

Report of Working Group on *Climate and Ecosystem Predictability*

The second meeting of Working Group 40 (WG 40) on *Climate and Ecosystem Predictability* was held on October 26, 2018 in Yokohama, Japan. There were 16 members and observers in attendance plus two remote participants (*WG 40 Endnote 1*). The group focused on further familiarizing everyone with the research of the WG and its members, summarizing ongoing efforts in North Pacific marine ecosystem prediction, and planning upcoming workshops, sessions, and products for the WG. From this meeting proposals were developed for an inter-sessional WG meeting and a topic session at PICES-2019. Below are the agenda items (*WG 40 Endnote 2*) and related notes from the meeting.



WG 40 participants 40 at PICES-2018 in Yokohama, Japan. Left to right: Antonietta Capotondi, Jinqiu Du, Caihong Fu, Mike Jacox, Fei Chai, Jim Christian, Masami Nonaka (standing), Chan Joo Jang, Ryan Rykaczewski, Akinori Takasuka (standing), Barb Muhling, Elena Ustinova, Emi Yati, Manu Di Lorenzo, Steven Bograd. Missing from photo: Vladimir Kulik, and Shoshiro Minobe who participated remotely.

AGENDA ITEM 1

Welcome and introductions

Because WG 40 was established mid-year in 2017, there was limited participation at the first business meeting (Vladivostok, Russia; 2017) and many participants had not yet met. All attendees briefly introduced themselves and their interests and expertise.

AGENDA ITEM 2

Brief summaries of relevant research efforts by WG members

Group members who were unable to present research at the first business meeting last year were invited to give brief research summaries to introduce relevant research efforts. The topics of research that were presented are outlined below.

Vladimir V. Kulik

- Saury and mackerel predictions based on a moving average statistical model (essentially persistence forecast) are available on TINRO's website at <http://www.tinro-center.ru/uslugi-i-produkcija/podderzka-promysla/mesacnye-prognozy> (link for all publicly available TINRO forecasts is <http://www.tinro-center.ru/home/operativnaa-okeanologiceskaa-informacia>);
- Also looking at using numerical modeling to link fronts to squid and saury distributions, though this is currently research, not operational.

Caihong Fu

- As part of the Indicators for the Seas (IndiSeas) program, developing statistical estimates of influences on ecosystem from fishery and environmental changes based on 14 indices;
- Identifying key indicators is relevant to WG TOR 1.

Fei Chai

- Biogeochemical observations based on Argo floats, and physical oceanography-biogeochemical modeling and prediction in the Chinese marginal seas;
- Five-day forecasts are available online, with a “stop light” product for the output, though no skill assessments or derived products have been developed yet.

Akinori Takasuka

- Comparisons of relationships between spawning and environmental factors for anchovy and sardine in the Kuroshio and Humboldt current regions.

Masami Nonaka

- Relationship between fish catches in Sukumo Bay, Kochi, Japan, and ocean temperature and sea surface height, and its predictability with about one-year lead time.

Emi Yati

- Long time-scale ecosystem variability in the North Pacific based on EOF analysis of many ecosystem indices (~30 western Pacific, ~90 western Pacific) for fishes, planktons, *etc.*
- Identified links between climate and fish could potentially be exploited for predictions.

AGENDA ITEM 3

Potential products

We conducted discussions about potential products of WG 40. One product is already in preparation (see Agenda Item 4), and the next likely product is a small collection of papers describing North Pacific marine forecasting efforts. This collection is expected to include several papers by WG members and their collaborators on marine ecosystem forecasting research that is mature enough for publication. We aim to have a common format through the papers, which will cover different applications and regions, and to have an overview paper. In aid of the preparation for this special issue, we have proposed an inter-session three-day workshop (WG 40 Endnote 3).

The group also discussed the possibility of a more applied product (*e.g.*, a tool for use by the broader research community). One potential product is a tool that allows the user to quickly assess the predictability of specific variables for a given region of interest on seasonal timescales. On the back end, this would require that readily available seasonal climate reforecasts (*e.g.*, from the North American Multi Model Ensemble) be evaluated against observations (*e.g.*, output from global reanalyses like ERA5) for a specified variable, region, and lead time. The utility of a product like this for seasonal forecasting would be similar to the NOAA climate change web portal for climate projections (<https://www.esrl.noaa.gov/psd/ipcc/>).

AGENDA ITEM 4

Census of North Pacific marine ecosystem forecasting efforts

We continued work on a census of existing marine ecosystem forecasting efforts in the North Pacific. Prior to the WG meeting, a table was prepared to summarize key information for each forecast including the region, forecast type, lead time, key contacts/references, and other information. During the meeting additional information deemed important (end users, skill assessment, sources of uncertainty) was added. At present, we have collected information on ~15 forecast efforts spanning the western to eastern Pacific, products from physical anomalies to distributions of top predators, and lead times from days to years.

AGENDA ITEM 5

Tasks

Dr. Antonietta Capotondi, Co-Chair (CLIVAR), offered to introduce activities of WG 40 at the FUTURE mini symposium (S6). Outlines and co-conveners were decided for a topic session at PICES-2019 (**WG 40 Endnote 3**) and for an inter-sessional meeting to be held in spring/summer 2019 (**WG 40 Endnote 4**). Drs. Mike Jacox and Ryan Rykaczewski offered to lead the topic session and inter-sessional workshop proposals, respectively.

AGENDA ITEM 6

Presentation from Mark Payne, Chair of ICES S2D working group

Dr. Mark Payne, Chair of ICES WG on “Seasonal to Decadal Prediction of Marine Ecosystems” (WGS2D) attended remotely and introduced the terms of reference and the activities of WG. Mike Jacox had similarly introduced WG 40 to WGS2D during the WGS2D annual meeting earlier in the year. PICES WG 40 and the ICES WGS2D have already co-organized a session at the Fourth International Symposium on “*The effects of climate change on the world’s oceans*” (June 2018, Washington, DC, USA), and further collaborations are expected.

AGENDA ITEM 7

Summarize to-do lists and assignments

The group summarized action items including preparation and submission of session proposals.

The meeting adjourned at 18:00.

WG 40 Endnote 1

WG 40 participation list

Members

Antonietta Capotondi (USA, CLIVAR Co-Chair)
Fei Chai (China)
James Christian (Canada)
Emanuele Di Lorenzo (USA)
Jinqiu Du (China)
Caihong Fu (Canada)
Michael Jacox (USA, PICES Co-Chair)
Chan Joo Jang (Korea)
Vladimir Kulik (Russia)
Shoshiro Minobe (Japan, CLIVAR Co-Chair)*
Masami Nonaka (Japan, PICES Co-Chair)
Ryan R. Rykaczewski (USA, CLIVAR Co-Chair)
Akinori Takasuka (Japan)

Members unable to attend

China: Ying Bao
Korea: MinHo Kwon, Chung Il Lee
Russia: Yury Zuenko
USA: Samantha Siedlecki

Observers

Steven Bograd (FUTURE SSC Co-Chair/USA)
Barbara Muhling (USA)
Mark Payne (ICES/Denmark)*
Elena Ustinova (Russia)
Emi Yati (Japan)

*Participated remotely

WG 40 Endnote 2

WG 40 meeting agenda

1. Welcome and introduction
2. Brief summaries of relevant research efforts by WG members
3. Discussion of potential WG 40 products
4. Work on census of North Pacific marine ecosystem forecasting efforts
5. Work on additional tasks
 - Presentation for FUTURE mini symposium (S6)
 - Begin drafting proposal for PICES-2019 session
6. Presentation from ICES S2D Working Group (Mark Payne)
7. Summarize to-do lists and assignments
8. Adjourn

WG 40 Endnote 3**Proposal for a Topic Session on “*Advances in North Pacific marine ecosystem prediction*”
at PICES-2019**

Potential sponsors: ICES, NOAA/MAPP

Duration: 1 day

Convenors: Mike Jacox (USA), Fei Chai (China), Jinqiu Du (China), Shoshiro Minobe (Japan)

Suggested Invited Speakers: Takeshi Doi (Japan), Nicole Lovenduski (USA), Stephanie Brodie (USA)

Publication: At minimum, a PICES Press article

Modern ocean and ecosystem models are rapidly developing the ability to make skillful forecasts of the physical, and more recently biogeochemical and higher trophic level, components of marine ecosystems at timescales from days to decades. Such forecasts often align with the tactical decision-making timescales of individuals, businesses, and governments, giving them significant potential to inform climate-ready management strategies. Much work has now been done to establish potentially predictable ecosystem components and to develop prototype forecast systems. In this session we will seek contributions that highlight advances in marine ecosystem prediction, spanning physics to upper trophic level responses and potentially socioeconomic impacts (*e.g.*, fish catch).

This session is intended to advance the terms of reference of WG 40 and build on strong momentum from (1) the ECCWO session “From prediction to projection: the role of seasonal to decadal forecasts in a changing climate”, (2) the PICES 2018 session “Ecological responses to variable climate changes and their applicability to ecosystem predictions”, and (3) NOAA’s Marine Prediction Task Force (MPTF), whose lifespan matches that of WG 40 (2017–2020) and whose intent is to improve seasonal forecasts for management of living marine resources. PICES WG 40 aims to identify, diagnose, and quantify predictable response in North Pacific marine ecosystems that arise from regional and large-scale climate processes. The ECCWO session demonstrated the rapid development of marine ecosystem forecasting efforts, and our PICES-2018 session was proposed to identify robust climate-ecosystem relationships that may permit skillful forecasts. The proposed session would be a forum to learn and discuss how these relationships are being exploited for North Pacific marine ecosystem forecasts.

WG 40 Endnote 4

**Proposal for a 3-day intersessional workshop on
“Towards an integrated approach to regional ecosystem forecasting efforts in the North Pacific”**

Prediction Consortium (China, and others to be further explored)

Duration: 3 days

Convenors: Ryan Rykaczewski (USA), Antonietta Capotondi (USA), Masami Nonaka (Japan), Fangli Qiao (China)

Description including background and objectives

In the North Pacific, regional and large-scale climate forcings (*e.g.*, ENSO and Pacific Decadal Variability) impact a wide range of ecological processes, many of which are relevant to issues of societal concern (*e.g.*, harmful algal blooms, fisheries distribution and production, and hypoxia). Much work has been conducted to understand the mechanisms relating ecosystem conditions to physical processes. In parallel, the ocean and climate forecasting community has made advances in the development of regional ocean prediction systems that can provide reliable estimates of physical processes. Hence, substantial potential exists to develop forecasts of marine ecosystem responses to climate variability. With this motivation, PICES WG 40 was established “to identify, diagnose and quantify predictable response in North Pacific marine ecosystems that arise from regional- and large-scale climate processes.” This overarching goal is to be achieved through our 6 terms of reference.

To deepen our understanding of the climate processes that generate predictability and to assess the range of forecasting methods applied, we propose a 3-day workshop in 2019. Specifically, the workshop participants will review the current efforts and state of ocean and climate regional forecasting in target coastal areas (to be identified based on interest from the PICES member countries), assess the mechanisms responsible for predictability in the different areas and their degree of inter-relationship, and discuss the steps and action required to develop a common framework to forecasting activities. Empirical stochastic models could be used as an initial first step to identify common or related sources of predictability and provide a unifying framework to the physical and biogeochemical forecasting applications. Prior to the workshop, participants will be tasked with addressing specific questions and developing presentations that address these topics. Topics include:

- Motivations for forecast development, forecast type and model details, forecast lead time,
- Key mechanisms of predictability,
- Skill assessment and sources of uncertainty,
- End users of ecosystem predictions.

We aim to produce a special issue in a peer-reviewed journal in which individual papers will follow a common format.