

## Report of the Biological Oceanography Committee

The meeting of the Biological Oceanography Committee (BIO) took place from 18:00–20:00 h on November 6 and 14:00–19:00 h on November 9, 2016, in San Diego, USA. The Chair, Dr. Angelica Peña, called the meeting to order and welcomed members and observers (*BIO Endnote 1*). Dr. Peña introduced the new BIO members, Dr. Julie Keister representing the USA, and Drs. Taewon Kim and Wongyu Park representing Korea. It was noted that several members were not present at the meeting, and that only China was not represented this year. The draft agenda was circulated. There were no changes/additions offered and the agenda was adopted (*BIO Endnote 2*). Dr. Debora Iglesias-Rodriguez agreed to act as rapporteur.



BIO participants at PICES-2016, from left: Hye-Won Moon, Yong-Rock An, Julie Keister, Atsushi Tsuda, Se-Jong Ju, Angelica Peña, Tsuneo Ono, Debora Iglesias-Rodriguez, Motomitsu Takahashi, Alexei Orlov, John Pinnegar, Akash Sastri, Wongyu Park, Taewon Kim.

### AGENDA ITEM 4

#### **Annual review of BIO activities**

- a) PICES-2016 BIO Paper/Topic Sessions and Workshops, and selection of judges for BIO Best Presentation and Poster awards

At the PICES-2016, BIO sponsored four 1-day Topic Sessions:

- *Early Life History Stages as Indicators and Predictors of Climate Variability and Ecosystem Change (S2),*
- *Understanding our Changing Oceans through Species Distributions and Habitat Models based on Remotely Sensed Data (S5),*

## BIO – 2016

- *What Factors make or break Trophic Linkages?* (S6)
- *Causes and Consequences of 25 Years of Variability in Ocean Conditions on the Ecosystems of the North Pacific* (S12),

Two Poster Sessions:

- *Recent Progress in Deep-Sea Research and Conservation: Lessons from Various Parts of the Globe*
- Contributed Poster Session

Two Workshops:

- *Distributions of habitat-forming coral and sponge assemblages in the North Pacific Ocean and factors influencing their distributions* (W3),
- *Consumption of North Pacific forage species by marine birds and mammals*(W6).

The ‘Procedures for Documenting PICES Sessions’ were circulated among members. Two volunteers were appointed to evaluate oral presentations by early career scientists at S2 (Dr. Takahashi and Dr. Perry) and S5 (Dr. Sastri and Dr. Kim) and four volunteers to evaluate poster by early career scientists (Dr. Ju, Dr. Kiester, Dr. Tsuda, and Dr. Iglesias-Rodriguez). Rankings were compiled by the Chair before the Closing Ceremony. The Best Presentation Award for a BIO-sponsored topic session was given to Dorothy Dick (*Forecasting the flock: Using species distribution models to evaluate the effects of climate change on future seabird foraging aggregations in the California Current System*) and BIO Best Poster Award to Lian Kwong (*A novel approach to estimating active carbon flux using the biomass size spectra*). See also the list of Best Presentations in the 2016 Summary of Scientific Sessions and Workshops.

b) Inter-sessional symposia/session/workshop/meetings.

A brief summary and the highlights of the PICES/ICES 6<sup>th</sup> International Zooplankton Production Symposium on “*New challenges in a changing ocean*” (May 9–13, 2016, Bergen, Norway) were reported by Dr. Atsushi Tsuda, a convenor of the Symposium. Overall, the meeting was a success with a strong scientific program and participants from several countries.

c) Publications.

Two PICES Scientific Reports were submitted to BIO after last year’s Annual Meeting: the Final Report of WG 26 on *Jellyfish Blooms around the North Pacific Rim: Causes and Consequences* (Editors: S. Uye and R. Brodeur) and the Scientific Report of AP-MBM on “Spatial ecology of marine top predators in the North Pacific: Tools for integrating across datasets and identifying high use areas” (Editors: Y. Watanuki, R. Suryan, H. Sasaki, T. Yamamoto, E. Hazen, M. Renner, J.A. Santora, P.D. O’Hara, W.J. Sydeman). Dr. Debora Iglesias-Rodriguez and Dr. Tsuda reviewed the first report and Dr. Se-Jong Ju and Dr. Peña the second one. After all reviewers’ changes and comments were considered, BIO recommended the publication of both reports to Science Board.

d) Reports in preparation

The activities of WG 28 on *Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple Stressors* and WG 29 on *Regional Climate Modeling* finished last year and the Final Report from these groups should be coming up soon. Dr. Motomitsu Takahashi, WG 28 Co-Chair, explained that there have been delays in the writing of the report but that they are planning to complete the report before the ISB-2017. Similarly, Co-Chair, Dr. Chan Joo Chan presented an update on the WG 29 report, which is also planned to be submitted to BIO before ISB-2017.

## AGENDA ITEM 5

### Reports of BIO active groups

Section on *Climate Change Effects on Marine Ecosystems* (S-CCME)

Co-Chair, Dr. John Pinnegar, presented the report of this joint PICES/ICES section. There are several new members being nominated, mostly to replace members who have recently retired. He reviewed the activities

carried out in 2016, which included participation of S-CCME members at:

- i) the CLIVAR/PICES Workshop on ENSO Predictability, August 10–11, 2016, San Diego, USA,
- ii) the ICES/PICES Workshop on “*Economic modelling of the effects of climate change on fish and fisheries*” (WKSICCME\_Econ), May 30–June 3, 2016, in Brest, France;
- iii) the ICES/PICES Workshop on “*Phase 1: Modelling effects of climate change on fish and fisheries*” (WKSICCME\_Phase1), PICES-2016, San Diego, USA;
- iv) a Theme Session I on “*Seasonal-to-decadal prediction of marine ecosystems: Opportunities, approaches, and applications*”, at the ICES 2016 ASC, September 19–23, 2016, in Riga, Latvia.

For 2017, S-CCME is proposing an ICES/PICES Theme Session on “*Projected impacts of climate change on marine ecosystems, wild captured and cultured fisheries, and fishery dependent communities*”, at ICES ASC 2017, and a S-CCME Workshop, held in conjunction with the International Symposium on “*Drivers of dynamics of small pelagic fish resources*”, to discuss Phase III of S-CCME, March 6–11, 2017, Victoria, BC, Canada.

#### Section on *Carbon and Climate* (S-CC)

A summary of the activities carried out and planned for next year was given by S-CC Co-Chair, Dr. Tsuneo Ono. In the last three years, S-CC is focusing on producing a basin-scale assessment of ocean acidification. At this PICES-2016, S-CC:

- i) completed the collection of information during the Workshop on “*Acidification on the North Pacific Ocean: A basin-wide assessment*” (W1), which they are planning to publish in 2017 in a PICES Scientific Report;
- ii) co-sponsored a Topic Session on “*New stage of ocean acidification studies: Responses of oceanic ecosystem including fisheries resources*” (S7).

They are also organizing an ICES/PICES Workshop on “*Understanding the impacts and consequences of ocean acidification for commercial species and end-users*” December 5–9, 2016, in Copenhagen, Denmark.

#### Section on *Marine Birds and Mammals* (S-MBM)

The Section on *Marine Birds and Mammals* (S-MBM) was formed at PICES-2015 to replace the existing AP-MBM. At PICES-2016, Dr. Patrick O’Hara (Canada) was elected new Co-Chair to replace Dr. Rolf Ream (USA). Members of S-MBM reviewed their Terms of Reference, and the slightly modified ToRs were presented by Dr. Ream and approved by BIO members. Because only eight members attended their annual meeting, the Co-Chair asked BIO to request that countries review membership of the new Section to improve participation. BIO agreed to bring this request to Science Board. Other S-MBM activities included organizing a workshop (W6, *Consumption of North Pacific forage species by marine birds and mammals*) and two topic sessions (S5, *Understanding our changing oceans through species distributions and habitat models based on remotely sensed data* and S6, *What factors make or break trophic linkages?*) at PICES-2017. In 2017, S-MBM is proposing a topic session on “*Seasonal and climatic influences on prey consumption by marine birds, mammals, and predatory fish*” at the next Annual Meeting.

#### Working Group (WG 32) on *Biodiversity of Biogenic Habitats*

Dr. Anya Dunham, acting Co-Chair of WG 32, presented a summary of 2016 activities and plans for next year. At PICES-2017, the WG organized a 2-day Workshop (W3) on “*Predicting distributions of habitat-forming coral and sponge assemblages in the North Pacific Ocean and identification of factors influencing their distributions*” where they reviewed potential factors and processes influencing the distributions of shallow water corals and deep-water corals and sponges. For PICES-2017, WG 32 is proposing a 1-day topic session on “*Indicators for assessing and monitoring biodiversity of biogenic habitats*”, aimed to improve the understanding of ecologically relevant, sensitive, observation-based indicators for assessing and monitoring biogenic habitats, and to review functional associations between commercially important species and biogenic habitats.

## BIO – 2016

### Working Group (WG 33) on *Climate Change and Biologically-driven Ocean Carbon Sequestration*

Members of the joint ICES/PICES WG 33 did not meet at PICES-2016. A report on the group activities and plans is expected in the near future.

#### AGENDA ITEM 6

##### **Relation with other international organizations/programs**

ESSAS (Ecosystem Studies of Sub-Arctic and Arctic Seas) is a regional program of IMBER now. Its goal is to compare, quantify and predict the impact of climate variability and climate change on the productivity and sustainability of Subarctic and Arctic marine ecosystems. Dr. Franz Mueter presented a summary of recent and future activities that include: i) sponsoring a session on “*Biophysical processes at the Arctic–Sub-Arctic iInterface*” at the Ocean Sciences Meeting, February 25, 2016, in New Orleans, USA, ii) a workshop on “*Resilience and adaptation to climate change in the Arctic (RACArctic)*”, March 1–3, 2016, in Hakodate, Japan, and iii) organizing the ESSAS Annual Meeting on “*Scientific challenges in a changing subarctic and Arctic*” in March 2016 in Yokohama, Japan, and iv) a topic session (S9) on “*Resilience, transitions and adaptation in marine ecosystems under a changing climate*” at PICES-2016. In 2017, an ESSAS Open Science Meeting on “*Subarctic and Arctic science*”, which is co-sponsored by PICES and ICES, will be held June 11–15, 2017, in Tromsø Norway.

IMBER’s (Integrated Marine Biogeochemistry and Ecosystem Research) goal is to understand, quantify, and compare historic and present structure and functioning of linked ocean and human systems to predict and project changes. Dr. Gro van der Meeren provided a history of IMBER, key themes, regional programs and working groups. She highlighted several areas of common interests of IMBER and PICES. The new science plan for 2016–2025 aims to link the ocean and human systems. Next steps are to revise and launch the new science plan, the new name – Integrated Marine Biosphere Research (IMBeR), the new logo (almost finalised), the new website (<http://www.imber.info/>), and to implement the new Science Plan by developing regional programmes, working groups and task teams.

BIO reviewed the information provided on theme sessions that were approved by ICES for their 2017 ASC and suggested that Session 07 “*Projected impacts of climate change on marine ecosystems, wild captured and cultured fisheries, and fishery dependent communities*” be co-sponsored by PICES.

#### AGENDA ITEM 7

##### **Review of PICES Standing Committees by Science Board**

There was some discussion among BIO members on the main topics of interest to the Committee. Several topics were identified as of interest to BIO and it was suggested that the Committee should start addressing additional themes such as genomics. Because it was not clear what was being requested by Science Board, further discussion was postponed until more information was provided.

#### AGENDA ITEM 8

##### **Update on FUTURE Science Program**

Drs. Sinjae Yoo and Perry, the FUTURE SSC liaisons to BIO, did not provide an update on the FUTURE science program.

## AGENDA ITEM 9

**Status of North Pacific Ecosystem Status Report**

Dr. Se-Jong Ju provided an update on activities, including the third Ecosystem Status Report Implementation Plan prepared by the Study Group (SG-NPESR3) on the *North Pacific Ecosystem Status Report*. The SG held an inter-sessional workshop on June 28–30, 2016, in Sidney, Canada where participants reviewed the environmental time series (ETSOs) that were nominated by the Standing Committees (443 in total), organized them by discipline and geographical locations and after some discussion, recommended the use of Large Marine Ecosystems as organizational units. The plan is to create an online database for ETSOs that will be used to build the next generation of NPESR. A web site has been created for this purpose that has a description on how to contribute data. The next steps are to send invitations and confirmations to authors (through December 2016), review nominations and identify gaps, and receive ETSO submissions. In 2017, the plan is to convene a North Pacific Synthesis Workshop (February 2017), carry out synthesis of ETSOs (October 2016–December 2017), and prepare publications (web based and printed reports). BIO members asked questions related to data submission and synthesis.

## AGENDA ITEM 10

**Proposals for new expert groups and proposal by an existing expert group**

Dr. Akash Sastri gave a presentation on a proposed Working Group on *Zooplankton Production Methodologies, Applications and Measurements in PICES Regions* that would be parented by BIO. He pointed out that there is a good understanding of primary production rates but not of secondary production despite the importance of zooplankton for fisheries. The proposed WG plans to focus on assessing the applicability of current methodologies (*i.e.*, traditional and biochemical methodologies) for measuring rates of zooplankton production of natural populations and communities and for applying the most practical methods to existing zooplankton time-series. He presented the proposed ToRs, work plan, and deliverables. There was some confusion regarding when the WG activities would be initiated. BIO members suggested some changes to the ToRs and work plan timeline, which were implemented. BIO strongly supports the creation of this group and unanimously agreed to take the proposal (BIO Endnote 3) to Science Board.

Dr. William Crawford presented an overview of a proposed Working Group on *Mesoscale and Sub-mesoscale Processes in the North Pacific* which aims to improve understanding of both mesoscale and submesoscale processes such as transport, mixing and impacts, which would be parented by POC. There was some interest and discussion on the applications and implications for BIO, but since the proposed WG focuses mostly on the physics, BIO did not consider the need to co-sponsor this proposal.

BIO briefly discussed the proposal for a Working Group on *Climate and Ecosystem Predictability* and for a Working Group on *Ecosystem Reference Points as a Common Currency across the PICES Member Countries* (WG-CERP). In general, BIO found these proposals interesting and supports the decision of the proposed parent committees.

A 5-day PICES Summer School on “*Coastal ocean observing systems and ecosystem monitoring*”, in July or August 2018, on Vancouver Island, Canada, was proposed by the Advisory Panel on North Pacific Coastal Ocean Observing Systems, parented by MONITOR and TCODE. It was also proposed that this be the first of annual summer school events on coastal ocean observing. The summer school proposal is patterned after a successful pilot coastal ocean observing summer school held in 2013 in Newport, Oregon. There is high demand for this type of early career training. The annual summer school will alternate being offered on the east and west sides of the North Pacific. BIO supports the proposal and agrees there is a need to train young marine scientists on how to make high-quality observations from the coastal ocean but the Committee is uncertain about making it an annual event.

## BIO – 2016

### AGENDA ITEM 11

#### **Planning PICES 2017 Annual Meeting**

The next PICES Annual Meeting with the theme, “*Environmental changes in the North Pacific and impacts on biological resources and ecosystem services*” will be held September 20–October 1, 2017 in Vladivostok, Russia. BIO members revised and discussed all the topic sessions and workshops being proposed and ranked them according to their relevance. BIO gave the highest rank to the following topic sessions:

- “*Indicators for assessing and monitoring biodiversity of biogenic habitats*”,
- “*Meso-/submeso-scale processes and their role in marine ecosystems*”, and
- “*Seasonal and climatic influences on prey consumption by marine birds, mammals, and predatory fishes*”.

In addition, the new system of funding and prioritizing invited speakers was discussed and agreed upon.

### AGENDA ITEM 12

#### **Proposed inter-sessional meeting for 2016 and beyond**

The following meetings will be held in the near future:

- i) NPFC Workshop on “Pacific saury stock assessment” (December 13-15, 2016, Busan, Korea). The organizers are looking for a PICES representative from BIO and/or FIS to attend the workshop. No one from BIO is interested in attending the workshop.
- ii) International Symposium on “*Drivers of dynamics of small pelagic fish resources*”, co-sponsored by PICES, ICES (March 6–11, 2017, Victoria, Canada). Dr. William Peterson was recommended SSC member by BIO in 2015.
- iii) PICES/ICES Early Career Scientist Conference on “*Climate, oceans and society challenges and Opportunities*” (May 30–June 2, 2017, Busan, Korea).

### AGENDA ITEM 13

#### **Documenting Sessions and Workshops**

The BIO Chair recalled the request to convenors to submit their session/workshop summaries and for BIO and its expert groups submit their business meeting reports to the Secretariat within one month after the Annual Meeting.

### AGENDA ITEM 14

#### **Election of new Chair of BIO**

Dr. Se-Jong Ju (Korea) was elected as Chair and Dr. Debora Iglesias-Rodriguez was elected as Vice-Chair of the Biological Oceanography Committee.

### AGENDA ITEM 15

#### **Other business**

No other business was discussed

AGENDA ITEM 16

**Summary of BIO decisions and recommendations to Science Board**

- i) BIO recommends approval of the revised ToRs of S-MBM and welcomed the new Co-Chair, Dr. Patrick O’Hara.
- ii) At the request of S-MBM Co-Chair, BIO recommends that countries review their membership for this new Section and send their delegates to S-MBM Annual Meetings.
- iii) BIO strongly supports the creation of a Working Group on *Zooplankton Production Methodologies, Applications and Measurements in PICES Regions* to be parented by BIO.
- iv) BIO supports the proposal of a Working Group on *Mesoscale and Sub-mesoscale Processes in the North Pacific* to be parented by POC.
- v) BIO supports the proposal for a PICES Summer School on “*Coastal ocean observing systems and ecosystem monitoring*” in 2018.
- vi) BIO request travel support for an early career scientist to attend the Lowell Wakefield Symposium on “*Impacts of a changing environment on the dynamics of high-latitude fish and fisheries*” (May 9–12, 2017, Anchorage, USA), and for a PICES co-convenor to attend ICES ASC 2017.
- vii) Dr. Se-Jong Ju was elected Chair and Dr. Debora Iglesias-Rodriguez was elected as Vice-Chair of the Biological Oceanography Committee.

***BIO Endnote 1***

**BIO participation list**

Members

Debora Iglesias-Rodriguez (USA)  
 Se-Jong Ju (Korea, Vice-Chair)  
 Julie Keister (USA)  
 Taewon Kim (Korea)  
 Alexei Orlov (Russia)  
 Wongyu Park (Korea)  
 Angelica Peña (Canada, Chair)  
 Akash Sastri (Canada)  
 Motomitsu Takahashi (Japan)  
 Atsushi Tsuda (Japan)

Members unable to attend

Canada: Janelle Curtis  
 China: Yingjie Liu, Song Sun, Ping Zhuang  
 Japan: Kaoru Hattori  
 Russia: Boris N. Kotenev  
 USA: William Peterson

Observers

Yong-Rock An (Korea, S-MBM)  
 Keyseok Choe (Korea)  
 William Crawford (Canada)  
 Anya Dunham (Canada, FIS, acting Co-Chair WG 32)  
 Mai Miyamoto (Japan)  
 Hye-Won Moon (Korea, WG 32)  
 Franz Mueter (ESSAS)  
 Tsuneo Ono (Japan, S-CC Co-Chair)  
 Patrick O’Hara (Canada, S-MBM)  
 John Pinnegar (UK, S-CCME Co-Chair/ICES)  
 Rolf Ream (USA, S-MBM Co-Chair)  
 Chris Rooper (USA, WG 32)  
 Hiroko Sasaki (Japan)  
 Gro van der Meeren (IMBER)  
 Sinjae Yoo (Korea, FUTURE SSC, Co-Chair WG 35 )

**BIO Endnote 2**

**BIO meeting agenda**

1. Welcome, introductions, opening remarks
2. Membership changes: Dr. Julie Keister is as a new member of BIO Committee replacing Dr. Michael P. Seki and representing the USA
3. Changes to, adoption of, agenda and appointment of rapporteur
4. Annual review of BIO activities
  - a) 2016 PICES BIO Paper/Topic Sessions and Workshop and selection of judges for BIO Best Presentation (from S2 and S5) and Poster Award (from S2, S5, BIO-P1 and BIO-P2)

Title	Convenors	Invited speakers	Duration (day)	Date (Nov.)	Committees (Sponsors)
<i>S2: Early Life History Stages as Indicators and Predictors of Climate Variability and Ecosystem Change</i>	Richard Brodeur (USA) Tony Koslow (USA) Ian Perry (Canada) Moto Takahashi (Japan)	Janet Duffy-Anderson (USA) Jon Hare (USA) Akinori Takasuka (Japan)	1	10	BIO/ TCODE/ FIS
<i>S5: Understanding our Changing Oceans through Species Distributions and Habitat Models based on Remotely Sensed Data</i>	Patrick O’Hara (Canada) Elliott Hazen (USA) Sei-Ichi Saitoh (Japan) Yutaka Watanuki (Japan)	Robert Suryan (USA)	1	8	BIO/ MONITOR/ MEQ
<i>S6: What Factors make or break Trophic Linkages?</i>	Elliott L. Hazen (USA) Jameal Samhouri (USA) Shin-Ichi Ito (Japan) Jennifer Boldt (Canada)	Masashi Kiyota (Japan) Kenneth Rose (USA)	1	8	POC/MEQ/ MONITOR/ BIO
<i>S12: Causes and Consequences of 25 Years of Variability in Ocean Conditions on the Ecosystems of the North Pacific</i>	Bill Peterson (USA) Jack Barth (USA) Sanae Chiba (Japan) Yury Zuenko (Russia)	Emanuele Di Lorenzo (USA) Art Miller (USA)	1	10	MONITOR/ BIO/ TCODE
<i>BIO Poster Session 1 Recent Progress in Deep-Sea Research and Conservation: Lessons from Various Parts of the Globe</i>	Alexei Orlov (Russia) Tony Koslow (USA) Orio Yamamura (Japan) Evgeny Pakhomov (Canada)		4	7–10	BIO
<i>BIO Contributed Poster Session 2</i>	Angelica Peña (Canada) Se-Jong Ju (Korea)		4	7–10	BIO
<i>W3: Distributions of habitat-forming coral and sponge assemblages in the North Pacific Ocean and factors influencing their distributions (2 days)</i>	Kwang-Sik Choi (Korea) Janelle Curtis (Canada) Masashi Kiyota (Japan) Chris Rooper (USA)	Hiroya Yamano (Japan)	2	2–3	BIO
<i>W6: Consumption of North Pacific forage species by marine birds and mammals</i>	Andrew Trites (Canada) Elliott Hazen (USA) Tsutomu Tamura (Japan) Yutaka Watanuki (Japan)	Julie Thayer	1	3	BIO

2016 Inter-sessional symposia/sessions/workshops/meetings

- 6<sup>th</sup> International Zooplankton Production Symposium on “*New challenges in a changing ocean*” (May 9–13 2016, Bergen, Norway). Convenors: Atsushi Tsuda (Japan, PICES), Padmini Dalpadado (Norway, ICES) and Astthor Gislason (Iceland, ICES).

- b) Publications
  - Final report of the WG 26 on “*Jellyfish Blooms around the North Pacific Rim: Causes and Consequences*” (Editors: S. Uye and R. Brodeur).
  - PICES Scientific Report of MBM-AP on “Spatial ecology of marine top predators in the North Pacific: tools for integrating across datasets and identifying high use areas” (Editors: Y. Watanuki, R. Suryan, H. Sasaki, T. Yamamoto, E. Hazen, M. Renner, J.A. Santora, P.D. O’Hara, W.J. Sydeman).
- c) Reports in preparation:
  - Final report of the WG 28 on *Development of Ecosystem Indicators to Characterize Ecosystem Responses to Multiple Stressors* (Motomitsu Takahashi)
  - Final report of the WG 29 on *Regional Climate Modeling* (Chan Joo Jang)
- 5. Progressive reports and future plans of BIO active groups
  - a) S-CCME: Joint PICES/ICES Section on *Climate Change Effects on Marine Ecosystems* (Shin-ichi Ito or A. Hollowed)
  - b) S-CC: Section on *Carbon and Climate* (T. Ono)
  - c) S-MBM: Section on *Marine Birds and Mammals* (R. Ream)
  - d) WG 32: Working Group on *Biodiversity of Biogenic Habitats* (M. Kiyota)
  - e) WG 33: Joint PICES/ICES Working Group on *Climate Change and Biologically-driven Ocean Carbon Sequestration* (R. Rivkin or N. Jiao)
- 6. Relation with other international organizations/programs
  - ESSAS (Franz Mueter)
  - IMBER (Gro van der Meeren)
- 7. Review of PICES Standing Committees by Science Board (SB)
- 8. FUTURE Program
  - *Update on FUTURE Science Program* (Sinjae Yoo)
  - *Discuss ideas on how to display and raise the prominence of FUTURE*
- 9. Status of North Pacific Ecosystem Status Report (Se-Jong Ju)
- 10. Review proposals of new Expert Groups
- 11. Planning PICES 2017 Annual Meeting: theme “*Environmental changes in the North Pacific and impacts on biological resources and ecosystem services*”, Vladivostok, Russia, Dates TBA
  - BIO related sessions and workshops: discuss ranking and sponsorship
  - New system of funding and prioritizing invited speakers. Provide feedback to SB
- 12. Proposed inter-sessional meetings for end of 2016 and beyond
  - a) PICES/ICES Symposium on “*Drivers of dynamics of small pelagic fish resources*” (March 6-11 2017, Victoria, Canada). BIO recommended Bill Peterson as SSC member.
  - b) PICES/ICES Early Career Scientist Conference on “*Climate, oceans and society challenges and opportunities*” (May 30 – June 2, 2017, Busan, Korea).
  - c) NPFC Workshop on “*Pacific saury stock assessment*” (December 13-15, 2016, Busan, Korea). Looking for a PICES representative from BIO and/or FIS to attend the workshop.
- 13. Documenting business meetings, topic sessions and workshops
- 14. Election of new Chairperson of BIO
- 15. Other business
- 16. Summary of BIO decisions and recommendations to Science Board

**BIO Endnote 3**

**Proposal for a Working Group on Zooplankton Production Methodologies, Applications and Measurements in PICES regions**

**Proposed Parent Committee: BIO**

**Potential Co-Chairs:** Toru Kobari (Japan), Akash Sastri (Canada)

**Potential Members:** William T. Peterson (USA), Wim J. Kimmerer (USA), Jung-hun Kang (Korea), Se-Jong Ju (Korea), Todd O'Brien (USA)

**Background**

Knowledge of marine zooplankton productivity is key to understanding how ecosystem-scale resource production (i.e. harvested fisheries) and biogeochemical processes will respond to broad-scale physical forcing such as climate change. The limited number and poor spatio-temporal resolution of traditional zooplankton production rate measurements does not currently permit characterization of the variability of this rate relative to current and predicted physical, chemical and biological conditions. A fundamental barrier to improving our understanding of the processes driving variation in zooplankton production rates (population and community-level) is the lack of consensus on the most practical and relevant methods for measuring rates across a wide range of phyla and trophic levels. Development and application of practical approaches for estimating zooplankton productivity are urgently needed.

The proposed Working Group (WG) will focus on assessing the applicability of current methodologies (i.e., traditional and newer biochemical methodologies) for measuring rates of zooplankton production for natural mesozooplankton populations and communities (including non-crustaceans); and for applying the most practical methods to existing zooplankton time-series. It is particularly timely to focus on zooplankton production because assumptions and limitations underlying the most commonly applied methods have now been reconsidered and other methods have been developed since the publication of the *ICES Zooplankton Methodology Manual* in 2000. A consequence of these recent developments has been a general confusion about how these methods should be applied for natural zooplankton populations and communities, and how the various estimates can be compared. The latest IPCC report (IPCC 2013) has reaffirmed that global warming exerts widespread impacts on natural systems; a quantitative evaluation of secondary productivity is therefore both timely and critical for understanding how marine ecosystems adapt to continued global climate change. However, there is still little information on zooplankton production as a proxy for the integrated biological response of lower trophic levels in marine food webs. Indeed, the generation of global maps of primary productivity is now routine, but the ability to make similar spatial comparisons is lacking for zooplankton productivity. At this stage, a comprehensive review of zooplankton production methodologies (in the context of recent advances) would allow us to:

- 1) Elaborate on recommendations for the standardized application of traditional and biochemical zooplankton production measurement methodologies for worldwide users
- 2) Develop and apply practical methods for estimating zooplankton production to existing time-series.

It is reasonable that the WG activities proposed here are sponsored by an international scientific organization such as PICES, since similar terms of reference are ongoing for the ICES Working Group on Zooplankton Ecology (WGZE). A PICES-BIO sponsored WG would not only promote information exchange and collaborations between PICES and ICES but also among previous (e.g., SCOR WG125) and ongoing projects (e.g., IGMETS and IMBER). Also, the WG would provide a basis for sharing technological approaches for estimating zooplankton production in countries bordering the North Pacific Ocean.

## Terms of Reference

1. Summarize assumptions, recent advances and limitations of both traditional and biochemical methodologies for measuring zooplankton production of natural populations and communities;
2. Produce recommendations and procedures for both traditional and biochemical zooplankton production rate measurement methodologies and make them available on a website for worldwide access;
3. Develop practical models for estimating zooplankton production from time-series observations;
4. Develop an interactive website for exchange of information on zooplankton production measurements for regional and/or global mapping;
5. Build a network of scientists and laboratories measuring zooplankton production among PICES and ICES nations as well as developing countries;
6. Promote international collaborations among zooplankton production researchers through PICES and other international organizations such as ICES and IMBER;
7. Publish a final report summarizing our results.

## Work plan

### Year 1 (2017)

1. WG meeting (during PICES annual meeting: Russia)
  - ✓ Discuss schedules, plans and contributors for terms of reference and deliverables;
  - ✓ Discuss schedules and plans for a topic session during the next PICES annual meeting in Japan.
2. PICES workshop (during PICES annual meeting: Russia)
  - ✓ Summarize practical disadvantages and limitations of both traditional and biochemical methodologies for measuring natural zooplankton production;
  - ✓ Develop the recommendations and standardized protocols for the traditional and biochemical methodologies;
  - ✓ Develop the methodologies or approaches for estimating zooplankton production which are applicable to zooplankton time-series.
3. Contact information
  - ✓ Make a list of contact information on scientists and laboratories measuring zooplankton production.
4. Review articles
  - ✓ Prepare manuscript drafts to review the assumptions, advantages and limitations of traditional and biochemical methodologies for measuring production of natural zooplankton populations or communities.

### Year 2 (2018)

1. WG meeting (during PICES annual meeting: Japan)
  - ✓ Revise schedules and discuss plans for terms of reference and deliverables;
  - ✓ Apply practical models for estimating zooplankton production to select zooplankton time-series and compare the estimates and sensitivity of the model results;
  - ✓ Share recommendations and standardized protocols for both traditional and biochemical zooplankton production rate measurement methodologies on a website.
2. PICES topic session (during PICES annual meeting: Japan)
  - ✓ Overview of plankton ecosystem status in PICES and ICES regions (Invited talks);
  - ✓ Introduce IGMETS project and the achievements (Invited talk);
  - ✓ Integrate latest information on zooplankton production methodologies, applications and measurements in PICES and the other regions.
3. Contact information
  - ✓ Develop a mailing list and share on a website the contact information on scientists and laboratories measuring zooplankton production.
- Review articles

- ✓ Submit, revise and publish review articles on both traditional and biochemical methodologies for measuring zooplankton production.
- 4. PICES scientific report
  - ✓ Make a draft of PICES scientific report, including the following information on traditional and biochemical methodologies for measuring zooplankton production:
    - Review of the assumptions, advantages and limitations applying natural zooplankton community;
    - Recommendations and standardized protocols;
    - Application of practical model to some zooplankton time-series and comparison of the production estimates;
    - Regional and global mapping of zooplankton production estimated with the practical models.

Year 3 (2019)

1. WG meeting (during PICES annual meeting: Canada)
  - ✓ Discuss and revise PICES scientific report;
  - ✓ Make a regional and global map of zooplankton production estimated with the practical models applied to regional and global zooplankton time-series.
2. Topic Session (during PICES annual meeting)
  - ✓ Zooplankton production in marine systems (Invited talk);
  - ✓ Biochemical or physiological approach for estimating zooplankton production (Invited talk);
  - ✓ Introduction of latest zooplankton production measurements by both traditional and biochemical approaches.
3. PICES scientific report
  - ✓ Submit a final scientific report to PICES.

**Deliverables**

1. Reports or Peer-reviewed articles summarizing the assumptions, recent advances and limitations of both traditional and biochemical methods to estimate zooplankton production of natural populations and communities.
2. Guidelines on recommendations and procedures for both traditional and biochemical methods on a website of an international organization such as PICES and/or ICES.
3. Lists of contact information on scientists and laboratories measuring zooplankton production among PICES and ICES nations.
4. An interactive website for regional to global scale mapping of zooplankton production estimates incorporated to zooplankton time-series on a website.
5. A final report summarizing the results of the WG as a Scientific Report in PICES.