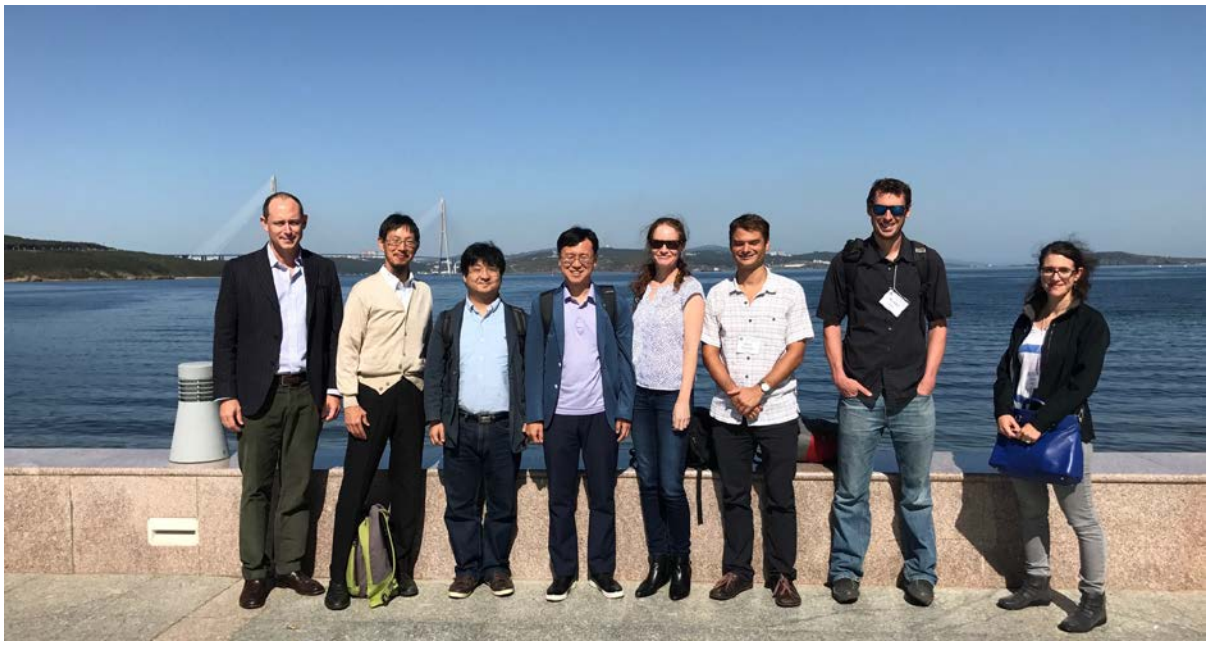
Report of Working Group on *Climate and Ecosystem Predictability*

The first business meeting of Working Group (WG 40) on *Climate and Ecosystem Predictability* was held from 9:00–18:00 on September 23, 2017 in Vladivostok, Russia, under the chairmanship of Drs. Michael Jacox (USA) and Masami Nonaka (Japan). With 12 members and observers in attendance, plus two remote participants (***WG 40 Endnote 1***), the group focused on introducing everyone to the WG and its goals and familiarizing each other with relevant ongoing research efforts. From this meeting proposals were developed for an inter-sessional working group meeting and a topic session at the 2018 PICES annual meeting. Below are the agenda items (***WG 40 Endnote 2***) and related notes from the meeting.



Participants of the first meeting of WG 40 at PICES-2017 in Vladivostok, Russia. Left to right: Emanuele Di Lorenzo, Masami Nonaka, MinHo Kwon, Chan Joo Jang, Barbara Muhling, Ryan Rykaczewski, Michael Jacox, Desiree Tommasi. Some attendees (Nicholas Bond, James Christian, Anna Vazhova, Yury Zuenko) were only available for portions of the day and were not present for the group picture. Antonietta Capotondi and Shoshiro Minobe participated remotely.

AGENDA ITEM 2
Review of WG 40 background

Dr. Emanuele Di Lorenzo gave a background of the WG, which follows from the Study Group on *Climate and Ecosystem Predictability* (SG-CEP; 2015–2016) recommendations for the establishment of a working group. He detailed the motivation of SG-CEP and the working group and the proposed relationship of WG 40 to previous PICES working groups.

AGENDA ITEM 3
Brief summaries of relevant research efforts by WG members

Group members were invited to give brief research summaries to introduce each other to relevant research efforts on both sides of the North Pacific. Enthusiasm for nearly every topic stimulated brief discussions,

and the proposed 5-minute durations became rather flexible. Several of the presenters indicated the specific points in the WG 40 Terms of Reference that were relevant for the presenter's research focus. The topics of research that were presented are outlined below.

- Antonietta Capotondi: Influence of different types of ENSO events on oceanographic conditions in the Eastern North Pacific;
- Mike Jacox: Attribution and prediction of physical and biogeochemical anomalies in the Eastern North Pacific;
- Ryan Rykaczewski: Propagation of biogeochemical anomalies across the North Pacific in a global earth-system model;
- Nicholas Bond (on behalf of Samantha Siedlecki): Development of a semi-operational climate/ocean prediction system of the North Pacific eastern boundary region;
- Emanuele Di Lorenzo: Ocean subsurface dynamics and the potential for decadal-scale predictions in the eastern North Pacific region;
- James Christian: Introduction to the Canadian seasonal to interannual climate prediction system (CanSIPS) and research on migration of salmon;
- Yury Zuenko: Impacts of interannual to decadal scale environmental changes of plankton and fishes in marginal seas of the western and northern North Pacific;
- Anna Vazhova (in collaboration with Vladimir Kulik): Multivariate analysis of environmental processes influencing CPUE of pollock in the western North Pacific;
- Shoshiro Minobe: Research plans to conduct a study for fish stock and environmental variables modeled after Hare and Mantua (2000), and introduction of semi-operational ocean/climate predictions at a 2-year time scale;
- Masami Nonaka: Seasonal to interannual climate prediction system in Japan, and research on predictability of interannual variability in the Kuroshio Extension;
- Chan Joo Jang: Development and plans for an ocean medium-range forecast system in Korea with relevance to regional fisheries.

AGENDA ITEM 4

Review of WG 40 Terms of Reference

Members in attendance were asked if any changes to the existing TOR were needed (see ***WG 40 Endnote 3***). No changes were requested. However, in discussion, the group noted that while many efforts to model and predict the physical and biogeochemical conditions were underway (TOR 3), the robustness of relationships to fisheries and other living marine resources was less certain (TOR 1). Following this discussion, the group decided to strategically propose a session at the PICES-2018 to bolster the community's understanding of climate–ecosystem relationships and whether they can be expected to persist over time (furthering our progress toward accomplishing goals set forth in TOR 1). Given the expertise within the group, we felt that a potential intersessional meeting of members should focus on further accomplishing goals set forth in TOR 3 (*i.e.*, improving understanding and utilization of dynamical and statistical downscaling).

AGENDA ITEM 5

Potential products

Potential products that WG 40 could ultimately produce include a review paper, special issue, and a common approach to tie prediction efforts in PICES regions together. However, the group decided it was premature to focus much on potential products at this point. The present focus is on the next meetings/sessions sponsored by the group (see the next Agenda Items) and on engaging members who were unable to attend this meeting.

AGENDA ITEM 6

Possible session ideas for PICES-2018

WG 40 proposed a Topic Session for PICES-2018 titled "*Ecological responses to variable climate changes and their applicability to ecosystem predictions*", which will support TOR 1 (***WG 40 Endnote 4***).

AGENDA ITEM 7

Goals and agenda for an inter-sessional workshop

WG 40 requested an inter-sessional WG workshop (***WG 40 Endnote 5***) in conjunction with the PICES-sponsored 4th Symposium on "*The effects of climate change on the world's oceans*" (June 4–8, 2018, Washington, DC, USA). This meeting will serve two main purposes: (i) to provide WG 40 an opportunity to meet again, with participation from many members who were not in Vladivostok, before the next annual meeting in Yokohama, and (ii) further TOR 3 in a clear way, with input from many experts that will be at the Washington, D.C. meeting. WG 40 requests partial travel support for some members.

AGENDA ITEMS 8 AND 9

Work on tasks, review to-do lists, and assignments

Dr. Jacox volunteered to take the lead preparing the inter-sessional proposal and slides for presentation at the meetings WG 40's parents, FUTURE SSC and POC. Dr. Ryan Rykaczewski volunteered to take lead preparing the topic session proposal for PICES-2018. Members will offer comments/edits to be included with the proposals before proposal submissions.

AGENDA ITEMS 8 AND 9

Adjourn

The meeting adjourned at 18:00.

WG 40 Endnote 1

WG 40 participation list

Members

Antonietta Capotondi (USA, CLIVAR Co-Chair)*
James Christian (Canada)
Emanuele Di Lorenzo (USA)
Michael Jacox (USA, PICES Co-Chair)
Chan Joo Jang (Korea)
MinHo Kwon (Korea)
Shoshiro Minobe (Japan, CLIVAR Co-Chair)*
Masami Nonaka (Japan, P ICES Co-Chair)
Ryan R. Rykaczewski (USA, CLIVAR Co-Chair)
Yury Zuenko (Russia)

*Participated remotely

Members unable to attend

China: Caihong Fu, Ying Bao, Fei Chai
Japan: Akinori Takasuka
Korea: Chung Il Lee
Russia: Vladimir V. Kulik
USA: Samantha Siedlecki

Observers

Anna Vazhova (Russia)
Désirée Tommasi (USA)
Barbara Muhling (USA)
Nicholas Bond (USA)

WG 40 Endnote 2

WG 40 meeting agenda

1. Welcome and introduction
2. Review of WG 40 background
3. Brief summaries of relevant research efforts by WG members
4. Review of WG 40 Terms of Reference
5. Discussion of potential products
   - Review paper?
   - Special Issue?
   - Common approach to tie efforts in PICES regions together?
6. Discussion of possible session ideas for PICES-2018
7. Discussion of goals and agenda for an inter-sessional workshop (in conjunction with the "Effects of Climate Change on the World's Oceans" symposium; June 2018 in Washington D. C., USA
8. Work on tasks
9. Review to-do lists and assignments
10. Adjourn

WG 40 Endnote 3

WG 40 Terms of Reference

1. Identify a set of North Pacific ecological indicators and/or marine ecosystem functional responses of fish and shellfish, which show predictable responses to large- and regional-scale climate forcing;
2. Quantify the predictability of the regional ecosystem drivers that are controlled by large-scale climate variability and change;
3. Identify dynamical and statistical modeling frameworks for climate and ecosystem predictability;
4. Identify how and which ecosystem predictions can be integrated in the management of ecosystem services;
5. Identify climate and ocean products that can be used to begin making predictions of North Pacific marine ecosystems;
6. Outcomes and synergies with international efforts.

WG 40 Endnote 4

Proposal for a Topic Session on "*Ecological responses to variable climate changes and their applicability to ecosystem predictions*" at PICES-2018.

Duration: 1 day

Convenors: Ryan Rykaczewski (USA), Akinori Takasuka (Japan), Chan Joo Jang (Korea)

Suggested Invited Speakers: Won Moo Kim (Korea), Susan Allen (Canada), Takeshi Doi (Japan)

In the North Pacific, regional and large-scale climate forcing impacts a range of physical and ecological characteristics including temperature, stratification, ocean circulation, upwelling, biogeochemical properties, and primary and secondary production. These characteristics, in turn, can impact the distribution, composition, and productivity of fisheries resources. However, the accuracy of many climate-ecosystem relationships derived from historical observations deteriorates when faced with new observations. Reducing the uncertainty associated with climate-ecological relationships requires an

understanding of the mechanisms that govern empirical correlations. In this session, we seek presentations focused on climate-ecosystem relationships and whether such relationships can be expected to persist under future (*e.g*., months to decades) climate conditions. Many regional and large-scale properties of the physical ocean state can be skillfully predicted over scales of seasons (and years for some properties), and we hope that such ability, with further clarification of predictable properties in different regions on different timescales, can be used in combination with understanding of robust climate-ecosystem relationships to provide forecasts of marine ecosystems that will be useful to resource management and utilization.

WG 40 Endnote 5

Proposal for a 1-day inter-sessional meeting on
"A Census of marine ecosystem forecasting efforts in the North Pacific"
to be held at the 4th Symposium on the "*Effects of climate change on the world's oceans*" in 2018

In the North Pacific, regional- and large-scale climate forcing impacts a wide range of physical and biotic processes, and also imparts some predictability in the physical system. As a result, 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 6 terms of reference (TOR), of which the first 3 are to be prioritized in 2017–2018.

An intersessional meeting is proposed with a primary focus of addressing TOR 3, "Identify dynamical and statistical modeling frameworks for climate and ecosystem predictability". Several factors motivate this approach: (i) relatively few WG 40 members were able to attend the first WG 40 business meeting, in Vladivostok. A survey of all WG members indicated that many are planning to attend the "*Effects of climate change on the world's oceans*" (ECCWO) symposium in Washington DC in June 2018, (ii) TOR 1 is the focus of a separate session proposed for the 2018 PICES annual meeting, (iii) the WG already has relatively strong experience in TOR 2, and (iv) there will be a science session at ECCWO focused on seasonal to decadal prediction of marine ecosystems, which we plan to leverage to provide content and expertise for the proposed WG inter-sessional meeting.

The main product of the intersessional meeting will be a census of relevant ecosystem forecasting efforts across the North Pacific. The census will take the form of an easily digestible summary of key information about these efforts (*e.g*., ecological targets, regional foci, modeling methodologies and frameworks, skill assessments, observational datasets). The census will form the basis for developing ecosystem forecasting case studies as well as coherent approaches to ecosystem forecasting.