

2012 Inter-sessional Workshop on a Roadmap for FUTURE

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Background

By the end of 2011, four new expert groups were established for the PICES FUTURE (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems) science program, which now has the minimal number of expert groups required to undertake the tasks identified in the FUTURE Science Plan and Implementation Plan. These expert groups will interact and exchange information and products that contribute to fulfilling the FUTURE objectives. Understanding the roles and responsibilities of each expert group within the FUTURE framework and conducting the necessary work in concert with other groups in a timely manner are vital for the success of FUTURE. A 2.5-day inter-sessional workshop was held May 22–24 in Busan, Korea, to develop a higher level coordination plan where tasks and roles of expert groups, information flows, and products were specified and aligned. A total of 42 participants representing expert groups and PICES member countries gathered and reviewed the plans of the existing expert groups, identified potential new expert groups, and discussed a roadmap where outputs and products of FUTURE are specified within a timeline.

FUTURE objectives and expert groups

FUTURE products/outcomes are described under the two Objectives in the Implementation Plan:

- (1) Understanding critical processes in the North Pacific;
- (2) Engagement with human society with useful products such as status reports, outlooks, and forecasts.

Expert groups that are responsible for each Objective gave short presentations, which were followed by discussions.

For Objective 1, there are three overarching Key Scientific Questions: (1) What determines an ecosystem's intrinsic resilience and vulnerability to natural and anthropogenic forcing? (2) How do ecosystems respond to natural and anthropogenic forcing, and how might they change in the future? (3) How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems? The review began with a summary report of the results of the FUTURE Workshop on "Indicators of status and change within North Pacific marine ecosystems" held April 26–28, 2011, in Honolulu, USA, to tackle the major issues of the Key Scientific Question 1: ecosystem indicators and assessments, ecosystem resilience, and indicator uncertainty (PICES Press, Vol. 19, No. 2, pp. 5–8). The workshop recommended that FUTURE develop a framework to be used for identifying and calculating indicators for the common descriptors and attributes for North Pacific ecosystems. Through the discussion there was also a consensus that the concept of ecosystem resilience is still poorly developed and many aspects need to be studied. This requires an expert group to deal with theoretical and operational issues of resiliency and vulnerability. A tangible outcome from the workshop was the establishment of a Working Group on *Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple Stressors* (WG 28). This group will focus mainly on Key Scientific Questions 1 and 3, and analyze the regional activities/stressors, habitats, vulnerabilities, and potential indicators in the North Pacific. Based on this analysis, a database of activities/stressors, habitats, and vulnerabilities of these habitats will be developed to produce indicators suitable for member countries. WG 28 will also provide new information which will enable a working



Group photo of the workshop participants.

group to be formed in the next 2–3 years that will address the ecosystem resilience issue.

The Working Group on *North Pacific Climate Variability and Change* (WG 27) will develop mechanism-based conceptual frameworks that link climate variability and ecosystem change in the North Pacific. Results from this expert group will be utilized in developing models for forecasting the ecosystem changes, and thereby address Key Scientific Question 2. WG 27 will also develop a method to identify and provide uncertainty estimates of decadal variability in recent historical climate and ecosystem time series.

The Working Group on *Regional Climate Modeling* (WG 29) will evaluate the projections from the 5th Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) and examine how to downscale the outputs from global climate-ocean models so that these outputs (circulation, mixed layer depth, *etc.*) can be used in regional ecosystem models. The current gaps are limited biogeochemical modeling and upper trophic level modeling, limited regional coverage, and nonexistent or inadequate boundary conditions.

The Section on *Ecology of Harmful Algal Blooms in the North Pacific* (S-HAB) interests in ecosystem disruption of primary producers, which will propagate through food webs, is related to the Key Scientific Question 2 and 3. Although it is not possible (yet) to predict the occurrence of HABs, it may be feasible to produce ecosystem ‘market’ reports which forecast how HABs may respond to specific temporal or spatial changes in ocean conditions.

The Section on *Carbon and Climate* (S-CC) will provide expertise in ocean biogeochemistry and acidification and produce data products related to ocean acidification and deoxygenation.



The authors of this article, Thomas Therriault (Canada/AICE), Hiroaki Saito (Japan/COVE), Hal Batchelder (USA/SOFE) and Sinjae Yoo (Science Board Chairman, discuss FUTURE objectives.

The goals of the Section on *Climate Change Effects on Marine Ecosystems* (S-CCME) are to build predictive capability of the impacts on fish and fisheries of future climate change, such as that from IPCC AR5 assessments. S-CCME will evaluate and project climate change impacts on marine ecosystems through international collaboration with organizations such as ICES. This group is expected to play a central role in FUTURE by producing a regional synthesis.

Users and products

Scientists are the primary users of the products from FUTURE Objective 1, as this is basically about scientific understanding. FUTURE Objective 2 aims to provide products to various segments of human society, which will face significant challenges, especially in coastal ecosystems that provide many ecosystem services, but are most vulnerable to sea-level rise, overexploitation of living marine resources, and anthropogenic pollution, among others. The users of the products from Objective 2 remain ill-defined. The discussion in the workshop naturally continued with the question about who the users are. The question is fundamental—FUTURE has to identify who the users are, and engage them to determine what products they desire and whether those are attainable. PICES is strongly linked with fisheries agencies, but there is a need to have a broader engagement. The Organization is a leader in ecosystem-climate variability research but the anticipated products of FUTURE are beyond the scope of what PICES has produced in the past. However, it is important for PICES to maintain scientific excellence. One dilemma is that our scientific capability is weaker at making predictions on short time scales than on longer time scales, yet society needs short-term predictions for management. Societal priorities are also on the emerging “hot topic” issues, which demand advice suitable for rapid responses. Recent drastic changes have made people want to know about new problems. For example, in China after the green algal blooms in 2008, there were public requests for scientists to provide advice on algae and jellyfish. FUTURE products should address pressing societal needs and goals.

Draft proposal on NPESR

The North Pacific Ecosystem Status Reports (NPESR) of PICES have been highly valued. The first edition was published in 2004 and the second in 2010. These reports provide a test case for future FUTURE products. Phil Mundy, representing the FUTURE Advisory Panel on *Status, Outlooks, Forecasts, and Engagement* (SOFE), presented a draft proposal for updating and expanding NPESR in the future. It was suggested that NPESR should be incrementally updated annually-to-biennially through a web-based system, with more detailed analysis at five- or six-year intervals.



The workshop participants are debating scientific and communication issues during coffee breaks; left photo, left to right: Shin-ichi Ito (Japan), Enrique Curchitser (USA), Igor Shevchenko (Russia) and Chan Joo Jang (Korea); right photo: Mark Wells (USA), Jackie King (Canada) and Hiroaki Saito (Japan).

The proposal also described some details on the organization of a writing team, quality assurance, maintenance of the database, review processes, and establishment of target group focused outreach products. A suite of agreed variables for each PICES region would be developed through specific processes. For example by use of an “indicator selection framework” (role for WG 28 and FUTURE Advisory Panel on *Climate, Oceanographic Variability and Ecosystems*, COVE) to select time series in climate physics (WG 27), nutrients, phytoplankton and zooplankton (Biological Oceanography Committee, BIO), birds, fish and mammals (BIO and Fishery Science Committee, FIS), economics and social impacts (Section on *Human Dimensions*, S-HD). Note that “indicators” in this context are observables of known measurement error; variables (sea surface temperature, fluorescence, dissolved inorganic carbon, dissolved oxygen, population estimates, etc.). The workshop participants agreed that the improvement of NPESR should be incremental and built upon the existing reports. As an efficient and inexpensive way of producing and updating reports, developing automating software using open source tools such as R- and S-weave were suggested. This software provides templates into which authors can input and update their data easily. This will facilitate making a standardized version which would be easier to produce and therefore, would be easier to translate into other languages to suit the specific needs of PICES member countries. Synthesis is a valuable part of NPESR, yet has been not fully accomplished in the previous versions. Trans-regional synthesis would be of great value. Timing and frequency of production of the electronic updates will be variable depending on regional needs and data availability. Since the report will be based on national monitoring activities, a question came up on whether all member countries are producing annual reports of all of their collected observations. It turned out that not all the countries are making annual reports and not all of the data collected (especially fisheries data) are openly available for wide distribution.

Communication strategy

There are communication issues on several levels in pursuing the goals of FUTURE. Communication within and across expert groups needs to become more efficient. A FUTURE web site is being constructed and could facilitate better communication among FUTURE scientists. Data exchange and sharing are also important issues for FUTURE science. Igor Shevchenko (TCODE) presented his experience with PICES Metadata Federation Project. He reviewed the characteristics of oceanographic data and how data sharing can facilitate research on various levels. Since biological data are the area where data sharing is least efficient, he made recommendations on how to improve the situation.

Outreach with the general public or targeted sectors beyond fisheries management is a new area where PICES has little experience, and consequently outreach has lagged some of the other FUTURE activities. However, SOFE is working to remedy the situation. Public outreach documents need to be created soon after the information is available, while the topic is still new. Ideally, outreach documents would be produced in English first, then translated into Japanese, Korean, Chinese and Russian as desired by PICES member countries. It was suggested that the highlights of the Yeosu symposium on “*Effects of Climate Change on the World’s Oceans*” held in May 2012, could be disseminated to the public using this approach.

Another question on outreach is whether we need the help of specialists in making outreach products such as brochures, press releases, web design. The consensus of the workshop participants is that PICES does not presently have the resources and expertise to produce outreach documents, and that a long-term strategy is necessary.

Gaps and actions

The gaps identified from the previous discussions were revisited, with questions on new expert groups to fill the gaps. Ecosystem resilience is one area that we continue to

study to answer the Key Scientific Question 1. A new working group on ecosystem resilience could possibly be formed based on the outcomes from WG 28 and S-CCME. This group could develop the theoretical framework, operational definition, and metrics for ecosystem resilience. S-HD will contribute in tackling economic and human-related issues in ecosystem resilience.

Counter-intuitively, FUTURE needs to develop greater capacity in coastal ecosystem modeling, despite ongoing work on this by WG 27, WG 29 and S-CCME. Significant gaps remain. For instance, WG 29 has limited capacity to develop biogeochemical models and higher trophic level models. S-CC has identified gaps in understanding and predicting future hypoxia because of limited information on benthic processes and coastal chemistry. S-HAB has also identified the high-resolution multi-species lower trophic model in coastal regions as a gap. Current ecosystem models do not adequately represent harmful algal species as state variables; without such an effort, ecosystem models are not capable of developing blooms of HAB species. All of these examples require some level of capacity building in coastal ecosystem modeling. Developing a Regional Ocean Climate Model Inter-comparison Project (ROCMIP) and/or establishing a Working Group on Earth System Modeling (WG-ESM) were suggested. At the same time, PICES has limited resources and there are other areas that require capacity building. It may be reasonable to defer action on some of these topics/gaps until WG 27, WG 29, and S-CCME provide their first products and have a better basis for assessing gaps in PICES modeling capacity.

The FUTURE Science Plan explicitly identifies the quantification of uncertainty of outlooks and forecasts as a goal. WG 27 will look into this issue and provide uncertainty estimates of decadal variability in recent historical climate and ecosystem time series. S-CCME and WG 28 will evaluate our skill on dealing with uncertainty, and will collaborate with each other on assessing the vulnerability of coastal communities, particularly related to food security. This assessment could be based on future economic scenarios or societal change scenarios, which S-HD will certainly be asked to provide.



The FUTURE workshop in session.

Products to be made in 2–3 years

Given that we do not know at the moment all the potential users of FUTURE products and their needs, the workshop participants agreed to take an adaptive approach in developing the products, that is, focus on products that are ready now or will be within next 2–3 years, and contact potential users to obtain feedback that will make products better or more relevant to end users (beyond scientists). The process of improving products must be accomplished through 2-way engagement of PICES scientists and targeted audiences. During this discussion, the following list of potential FUTURE products that are “doable” within 2–3 years was developed:

- Index/Atlas of non-indigenous species
- Global atlas/analysis distribution shift of fish/shellfish
- Indicators of cumulative stresses
- Circulation/mixed layer depth projections
- CMIP5 analysis of derived variables
- Press releases of FUTURE Symposium activities
- Core indicators from the Working Group on *Ecosystem-based Management Science and its Application to the North Pacific* (WG 19)
- Characteristics of North Pacific indices in modern models
- Yearly report on ‘hot topics’ products
- Expert group summary at the end of their term
- Update Wiki FUTURE site http://en.wikipedia.org/wiki/North_Pacific_Marine_Science_Organization
- Educational materials to engage early career scientists in PICES
- S-HD newsletter (seasonal, electronic)
- S-CCME briefing/news (non-periodic)
- Climate index links to original sources

Next steps – A roadmap for FUTURE

The workshop also discussed the next steps for FUTURE and future (lowercase!) meetings/workshops. The FUTURE Scientific Steering Committee will draft a roadmap for FUTURE that summarizes the outcomes and suggestions from the workshop. A draft will be reviewed and discussed at the next joint meeting of FUTURE Advisory Panels at PICES-2012 before being finalized. An inter-sessional FUTURE workshop in the spring of 2013 in western Russia will be planned to facilitate S-CCME activities, which will coordinate scientific participation and exchange between PICES and ICES. Another possible FUTURE meeting next year is a WG 29 workshop to deal with scientific issues related to regional downscale modeling, proposed by Seoul National University. A FUTURE Open Science Meeting (OSM) was also brought up at the workshop. By 2014, FUTURE will be approaching its fifth year, about the right time to evaluate what has been achieved and what has not. Also it will be a good time to adjust course, if needed, and to know where we are going. There was some discussion about the format and timing of the FUTURE OSM, and the consensus was that it should be in the spring of 2014, but the place is yet to be decided.