identified above which a species no longer needs legal protection?

Habitat management (conservation/restoration)

- General approach to management of habitats; this includes biological habitat, such as corals, sea-grass beds, *etc*., as well as physical habitat (describe ecological properties of the habitat that makes it significant.);
- Are specific habitats designated for protection, and what legislation allows for the designation?
- Are there monitoring and inventory activities in place?
- Are there restoration plans or activities underway?
- Are there ecologically or biologically significant habitat types/areas that can be identified and are they given special protection, and are there standards (*e.g.*, no activities allowed or just limitation of human activities in the habitat) for the level of protection?

Community/trophic structure management

- Are the characteristics of the community altered by human activities (*e.g.*, eutrophication, pollution, species introductions, sedimentation, altered coastal circulation, dredging and filling, altered hydrography of rivers, fishing, etc.)?

- Are management activities affecting food-webs or do existing food web perturbations constrain moving to a desired state.
- Does specific legislation address issues relevant to food webs?
- Are there monitoring and inventory activities in place?
- Are there restoration plans or activities underway?
- Are there ecologically or biologically significant species interactions that can be identified and are they given special consideration, and are there standards (*e.g.*, ballast water, coastal development, water quality etc.) for the level of protection?

Management of contaminants and pollutants

- General approach to management of ecosystem-wide effects of contaminants and pollutants;
- Does specific legislation address issues relevant to contaminants?
- Are there monitoring and inventory activities and standards in place?
- Are there restoration plans or activities underway?
- Which aspects of the ecosystem are being most affected by the effects of contaminants?

Management of aquaculture

- General properties of the aquaculture activities (*e.g.*, stocking or releasing of seed/fry/juvenile, production of individuals in contained environments);
- Do specific regulations address issues relevant to species selection, scale of the operation, spatial distribution, and environmental impacts of activities?
- Are there monitoring and inventory activities in place?
- Are there mitigation plans or activities underway?
- Are there significant ecological and biological interactions that can be identified and are they given special consideration?

Management of enhancement activities (species and habitat)

- General properties of the enhancement activities (*e.g.*, stocking or releasing of fry/juvenile, putting in artificial reefs, making seaweed beds, *etc*.);
- Do specific regulations address issues relevant to species selection, scale of the operation, spatial distribution, and environmental impacts of activities?
- Are there monitoring and inventory activities in place?
- Are there mitigation plans or activities underway?
- Are there significant ecological and biological interactions that can be identified and are they given special consideration?

WG 19 Endnote 4

Standardized format for reporting national monitoring

- Habitat classification (biogeographic zone)
- Biodiversity
- Species population abundance (fish, HABs, *etc*.)
- Species spatial distribution and movements (migration routes) – ecologically and biologically significant areas
- Temporal changes (cycles and trends) in physical environment
- Human influences
  - Pollution level, sedimentation, exotics, habitat alterations
  - Spatial locations (*e.g*., vessel location monitoring (VMS))
- Modeling, predictions and forecasting (identification of key indicators or gaps in knowledge)
- Ecosystem status reporting (state of ocean report); planning for reporting
- Level of integration, monitoring systems and data management and access

WG 19 Endnote 5

Proposal for a 1-day MEQ/FIS Topic Session at PICES XV on "*Criteria relevant to the determination of unit eco-regions for ecosystem-based management in the PICES area*"

The management of human activities that impact ocean ecosystems requires planning and engagement of stakeholders to meet the objectives of ecosystem-based management, which in turn requires identification of areas to determine which stakeholders need to be involved in each specific process. Area boundaries are typically based upon science (*i.e.* eco-regions), human community (*i.e.* coastal community composition), administrative (*i.e.* historical resource management areas) and international considerations (*i.e.* transboundary issues). This session will consider the science requirements for eco-region identification in the PICES area, and we solicit presentations that: 1) highlight national or regional experiences or frameworks in place for delineating marine sub-regions or eco-regions; 2) demonstrate the use of a variety of physical and/or biological criteria for region identification; or 3) explain the specific management purposes behind various sub-regional identification schemes. Session discussion will involve participants in reviewing the existing Large Marine Ecosystem boundaries of the PICES area and developing recommendations for criteria to be used in sub-regional identification in the North Pacific.

Recommended convenors: Glen Jamieson (Canada), Patricia Livingston (U.S.A.) and Chang-Ik Zhang (Korea).

WG 19-2005