

Acknowledgment

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Abbreviations and Acronyms

ABC	Allowable biological catch
ACC	Area Coordinating Committees, Japan
ADFG	Alaska Department Fish and Game
AMD	Acid mine drainage
ANN	Artificial neural network
As	Arsenic
BAEP	Basic Act of Environment Policy, Korea
BCCDC	British Columbia Conservation Data Centre
BOD	Biological oxygen demand
BRP	Biological reference point
BSAI	Bering Sea and Aleutian Islands
CCA	Cowcod Conservation Area, U.S.A.
CCIMA	Central Coast Integrated Management Area, Canada
CCLCRMP	Central Coast Land and Coastal Resource Management Plan, Canada
CCME	Canadian Council of Ministers of the Environment
Cd	Cadmium
CEAA	Canadian Environmental Assessment Agency
CEC	Commission for Environmental Cooperation of North America
CEDP	Community Economic Development Program
CEPA	Canadian Environmental Protection Act
CFIA	Canadian Food Inspection Agency
CITES	Convention on International Trade in Endangered Species
CN	Cyanide
CNY	Chinese yuan
COD	Chemical oxygen demand
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPS	Coastal pelagic species
CSSP	Canadian Shellfish Sanitation Program
CWS	Canada-wide Standard
CZMA	Coastal Zone Management Act, U.S.A.
DEPOMOD	Particle tracking model used in aquaculture waste modelling
DFO	Department of Fisheries and Oceans, or Fisheries and Oceans Canada
DO	Dissolved oxygen
DPSIR	Driver-Pressure-State-Impact-Response
EAM	Ecosystem approach to management
EBFM	Ecosystem-based fisheries management
EBM	Ecosystem-based management
EBS	Eastern Bering Sea
EBSA	Ecologically and Biologically Significant Area
Ecopath/Ecosim	Ecological/Ecosystem modelling software
EEZ	Exclusive Economic Zone
EFH	Essential fish habitat
EIA	Environmental impact assessment
EIS	Environmental Impact Statement
EL	Equilibrium line
EMA	Environmental Management Act, British Columbia
ENSO	El Niño–Southern Oscillation

EO	Ecosystem objective
EOA	Ecosystem Overview Assessment
EPA	Environmental Protection Agency, U.S.A.
ESA	Endangered Species Act, U.S.A.
ESS	Ecologically significant species
ESSCP	Ecologically significant species and community properties
ESSIM	Eastern Scotian Shelf Integrated Management, Canada
FAO	Food and Agriculture Organization, UN
FCA	Fisheries Cooperative Association, Japan
FIS	Fishery Science Committee, PICES
FMO	Fishery Management Organization, Japan
FMP	Fishery Management Plan, U.S.A.
FMR	Fisheries Management Region, Russia
FTA	Free Trade Agreement
FUTURE	Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems program, PICES
FWS	Fish and Wildlife Service, U.S.A.
GBAP	Georgia Basin Action Plan, Canada
GEF	Global Environmental Fund
GLOBEC	Global Ocean Ecosystem Dynamics Programme
GOA	Gulf of Alaska
GS	General Status of Wildlife in Canada
GVRD	Greater Vancouver Regional District, British Columbia
HAB	Harmful algal bloom
HADD	Harmful alteration, disruption or destruction
HAPC	Habitat areas of special concern
Hg	Mercury
HMP	Habitat Management Plan, Canada
HMS	Highly migratory species
EIM	Integrated ecosystem management
IFQ	Individual fishing quota
IM	Integrated Management
IMO	International Maritime Organization, UN
IPHC	International Pacific Halibut Commission
IPMA	Integrated Pest Management Act, British Columbia
IR/IU	Improved retention/improved utilization
IUCN	International Union for Conservation of Nature and Natural Resources
IVQ	Individual vessel quota
JPOI	Johannesburg Plan of Implementation
LME	Large marine ecosystem
LOMA	Large Ocean Management Area
MAFF	Ministry of Agriculture, Forestry and Fisheries, Japan
MARPOL	Marine Plastic Pollution Research and Control Act, U.S.A.
MBTA	Migratory Bird Treaty Act, U.S.A.
MEOW	Marine Ecoregions of the World
MEQ	Marine Environmental Quality (also Marine Environmental Quality Committee, PICES)
MIFAFF	Ministry of Food, Agriculture, Forest and Fisheries, Korea
MMPA	Marine Mammal Protection Act, U.S.A.
MOE	Ministry of Environment, British Columbia
MOMAF	Ministry of Maritime Affairs and Fisheries, Korea
MPA	Canada's Oceans Act-legislated marine protected area
mpa	Marine protected areas in general, <i>i.e.</i> , legislated by <i>Acts</i> other than Canada's Oceans Act
MRA	Maximum retention allowance
MRB	Maximum retainable bycatch

MSE	Management strategy evaluation
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act, U.S.A.
MSST	Minimum stock size threshold
MSVPA	Multispecies virtual population analysis
MSY	Maximum sustainable yield
NEPA	National Environmental Policy Act, U.S.A.
NFRDI	National Fisheries Research and Development Institute, Korea
NMFS	National Marine Fisheries Service, U.S.A.
NOAA	National Oceanic and Atmospheric Administration, U.S.A.
NPESR	North Pacific Ecosystem Status Report, PICES
NPFMC	North Pacific Fishery Management Council, U.S.A.
NWFSC	Northwest Fisheries Science Center, NOAA
OAP	Ocean Action Plan, Canada
OECD	Organisation for Economic Co-operation and Development
OFL	Overfishing level
OY	Optimum yield
PA	Precautionary approach
PBR	Potential biological removal
PCA	Principal components analysis
PCB	Polychlorinated biphenyl
PCPA	Pest Control Products Act, Canada
PDO	Pacific Decadal Oscillation
PFMC	Pacific Fishery Management Council, U.S.A.
PICES	North Pacific Marine Science Organization
PMRA	Pest Management Regulatory Agency, Canada
PNCIMA	Pacific North Coast Integrated Management Area, Canada
PULSE	<i>PICES Understanding, Linking and Synthesis of Ecosystems</i>
RCA	Rockfish Conservation Area, U.S.A.
RFCC	Regional Fisheries Coordinating Committees, Japan
ROV	Remotely operated vehicle
SAFE	Stock Assessment and Fishery Evaluation documents
SAIP	Stock Assessment Improvement Plan, U.S.A.
SakhNIRO	Sakhalin Research Institute of Fisheries and Oceanography, Russia
SARA	Species at Risk Act
SCOR	Scientific Committee on Oceanic Research
SEP	Salmonid Enhancement Program
SOA	State Oceanic Administration, China
SSB	Spawning stock biomass
SSC	Science and Statistical Committee, NPFMC
TAC	Total allowable catch
TAE	Total allowable effort
TINRO-Center	Pacific Research Institute of Fisheries and Oceanography, Russia
TMDL	Total maximum daily load
UNCED	UN Conference on Environment and Development
UNCLOS	UN Convention on the Law of the Sea
USSR	Union of Soviet Socialist Republics
VMS	Vessel monitoring system
WGEO	Working Group on Ecosystem Objectives
WMA	Waste Management Act, British Columbia
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WWTP	Municipal wastewater treatment plant
YRCA	Yelloweye Rockfish Conservation Area, U.S.A.

Executive Summary

In October 2004, PICES Working Group on *Ecosystem-based Management Science and its Application to the North Pacific* (WG 19) was established, under the direction of the Marine Environmental Quality Committee (MEQ) and Fishery Science Committee (FIS), with the following terms of reference:

1. Describe and implement a standard reporting format for Ecosystem-based Management (EBM) initiatives (including more than fishery management) in each PICES country, including a listing of the ecosystem based management objectives of each country.
2. Describe relevant national marine ecosystem monitoring approaches and plans and types of models for predicting human and environmental influences on ecosystems. Identify key information gaps and research and implementation challenges.
3. Evaluate the indicators from the 2004 Symposium on “*Quantitative Ecosystem Indicators for Fisheries Management*” for usefulness and application to the North Pacific.
4. Review existing definitions of “ecoregions” and identify criteria that could be used for defining ecological boundaries relevant to PICES.
5. Hold an inter-session workshop in Year 2 or 3 of the WG’s mandate that addresses the status and progress of EBM science efforts in the PICES region, with the deliverable being either a special journal issue or a review article.
6. Recommend to PICES further issues and activities that address the achievement of EBM in the Pacific.

The second term of reference above was never addressed, as it was later realized that no PICES country was advanced enough in EBM applications to be at the stage where it was monitoring and actively practicing EBM.

This Working Group report builds on the earlier Study Group on *Ecosystem-based Management Science and its Application to the North Pacific* report (Jamieson and Zhang, 2005), which documented that:

1. EBM challenges are different in China, Japan and Republic of Korea compared with Canada, Russia, and the United States because of differences in coastal population sizes and their different exploitation histories for most harvestable renewable resources. For the former three countries, EBM is, initially at least, focused on (a) minimizing existing impacts, (b) rebuilding depleted stocks to more acceptable levels, and (c) minimizing, in nearshore areas in particular, widespread impacts in the marine environment from land runoff from both industrial and urban developments. In contrast, human coastal populations and urban development in the latter three countries were generally much less, with fishing impacts and offshore oil and gas development and transport identified as the major impacts. In many instances, relatively unaffected habitat and biological communities still exist, and so the challenges there are often how to maintain them while permitting appropriate new economic activities to occur; and
2. While there are many human activity impacts on the marine environment (*e.g.*, fishing, mariculture, oil and gas exploration and development, pollution from land-based activities, disruption of freshwater discharges by urbanization, *etc.*), a relative lack of comprehensive databases has meant that reporting of ecosystem impacts has mostly focused on documenting and addressing only fishery impacts.

To date, management of human activities in the marine environment has been primarily sector-focused. For instance, fisheries have targeted commercially important species, without explicit consideration of non-commercial species and broader ecosystem impacts. There is an increasing international awareness of the cumulative impacts of sector-based activities on the ecosystem and the need to take a more holistic or EBM approach to ensure the sustainability of marine ecosystems. In this report, we track progress toward developing ecosystem approaches by PICES member countries in the North Pacific. The primary focus is on fisheries as one of the most common economically and socially beneficial uses of the North Pacific ecosystem. However, fisheries can be a significant driver of ecosystem change. Still, as is discussed herein, there are many other activities of importance to countries in the North Pacific and these, too, are increasingly becoming part of the

forward looking evaluation of ecosystem approaches to management (EAM). The diversity in approaches taken by the different PICES member countries is seen positively as experimenting with the concept of EAM/EBM consistent with each country's experience and circumstances. Through the process of documenting this diversity, it can be discerned about what works and does not work under particular circumstances. We therefore, also look beyond fisheries applications and suggest what a fully integrated EAM might entail as a long-term goal of management.

This report provides a summary of the emerging consensus on indicators of marine ecosystems, and makes recommendations applicable to North Pacific waters of PICES interest. In addition, it attempts to take a broader view of indicators for EBM of marine systems rather than the narrower application to fisheries management (even though most research to date has focussed on this narrower application). Specific recommendations relating to indicators include that PICES should:

1. explore the use of a consensus suite of indicators in each of its regions to develop a common set of indicators to be included in each iteration of the PICES North Pacific Ecosystem Status Report;
2. use the WG 19 Ocean Management Activity reports and FIS and MEQ committee inputs to help identify region-specific drivers of change and pressure measurements in order to interpret relevant status indicators;
3. establish collaborations with social scientists to develop indicators which describe the coupled marine social-ecological system and expand the understanding of human behaviors and responses to environmental forcing from the marine sector; and
4. recommend a research activity to explore the use of additional indicators for marine ecosystem-based management in each of its regions, building from those outlined here and elsewhere.

Accounting for spatially explicit trends, processes and relationships is a main component of EBM, and so the identification of spatial characteristics and the relevant spatial scales of marine ecosystems is important to provide a context for identifying stakeholders, defining objectives, conducting research, and implementing policies focused on sustainable management of species, goods and services. The Working Group found broad consistency in the criteria used to define and delineate marine ecosystems in the territories of PICES member countries, even though the member countries approached the issue in several different ways. All PICES countries also acknowledged cases where ecosystems extend beyond their Exclusive Economic Zone (EEZ), either into another nation's EEZ or into international waters. However, National Summaries contain less information about waters that lie beyond continental slopes and outside of their EEZs, even in cases where those waters are deemed part of the same ecosystem as (and are thus thought to be ecologically linked to) waters lying nearer to shore. PICES member countries varied widely in the formality of their approaches and the extent of their progress with respect to ecosystem delineation and sub-regionalization. Finally, at least two major challenges remain for formal delineation of ecosystems and subregions in the PICES area. First, PICES member countries need to determine the priority of developing, defining and implementing a standardized template for ecosystem delineation. This is relevant because many suggested ecoregions extend beyond national boundaries. Currently, such a template does not exist and its priority, both within individual nations and within PICES, remains unclear. Second, the delineation schemes described above were largely prepared by fisheries ecologists and likely reflect biases inherent to this sector. The limitations and consequences of those biases would need to be addressed, likely through inclusion of a broader number of disciplines.

The PICES EBM topic sessions and workshops held in association with Annual Meetings in Vladivostok, Russia (2005, Session 8 on "*Ecosystem indicators and models*"); in Yokohama, Japan (2006, Workshop W3 on "*Criteria relevant to the determination of unit eco-regions for ecosystem-based management in the PICES area*") and in Victoria, Canada (2007 Workshop W3 on "*Comparative analysis of frameworks to develop an ecosystem-based approach to management and research needed for implementation*") made progress in highlighting the above issues with respect to implementation of EBM in PICES member countries. From the presentations, especially at the 2007 workshop, it was clear that member countries are in different stages of implementation with respect to EBM. Some countries are still working on incorporating an ecosystem approach to fisheries management while others have national legislation that provides a mechanism for implementing a cross-sectoral approach to the management of marine activities to ensure environmental protection. The degree of advancement might be partly related to the nature of the different human pressures being exerted on the

marine environment. Even some of the countries that appeared to be more advanced in their implementation mentioned problems in actually making cross-sectoral management work in marine ecosystems. Particularly, the need for overarching legislation that requires action may be needed. It was clear that more than one agency was involved in EBM activities in each country and a challenge is to get agencies to work together in implementation. It was also noted that the main type of legislation in most nations that forced this cross-sectoral implementation was species-at-risk legislation.

Data requirements for EBM were discussed to some extent. The Australian experience demonstrated that implementation could involve both highly quantitative approaches and models if data are available but the framework could also include methods to evaluate ecosystem status and potential impacts even in qualitative ways. The ICES experience demonstrated how highly evolved data gathering for EBM advice could be, although it was noted that highly evolved advice did not necessarily translate into the political will to follow such advice. The PICES Technical Committee on Monitoring (MONITOR) outlined some of the data requirements that would require its involvement along with the involvement of all the PICES Committees. The 2007 workshop particularly noted the lack of socio-economic data to aid in decision-making in an EBM context.

Analytical tools being developed to aid in EBM frameworks included the highly structured risk assessment framework of Australia that allows for both quantitative and qualitative evaluation of risks and defining when actions are needed. The PICES MODEL Task Team described the suite of modeling tools that might be used to understand impacts of climate variability on marine ecosystems. Models such as Atlantis, used in the evaluation of management strategies, seem to be important tools in EBM decision-making.

Communicating results of EBM activities is ongoing in PICES member countries. Some are using highly structured reporting instruments such as ecosystem assessment documents. ICES advisory structure for communicating EBM advice in a tactical way is highly evolved although reporting its success in implementing EBM might not be so advanced. Reporting of ecosystem status is important but it was also recognized that identification and reporting of ecosystem pressures and ecosystem responses to management are important pieces of communication of EBM progress. Communicating measures of human health was noted as important in this regard. The PICES role in communicating EBM was seen to be more of a strategic one. There are a variety of potential scales useful in reporting results.

A major outstanding research gap is the need for inclusion of social science indicators and information. The advancement of risk assessment frameworks and tools also seemed particularly important.

Looking Beyond WG 19

We discussed how the findings and work of WG 19 could best be integrated and built upon within PICES in years ahead, particularly within the context of the new PICES integrative science program on **F**orecasting and **U**nderstanding **T**rends, **U**ncertainty and **R**esponses of North Pacific Marine Ecosystems (FUTURE). Development of EBM is still very much in its early stages in each of the PICES member countries, and so we recommend that PICES continue to actively monitor progress into the foreseeable future. To provide a long-term forum for this process, we concluded that the issues addressed by WG 19 might justify the establishment of a new group, with emphasis on developing an integrative, science-based, ecosystem-scale understanding of the human dimension (across a diversity of sectors). This group will be closely associated with FUTURE's Advisory Panel on *Anthropogenic Influences in Coastal Ecosystems* (AICE). We suggest the new group be called "*PICES Understanding, Linking and Synthesis of Ecosystems*" (PULSE). Below is a draft proposal on the objective, terms of reference and membership recommendations for PULSE:

Objective

To monitor and synthesize regional and basin-wide ecosystem-based management (EBM) studies and initiatives (ecosystem health) and to provide a forum for the integration of FUTURE-related EBM practices and their implementation.

Draft Terms of Reference

1. PULSE (*PICES Understanding, Linking and Synthesis of Ecosystems*) is the scientific body responsible for the promotion, coordination, integration and synthesis of research activities related to the implementation of EBM among PICES member nations. This goal would be accomplished by convening meetings, periodic scientific symposia or workshops, and by distributing information designed to foster cooperation and integration among existing or developing PICES programs, and possibly between and/or within member nations.
2. PULSE will provide the scientific body to identify and improve indicators to measure progress in the achievement of EBM. It will provide the forum to discuss the needs, impacts and responses of coastal communities in a changing marine environment, and to enhance the use of this information by governments and society at large. It will also provide a forum for the connection of ecosystem monitoring and status reporting of both environmental and social indicators (through linkage with MONITOR), and the subsequent implementation and adaptation of EBM.
3. Scientific collaboration and coordination with other international agencies, bodies and societies that are engaged in either EBM or human activities that are relevant to the achievement of EBM will be undertaken. This will engage expertise not previously active in PICES, such as social-scientists and policy makers.
4. PULSE will encourage establishment of other component activities, such as developing the basis for coupled human science-natural science models, and emerging approaches as needed to facilitate synthesis of the FUTURE Program.

Membership

We recommend a membership that will ensure core connection with PICES Committees, key expertise from the various disciplines involved in studying ecosystem approaches to management, and national representation. We advocate a nomination process that will closely connect PULSE to PICES Scientific Committees, such as ensuring that a member or designate from each Committee and perhaps from the current Study Group on *PICES Communications* in PULSE. There is also perhaps merit in having member participation from different sectors besides fishing (e.g., mariculture) and ecoregions.

Advice on the Structure and Content of Future North Pacific Ecosystem Status Reports

WG 19 also considered advice on the structure and content of future North Pacific Ecosystem Status Reports (NPESRs), and specifically the inclusion of EBM-related topics in status reports. An incremental improvement version of NPESR is being recommended by Science Board, and we recommend that enhanced information on pollution and socio-economics be considered for inclusion. We discussed the need to identify key pressures in each region, and how indicators on status and trends describing human well-being should be determined, and concluded that further review on these topics is needed. Establishment of a PICES Study Group on *Indicators of Human Well-Being: Benefits and Health* is recommended to assist in this effort. Terms of reference for such a group might include:

1. Identify potential indicators of human-well being and human impacts in relation to the PICES report on marine ecosystem status and trends; evaluate the Millennium Ecosystem Report indicators for their appropriateness.
2. Review how these measures might be quantified and standardized across member countries, and if the data are available to quantify these.
3. Review how these measures can be used in ecosystem models and management strategy evaluation frameworks.

4. Identify longer-term issues that might be covered by a working group on this topic (governance structures for implementation, *etc.*).

Criteria for selection of membership should include natural and social scientists, including in the latter those with strong economic, sociological and anthropologic expertise who are working on questions relating to marine ecosystem approaches and management issues.

Ecosystem-based Management in International Waters

In the above, all details and discussion presented have been focused on initiatives being undertaken within the EEZs of PICES member countries. While significant progress is being made in these regions to address issues related to EBM, the reality is that many species have spatial distributions in the Pacific Ocean that extend well beyond national jurisdictions. For these species, effective EBM can only be realized if national efforts to achieve EBM are harmonized with similar multinational efforts in international waters. To this end, many of the initiatives to determine appropriate EBM steps in national waters, such as identifying ecoregions (spatial areas with a basically similar mix of species and environment) and within them, ecologically and biologically significant areas and species, need to be undertaken in offshore international waters of the PICES region.

1 Introduction

Jamieson and Zhang (2005) noted that 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 biodiversity, productivity and physical and chemical properties of an ecosystem. EBM worldwide is now recognized as both timely and necessary because 1) in many environments, individual ecosystem components are presently being utilized, harvested or impacted with limited attention paid to the maintenance of the integrity of the overall ecosystem, and 2) the scale of these impacts is now so large that there is real danger of overall negative ecosystem change to the detriment of human society. Following recommendations of the PICES Study Group on *Ecosystem-based Management Science and its Application to the North Pacific* (Jamieson and Zhang, 2005), a working group was formed (Appendices 1 and 6) to deal with these issues, and this report builds on that initiative.

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1. Describe and implement a standard reporting format for EBM initiatives (including more than fishery management) in each PICES country, including a listing of the ecosystem based management objectives of each country.
2. Describe relevant national marine ecosystem monitoring approaches and plans and types of models for predicting human and environmental influences on ecosystems. Identify key information gaps and research and implementation challenges.
3. Evaluate the indicators from the 2004 Symposium on “Quantitative Ecosystem Indicators for Fisheries Management” for usefulness and application to the North Pacific.
4. Review existing definitions of “ecoregions” and identify criteria that could be used for defining ecological boundaries relevant to PICES.

5. Hold an inter-sessional workshop in Year 2 or 3 of the WG’s mandate that addresses the status and progress of EBM science efforts in the PICES region, with the deliverable being either a special journal issue or a review article.
6. Recommend to PICES further issues and activities that address the achievement of EBM in the Pacific.

The second term of reference above was never addressed, as it was later realized that no PICES country was advanced enough in EBM applications to be at the stage where it was monitoring and actively practicing EBM.

This is the final report of WG 19. It should be noted, though, that establishment of ecosystem-based approaches to management of human activities in the marine environment is very dynamic, and in the three years that this report has been in preparation, numerous changes have occurred in each of the PICES member countries. While attempts have been made to provide the most relevant and recent data at the time of report completion, there are likely many instances where, by the time this report is published, some elements may be somewhat dated. Nevertheless, this report does provide a snapshot in time in documenting where the different PICES countries are in their progress towards their achievement of EBM. Implementation of EBM is best viewed as an incremental adaptive approach, and thus countries should be considered to be in a constant process of adaptation toward achieving an agreed upon ecosystem approach to management.

This report is structured to first provide an overview of why EBM is relevant today, the incentives that are making its implementation such a high priority in each PICES member country, and how EBM is being approached by each of the six member countries in the North Pacific. Section 2 tracks the progress toward developing ecosystem approaches, and while the primary focus is on fisheries as one of the most common economically and socially beneficial uses of the North Pacific ecosystem and one that may be a significant driver in ecosystem change, there are many other relevant human activities of importance to

PICES countries in the North Pacific. These too are becoming part of the forward-looking evaluation of EBM.

The next section of this report focuses on the development and utility of marine ecosystem indicators, which is currently an active research topic worldwide. This is connected with the increased interest in moving forward with EBM of marine resources, and recognition of the need to index and summarize the state of marine ecosystems.

Section 4 focuses on identifying the spatial characteristics of North Pacific ecosystems, and how the different PICES member countries have incorporated these features into their management regimes. Because accounting for spatially explicit trends, processes and relationships is a main component of EBM, it follows that the spatial characteristics of marine ecosystems need to be identified in order to provide a context for identifying stakeholders, defining objectives, conducting research, and implementing policies focused on sustainable management of species, goods and services.

The report concludes by presenting a brief overview summary of regional approaches to EBM, and their implications, and suggests relevant actions for PICES in the future, *i.e.*, beyond the end of WG 19. It addresses the fact that while all EBM activities to date in the North Pacific are occurring within the Exclusive Economic Zones (EEZs) of member countries, *i.e.*, from the edge of each country's territorial sea (up to 12 nautical miles (22 km)) out to 200 nautical miles (370 km) from its coast, recent international conventions are beginning to focus development of EBM in international waters, *i.e.*, beyond the EEZs.

Finally, the PICES EBM topic sessions and workshops held in association with Annual Meetings in Vladivostok, Russia (2005, Session S8 on

"Ecosystem indicators and models"); in Yokohama, Japan (2006, Workshop W3 on *"Criteria relevant to the determination of unit eco-regions for ecosystem-based management in the PICES area"*) and in Victoria, Canada (2007 Workshop W3 on *"Comparative analysis of frameworks to develop an ecosystem-based approach to management and research needed for implementation"*); see Appendix 5) made progress in highlighting the above issues with respect to implementation of EBM in PICES member countries. From the presentations, especially at the 2007 workshop, it was clear that member countries are in different stages of implementation with respect to EBM. Some countries are still working on incorporating an ecosystem approach to fisheries management while others have national legislation that provides a mechanism for implementing a cross-sectoral approach to the management of marine activities to ensure environmental protection. The degree of advancement might be partly related to the nature of the different human pressures being exerted on the marine environment. Even some of the countries that appeared to be more advanced in their implementation mentioned problems in actually making cross-sectoral management work in marine ecosystems. Particularly, the need for overarching legislation that requires action may be needed. It was clear that more than one agency was involved in EBM activities in each country and a challenge is to get agencies to work together in implementation. It was also noted that the main type of legislation in most nations that forced this cross-sectoral implementation was species-at-risk legislation.

1.1 Reference

Jamieson, G. and Zhang, C.-I. (Eds.) 2005. Report of the Study Group on Ecosystem-Based Management Science and its Application to the North Pacific. PICES Sci. Rep. No. 29, 77 pp.