Report of the Study Group on *Biodiversity Conservation*

The Study Group on *Biodiversity Conservation* (SG-BC) met from 9:00 to 18:00 on October 18, 2014, at PICES-2014 in Yeosu, Korea, to review progress on its activities, prepare a set of recommendations for a new expert group, and prepare information for its final SG report. SG-BC Chair, Dr. Janelle Curtis, welcomed participants to the meeting, and introductions were made (*SG-BC Endnote 1*).

Dr. Curtis began the meeting with a review (*SG-BC Endnote 2*) of SG-BC activities and progress to date, a review of PICES past and present activities related to biodiversity conservation, and member country perspectives on the key drivers of biodiversity change and important knowledge gaps that PICES could address. The SG spent the afternoon reviewing the list of drivers of biodiversity change, identifying key research questions that could be addressed by a new PICES expert group, and drafted a set of recommendations on the roles that such a group would fulfill.

AGENDA ITEM 2
SG-BC activities and progress

Significant progress has been made on all SG-BC terms of reference, and the SG anticipates a final report will be submitted to Science Board in January 2015.

1. Review drivers of biodiversity change: draft review complete

All SG-BC members drafted summaries of key drivers which were reviewed and summarized in the SG draft final report. Key drivers were grouped into six themes: climate change, fishing, pollution, non-indigenous species, coastal development, and ecological factors. SG-BC members also noted the importance of interactions among multiple drivers (*SG-BC Endnote 3*, Table 1). The countries where these drivers are important were also identified. The driver themes were then cross-referenced with the topics of past and present PICES expert groups. While PICES has engaged in relatively little research related to biodiversity, of particular note is the lack of PICES expert group focused on the influences of fishing or ecological interactions on the spatial and temporal patterns of biodiversity.

2. Identify mechanisms for advancing biodiversity-based research: in progress

SG-BC members submitted ideas for mechanisms to advance biodiversity research in the North Pacific Ocean, as reviewed in the SG draft report. The report will be updated to reflect additional suggestions made during the SG-BC meeting, including the development of a basin-wide network of observation and monitoring sites, and support of new or existing databases for compiling biodiversity data.

3. Review biodiversity activities of PICES and other organizations, and 4. Opportunities for collaboration, new avenues of research, and provision of science advice

In addition to discussing the key points of the review in the draft report, the SG cross-referenced its list of knowledge gaps and important questions with the biodiversity-related activities, past and present, that PICES has already undertaken (*SG-BC Endnote 3*, Table 2). As noted in the table, the list of knowledge gaps and questions submitted by SG-BC members were grouped into five themes, though some questions could be grouped with multiple themes. The five themes were: establishing baseline inventories of species and habitats; monitoring to understand drivers of temporal trends in biodiversity; analyses to understand and predict spatial patterns in species or habitat distributions; vulnerability assessment of species and habitats; quantitative tools to support marine spatial planning and ecosystem-based management. Cross-referencing with PICES past and present activities shows that most knowledge gaps and questions identified by SG-BC have not yet been investigated by PICES expert groups. Thus SG-BC agreed there were several opportunities for new avenues of research.

5. Advice to Science Board on merits and roles of a new biodiversity expert group

In evaluating the merits of establishing a new expert group to focus on biodiversity, SG-BC took into consideration the following criteria raised by the SG members:

- Seeking commonalities among PICES member countries in terms of key knowledge gaps and research questions;
- Maintaining a narrow focus for ensuring efficiency and feasibility;
- Avoiding duplication in effort by other PICES expert groups;
- Avoiding duplication in effort by member countries within national waters: thus, consider focus on international waters;
- Developing Terms of Reference and action plan that are achievable with available resources;
- Aiming for a medium term duration of 2–5 years (*e.g.*, 3-year working group);
- Application: relevance for supporting management decisions.

Members discussed each theme in terms of developing an expert group to engage in related biodiversity research. Several ideas were proposed. Three options for a new biodiversity expert group were identified in particular (*SG-BC Endnote 3*, Table 3):

1. Establishment of a network of ocean observation sites for characterizing and monitoring changes in the distribution, abundance and diversity patterns of indicator species (*e.g.*, microbial communities, plankton, and nekton). Patterns in distribution and diversity would be correlated with environmental variables to identify key drivers of change and potential predictors. It was noted that the Kurishio Current influences the species distributions of five member countries (China, Korea, Japan, Russia and U.S.), and potential observation sites were proposed along the current as well as in the northeast Pacific Ocean.
2. Development of guidance on methods for monitoring changes in marine biodiversity. Guidance could address questions related to selection of indicator species, standards for data collection and analysis of temporal trends, advice on the distribution and networking of monitoring sites, a standard ecological or habitat classification system. This would lay a framework for future PICES research related to assessment and monitoring of marine biodiversity in the North Pacific Ocean.
3. Mapping known and predicted distributions of structure-forming species (or biogenic habitats) throughout the North Pacific Ocean, and relating patterns in distribution and diversity to potential drivers of biodiversity change. This proposal was viewed as added value in that PICES has not previously focused on deepwater benthic habitats/ecosystems or structure forming organisms. The work would be focused, with the potential of supporting assessments of vulnerable marine ecosystems (VMEs) led by the North Pacific Fisheries Commission (NPFC) or identification of ecologically and biologically significant areas (EBSAs) led by Convention on Biological Diversity (CBD). Structure-forming species were viewed as important indicators of biodiversity and of conservation interest. Members also discussed the potential for a working group to provide technical guidance to PICES on methods for developing and applying predictive models of species distributions, habitats, and biodiversity, and identifying hotspots of biodiversity.

AGENDA ITEM 3

Proposal for a new working group

There was consensus among SG-BC members to develop a proposal to establish a new biodiversity working group to focus research on option c, the distribution and diversity of structure-forming species in the deep sea waters of the North Pacific Ocean (*SG-BC Endnote 4*), but to recommend that PICES undertake options a and/or b in the future.

In addition SG-BC chairperson invites members to submit the names and affiliations of potential experts for a working group focused on biodiversity and distribution of biogenic species/habitats. Such persons could have expertise in deep sea ecology, species distribution modelling, biogenic habitats, or other related fields.

AGENDA ITEM 4
SG-BC final report

SG-BC members discussed timelines for completing the report to Science Board. Dr. Curtis proposed to integrate key points from the meeting into the draft report and circulate the new draft to all members for revision, editing and submission to Science Board by January 2015.

SG-BC Endnote 1

SG-BC participation list

Members

Janelle Curtis (Canada, Chair)
Jae Hoon Noh (Korea)
Thomas Hourigan (USA)
Wongyu Park (Korea)
Chris Rooper (USA)

Observer

Charity Mijin Lee (Korea)

PICES

Thomas Therriault (Science Board Chair)

SG-BC Endnote 2

SG-BC meeting agenda

1. Welcome, sign-in, introductions
2. SG-BC activities and progress
3. Proposal for a new working group
4. Timeline for SG-BC final report

SG-BC Endnote 3

Table 1 Key drivers of change in biodiversity identified by SG-BC members cross-referenced with PICES past and present activities.

Driver	Commonality among PICES member countries*	PICES past activities	PICES present activities
Climate change	6/6	WG 16; WG 25; SG-FERRRS; CCCC	WG 27; WG 29; S-CCME; FUTURE; AP-COVE
Pollution	5/6	SG-MP; WG 2, WG 15	WG 31; S-HAB
Fishing	4/6	–	–
Coastal development	4/6	–	AP-AICE
Non-indigenous species	3/6	–	WG 21
Ecological factors	3/6	–	–
Multiple stressors	1/6	–	WG 28

*Commonality among PICES member countries indicates the number of countries that identified a driver or stressor within the theme during their review.

SG-FERRRS = Study Group on *Fisheries and Ecosystem Responses to Recent Regime Shifts* (2003–2004)

SG-MP = Study Group on *Marine Pollutants* (2011–2013)
WG 2 = Working Group on *Development of Common Assessment Methodology for Marine Pollution* (1992–1994)
WG 15 = Working Group on *Ecology of Harmful Algal Blooms (HABs) in the North Pacific* (1999–2003)
WG 16 = Working Group on *Climate Change, Shifts in Fish Production, and Fisheries Management* (1999–2005)
WG 21 = Working Group on *Non-indigenous Aquatic Species* (2005–2013)
WG 25 = Joint PICES/ICES Working Group on *Forecasting Climate Change Impacts on Fish and Shellfish* (2008–2011)
WG 27 = Working Group on *North Pacific Climate Variability and Change* (2011–2015)
WG 28 = Working Group on *Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple* (2011–2015)
WG 29 = Working Group on *Regional Climate Modeling* (2011–2015)
WG 31 = Working Group on *Emerging Topics in Marine Pollution* (2014–2016)
S-HAB = Section on *Ecology of Harmful Algal Blooms in the North Pacific* (2003–
S-CCME = Joint PICES/ICES Section on *Climate Change Effects on Marine Ecosystems* (2011–
CCCC = Climate Change and Carrying Capacity Program (1995–2009)
FUTURE = Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems program (2009–
AP-COVE = FUTURE Advisory Panel on *Climate Ocean Variability and Ecosystems* (2009–2014)
AP-AICE = FUTURE Advisory Panel on *Anthropogenic Influences on Coastal Ecosystems* (2009–2014)

Table 2 Key biodiversity research themes identified by PICES member countries cross-referenced with topics addressed by PICES past and present expert groups.

Biodiversity research themes	Commonality among PICES member countries*	PICES past activities	PICES present activities
Establish baseline inventory of biodiversity (species, habitats) ▪ Survey meio- and microbenthos, ▪ Survey bathyal and abyssal depths, ▪ Survey seamounts, hydrothermal vents, coldwater seeps, abyssal plain and rocky trenches, ▪ Delineate benthic and pelagic biogeographic zones	4/5	CoML/PICES Special Publication 2	–
Understand and predict spatial distribution of biodiversity ▪ Develop predictive models for key indicator, species, biogenic habitats, and diversity, ▪ Identify environmental factors that influence biodiversity patterns, ▪ Identify ecological interactions that influence biodiversity patterns	4/5	–	–
Understand and predict temporal variation in biodiversity ▪ Develop indicators to detect change, ▪ Monitor coastal ecosystems (mudflats, coral reefs, mangrove forests), ▪ Monitor marine protected areas (MPAs), ▪ Identify ecological interactions that influence biodiversity patterns	3/5	WG 21	WG 28
Vulnerability assessment ▪ Assess status of biodiversity, ▪ Assess vulnerability to climate change, ▪ Assess susceptibility to anthropogenic activities, ▪ Assess risk of non-indigenous species	3/5	WG 21	–

Analytical methods for biodiversity conservation ▪ Apply criteria for VME/EBSA, ▪ Identify reference points for indicators, ▪ Measure value of biodiversity, ▪ Define principles for MPA networks, ▪ Evaluate MPA performance, ▪ Define appropriate scales for biodiversity conservation	3/5	–	S-HD

* Commonality among PICES member countries indicates the number of countries that identified a knowledge gap or research opportunity within the theme during their review (pending submission from one PICES member country).
WG 21 = Working Group on *Non-indigenous Aquatic Species* (2005–2013)
WG 28 = Working Group on *Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple* (2011–2015)
S-HD = Section on *Human Dimensions of Marine Systems* (2011–

Table 3 Evaluation of three research avenues for a new expert group on biodiversity.

Evaluation criteria	**Option a: Plankton/nekton biodiversity observation network**	**Option b: Technical guidance on monitoring biodiversity**	**Option c: Diversity and distribution of biogenic habitat**
Research on drivers of biodiversity change	Yes: climate change, pollution	No	Yes: climate change
Addresses common knowledge gaps identified in review	Yes: predictors of distribution; biodiversity indicators	No	Yes: deep-sea species; benthic habitats; predictors of distribution, biodiversity indicators
Clear linkages to PICES expert groups	Yes: BIO	Yes	Yes: WG 28; BIO
New PICES research	Probably not	Yes	Yes: new focus on benthic habitat
Narrow focus	Yes	Yes	Yes
Scientific paper(s)	Yes	Technical report	Yes
Achievable	Yes	Yes	Yes
Clear applications	No	Yes	Yes

SG-BC Endnote 4

Proposal for a new Working Group on *Biodiversity of Biogenic Habitats*

Parent Committee: BIO

Summary

The Study Group on *Biodiversity Conservation* (SG-BC) recommends establishment of a Working Group on *Biodiversity and Biogenic Habitats*, with an initial focus on coral- and sponge-dominated ecosystems. The proposed Working Group will advance understanding of the distribution of coral and sponge taxa in the North Pacific Ocean and their contribution to biogenic habitats and biodiversity. This effort represents a new emphasis on habitat research for PICES, and the initial focus on biogenic habitat could provide a proof of concept on how to undertake biodiversity research related to other taxa/ecosystems. Major applications of the science products developed by the Working Group would be provision of technical guidance on the development and application of species distribution models, maps of known and predicted distributions of biogenic habitats, and the development of biodiversity indicators.

Context

In 2014, PICES convened a 1-year Study Group on *Biodiversity Conservation* (SG-BC). PICES had no formal mechanism to exchange information on issues related to biodiversity in the North Pacific despite recent requests to do so, for example, from the Convention on Biological Diversity (CBD) in 2013. Marine biodiversity is important for maintaining ecosystem structure and function, which in turn supports numerous ecosystem goods and services, including sustainable fisheries.

The terms of reference for SG-BC included an assessment of the merits of establishing an expert group focused on biodiversity science within PICES, and providing recommendations on the role of such a group. Through inter-sessional work and a meeting at PICES-2014 (October 18, 2014, Yeosu, Korea) attended by members from Canada, Korea, and the United States and with written submissions from China and Japan to guide discussions, SG-BC identified several opportunities for further collaboration on marine biodiversity. Cooperation on advancing the understanding of corals and sponges as biogenic habitat in the North Pacific was deemed particularly timely and appropriate for the work of a new PICES Working Group.

Many corals and sponges are known to form fragile biogenic habitats. These three-dimensional features provide habitat for numerous fish and invertebrate species. They are associated with greater abundance of some commercially-targeted species and appear to enhance the local biological diversity of many ecosystems. Corals and sponges are also strongly influenced by biological and physical oceanographic processes, and their distribution and biodiversity are anticipated to respond to multiple stressors including global climate change, pollution, aragonite saturation, and fishing. Conservation of these biogenic habitats has been identified as a priority in a number of countries and international fora. Analyses of the spatial distribution and diversity of these taxa and associated fauna in the North Pacific have lagged significantly behind studies in the North Atlantic.

The merits of this focus include:

- A new research avenue for PICES, with clear linkages to PICES activities, particularly BIO, WG 28;
- An initial focus on biogenic habitat serves as a model for future biodiversity research on other taxa/ecosystems and addresses a lack of knowledge of benthic habitats in deeper waters;
- New data from at least five PICES members countries (Canada, China, Japan, Korea and U.S.) could be integrated to not only better understand factors that influence distribution and trends in biogenic habitat diversity, but also to test key scientific questions of broad interest (*e.g.*, model transferability).
- The focus on gathering knowledge, assessing current status, developing indicators to monitor change, and hypotheses to forecast responses to multiple stressors is aligned with the spirit of FUTURE. Moreover, the

key outputs of this Working Group (distribution maps, biodiversity indicators) would likely be of broad interest outside of PICES.
- Addressing a targeted ecological question that can lead to scientific products within 3 years.

Terms of Reference

Year1:
- Compile data on the distribution of coral and sponge taxa, and associated fish and invertebrate assemblages in the North Pacific within National Exclusive Economic Zones (EEZs) and facilitate their submission to appropriate biodiversity databases (*e.g*., Ocean Biogeographic Information System (OBIS));
- Compile data on key variables (temperature, velocity, ocean acidification, slope, aspect) hypothesized to influence coral and sponge distribution and diversity and catalogue sources of multibeam/swathe bathymetry data for distribution modeling within National EEZs;
- Hold a WG meeting, in conjunction with the PICES Annual Meeting.

Year 2:
- Review modeling approaches to predict the potential distributions of species and habitat suitability for corals and sponges (*e.g*., MaxEnt, Boosted Regression Trees, or high resolution bathymetry-based models) within National EEZs;
- Identify environmental and ecological predictors of patterns in the distribution and biodiversity of coral, sponge and associated taxa within National EEZs;
- Convene a session on biogenic habitat distribution and diversity at PICES Annual Meeting;
- Hold a WG meeting, in conjunction with PICES Annual Meeting.

Year 3:
- Review and propose potential indicators for assessing and monitoring diversity of biogenic habitats;
- Review and document associations between commercially important fish and invertebrate species and biogenic habitats;
- Prepare scientific reports for dissemination of results;
- Hold a WG meeting, in association with the PICES Annual Meeting.

Key scientific outputs:

- Technical guidance on development and application of predictive species and habitat modeling approaches for deep-sea corals and sponges;
- Maps of known and predicted distribution and abundance of biogenic habitat (and diversity) in North Pacific Ocean;
- Biodiversity indicators for biogenic habitat assessment and monitoring.