

SCOR and PICES Collaborative Activities

Report from PICES for the 2020 Virtual SCOR Meeting (19-23 October 2020)

Prepared by Hal Batchelder

The North Pacific Marine Science Organization (PICES) is an intergovernmental scientific organization established by an international convention in 1992, in order to promote and coordinate marine scientific research in the North Pacific and adjacent seas. Our current member countries are Canada, Japan, People's Republic of China, Republic of Korea, Russian Federation and the United States of America. PICES' goals are to (1) advance scientific knowledge and capacity available for the member countries, including information on human activities affecting, and affected by marine ecosystems, and (2) provide a mechanism for collaboration among scientists in addressing timely and critical scientific questions about the North Pacific. In the 28 years since its establishment, PICES has become a major forum for the discussion and sharing of marine science in the North Pacific. Information on the Organization and its activities is available on the PICES website at <http://www.pices.int>.

SCOR and PICES have developed cooperative methods that have made it possible for an international non-governmental organization and a regional intergovernmental organization to share their strengths. Continuing and expanding collaboration between PICES and SCOR is based on the recognition that PICES can play an important role in bringing a North Pacific perspective to the global activities of SCOR, and that by participating in and implementing these activities in the region, PICES can advance its own scientific agenda. PICES contributes scientific expertise to SCOR-sponsored international large-scale ocean research projects (HABS [GlobalHAB], IMBeR, SOLAS, GACS [Global Alliance of Continuous Plankton Recorder Surveys]), to ocean carbon activities (IOCCP [International Ocean Carbon Coordination Project]) supported by SCOR, and to several SCOR Working Groups. SCOR working groups supported by PICES have included WG125 (Global Comparisons of Zooplankton Time Series), WG134 (The Microbial Carbon Pump in the Ocean), WG137 (Patterns of Phytoplankton Dynamics in Coastal Ecosystems: Comparative Analysis of Time Series Observation), WG146 (Radioactivity in the Ocean, 5 decades later), WG149 (Changing Ocean Biological Systems (COBS): how will biota respond to a changing Ocean), WG154 (Integration of Plankton-Observing Sensor Systems to Existing Global Sampling Programs (P-OBS), and WG155 (Eastern boundary upwelling systems (EBUS): diversity, coupled dynamics and sensitivity to climate change). **In addition to the above, PICES and SCOR are both strong proponents of capacity building.**

To discuss on-going and future collaborations, SCOR and PICES continue to irregularly exchange observers to the others annual/executive meetings. In recent years, SCOR was represented by Dr. Sinjae Yoo (Korea) at the PICES-2014 annual meeting in Yeosu, Korea, Dr. Sun Song, Vice-president of SCOR at the PICES-2015 annual meeting in Qingdao, China, and Edward Urban at the PICES-2016 meeting in San Diego, USA. Dr. Harold Batchelder (PICES Deputy Executive Secretary, liaison member of SCOR Capacity Building Committee) attended the 2013 SCOR Executive Committee Meeting (Wellington, New Zealand), the 2014 SCOR meeting (Bremen, Germany), the 2015 meeting in Goa, India, the 2016 meeting in Sopot, Poland, the 2018 meeting in Plymouth, UK, and the 2019 meeting in Toyama, Japan. A written report and presentation of PICES activities in 2017 was prepared by PICES and presented by Song Sun (China) on behalf of PICES at the 2017 SCOR meeting in Cape Town, South Africa. According to our records, SCOR was not represented at PICES-2017 in Vladivostok nor PICES-2018 in Yokohama, Japan. Sinjae Yoo officially represented SCOR at the PICES-2019 annual meeting in Victoria, BC, Canada (16-27 Oct 2019).

This report provides an update on PICES-SCOR collaborations since the 2019 SCOR Meeting in Toyama—a period that includes the PICES Annual Meeting, which was held in Victoria, BC, Canada (Oct 16 – 27, 2019). The MSEAS (Marine Socio-Ecological Systems) International Meeting scheduled for May 2019 was postponed for a year due to the COVID-19 pandemic and the inability of many of the participants to obtain travel permission early in 2020 given the pandemic. It is currently scheduled to be held in Yokohama in 2021, but that remains uncertain until more is known about the ongoing severity of the COVID-19 pandemic. **The PICES Annual Meeting in October 2020 will be a virtual meeting.**

PICES is greatly appreciative of SCOR's long standing financial support, since it is difficult for PICES to fund participants from non-PICES countries to our annual meetings and sponsored international activities.

Examples of such sponsored international activities in the recent past are:

- (1) SCOR provided \$3000 USD to PICES to support international travel of early career scientists to attend the International Symposium on *Understanding Changes in Transitional Areas of the Pacific*, that was held in La Paz, Mexico, from 24-26 April 2018.
 - (2) SCOR provided \$3000 USD to PICES to support international travel of scientists from developing countries to attend the 4th Effects of Climate Change on the World's Oceans Symposium in Washington, DC, 2-9 June 2018.
 - (3) SCOR provided \$5200 USD to PICES on behalf of SOLAS to support international travel of scientists from developing countries to attend the 4th Effects of Climate Change on the World's Oceans Symposium (ECCWO-4) in Washington, DC, 2-9 June 2018.
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For the PICES 2019 Annual Meeting in Victoria, BC in October, SCOR provided substantial funding (\$10,000 USD) from the GlobalHAB program budget to support a 2.5 day Workshop (17-19 October 2019) titled "**W18: GlobalHAB: Evaluating, Reducing and Mitigating the Cost of Harmful Algal Blooms: a Compendium of Case Studies**", which is cosponsored by SCOR, ISSHA, NOWPAP, Greig Seafood Ltd., IOC UNESCO, GlobalHAB, and AXA XL Insurance). Efforts are underway to produce a series of papers to be published and archived on the PICES web page.

Workshop (W18) Description: Over the last 2 decades, several reports have compiled what is known about the economic effects of harmful algal blooms. Most coastal regions have neither conducted economic analyses of HABs nor collected data that can be used to generate reliable quantitative estimates of net economic losses and economic impacts. Better estimates of the economic impacts of HABs will require coordination among HAB scientists and economists.

This 2.5 day international workshop brought together expertise in the science of HABs and economics to review and analyze case studies for the study of economic impacts of HABs on fisheries and aquaculture. The workshop structure was:

Day 1 (1/2 day): Overview of Economics and HABs, Analysis of U.S. west coast impacts. *The discussion were focused on types of economic assessment that will guide our discussions of case studies on workshop day 2.*

Day 2 (full day): Case studies: examples of HAB impacts to wild fisheries, recreational fisheries and aquaculture worldwide. *The discussions were focused on what economic studies can be done in the future and where the data gaps are.*

Day 3 (full day): Mitigation strategies, Value of Information. *The discussions were focused on the value of HAB forecasts. Wrap up and writing assignments.*

The output of this workshop is a compendium of examples describing economic approaches used to estimate the costs of HABs and their mitigation, focusing on establishing connections between HAB scientists and economists. A shorter version of the compendium may be prepared for submission to a

journal. In addition, the workshop will (1) propose priorities for research and effective management in the future, (2) develop partnerships between economists and HAB researchers to develop transdisciplinary projects, and (3) attract resources to the field. There are currently 6 chapters and an appendix with definitions of concepts and terminology. These chapters will be published as a PICES Special Publication by late summer 2020 and will be posted on both the PICES and GlobalHAB websites.

CHAPTER 1: GlobalHAB Workshop: Evaluating, Reducing and Mitigating the Cost of Harmful Algal Blooms, a Compendium of Case Studies

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CHAPTER 2: Evaluating the economic impacts of harmful algal blooms: Issues, methods, and examples

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CHAPTER 3: Economic Impacts and Management of *Cochlodinium* in Korea

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CHAPTER 4: An Economic Assessment of *Ciguatera* Fish Poisoning Outbreaks—An Island Model

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CHAPTER 5: Estimating and mitigating the economic costs of harmful algal blooms on commercial and recreational shellfish harvesters

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CHAPTER 6: The economic impacts of harmful algal blooms on salmon cage aquaculture

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CHAPTER 7: Conclusions and Recommendations

Mark Wells, Raphe Kudela, Veronique Le Bihan, William Cochlan, WeolAe Lim, Doohoon Kim, Elisa Berdalet, Marc Suddleson, Takafumi Yoshida, Vera Trainer

APPENDIX 1. Definition of Economic Concepts and Terminology

Benefits: the benefits people get from something are equal to the maximum amount they are willing to pay for it.

Consumer surplus: the difference between the price that consumers pay and the price that they are willing to pay.

Cost-benefit analysis: measuring changes in economic value associated with a project, policy, or event.

Costs: the costs of something are all expenditures of productive resources or inputs required to produce it.

Counterfactual analysis: in the case understanding the impacts of a harmful algal bloom (HAB), a counterfactual analysis compares observed outcomes to a counterfactual, or what would have happened without the HAB.

Economic impact analysis: measuring changes in economic outcomes, such as income and employment.

Economic value: economic value, also referred to as economic welfare, is the sum of consumer and producer surplus and any external costs and benefits.

External benefits: benefits generated with the production or consumption of a good that are not considered by the producer or consumer, because they are not compensated for these benefits.

External costs: costs generated with the production or consumption of a good that are not considered by the producer or consumer, because they do not pay for the costs.

Externalities: any external benefits and costs.

Market demand curve: aggregates the quantity demanded by all consumers in the market for each price.

Market supply curve: aggregates the quantity supplied by all firms in the market for each price.

Markets: institutions in which buyers and sellers of goods and services carry out mutually agreed-upon exchanges.

Opportunity costs: the maximum value we give up by doing one thing instead of something else.

Private goods: must be bought in order to be consumed and whose ownership is restricted to the group or individual that purchased the good.

Producer surplus: the difference between the price that producers receive and the price that they are willing to accept.

Race to fish: harvesters compete with each other to capture the fish first.

Variable costs: costs that change when the quantity produced changes.

Willingness to accept (WTA): the minimum amount a producer would sell their product for.

Willingness to pay (WTP): the maximum amount a consumer would pay for a good.

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HARMFUL ALGAL BLOOM ACTIVITIES SUPPORTED BY SCOR

Co-sponsored symposia/conferences/workshops

PICES partnered with GEOHAB (with ICES and NOAA as other sponsors) in organizing and funding the workshop on “*Harmful algal blooms in a changing world*” (March 18–22, 2013, Friday Harbor, WA, U.S.A.) to assess the state of knowledge on HABs and climate change, and to identify the most critical research needs that can realistically be addressed over the next 5–10 years. The findings were published in the peer-reviewed journal *Harmful Algae*. Wells, M.L., V. L. Trainer, T. J. Smayda, B.S.O. Karlson, C.G. Trick, R.M. Kudela, A. Ishikawa, S. Bernard, A. Wulff, D. M. Anderson, W.P. Cochlan. 2015, Harmful algal blooms and climate change: Learning from the past and present to forecast the future. *Harmful Algae*, 49 (2015), 68–9.

SCOR generously provided \$10,000 USD to support a 2.5 day Workshop at PICES-2019 (17-19 October 2019) titled “*GlobalHAB: Evaluating, Reducing and Mitigating the Cost of Harmful Algal Blooms: a Compendium of Case Studies*”. More details about this workshop and SCOR’s participation is in earlier text of this document.

Under GlobalHAB Theme 12. Climate Change

- **Economic Impacts of HABs workshop** – held in October 2019 in conjunction with the PICES Annual Meeting in Victoria, BC (this is described above W18).

- **Special issue in *Harmful Algae*** (information from Chris Gobler). This special issue is complete and papers are listed below.
- **Best-practices Manual** (information from Marina) – The first meeting was held in Napoli on 26 Feb.-1 March 2018. They discussed interactions with SCOR WG 149 (COBS). The idea is not to build a manual for all possible scenarios. This item has not been updated since last year’s annual meeting, so may be dated.

Climate Change and HABs: Special Issue of Harmful Algae (Final)

1. Climate Change and Harmful Algal Blooms: Insights and perspective

Christopher J. Gobler

2. Pelagic harmful algal blooms and climate change: Lessons from nature’s experiments with extremes

Vera L.Trainer, ^aStephanie K.Moore, ^aGustaaf Hallegraeff, ^bRaphael M.Kudela, ^cAlejandro Clement, ^dJorge I.Mardones, ^eWilliam P.Cochlan^f

3. Perspective: Advancing the research agenda for improving understanding of cyanobacteria in a future of global change

M.A Burford, C.C Carey, D.P. Hamilton, J. Huisman, A. Wulff

4. Climate change and harmful benthic microalgae

Patricia A. Tester, R. Wayne Litaker, Elisa Berdalet

5. Cyst-forming dinoflagellates in a warming climate

Michael L. Brosnahan, Alexis D. Fischer, Cary B. Lopez, Stephanie K. Moore, Donald M. Anderson

6. Basin-specific changes in filamentous cyanobacteria community composition across four decades in the Baltic Sea

Malin Olofsson, Sanna Suikkanen, Justyna Kobos, Norbert Wasmund, Bengt Karlson

7. Dynamic CO₂ and pH levels in coastal, estuarine, and inland waters: Theoretical and observed effects on harmful algal blooms

John A. Raven, Christopher J. Gobler, Per Juel Hansen

8. Harmful algae at the complex nexus of eutrophication and climate change

Patricia M. Glibert

9. Harmful algal blooms: A climate change co-stressor in marine and freshwater ecosystems

Andrew W. Griffith, Christopher J. Gobler

10. Progress and promise of omics for predicting the impacts of climate change on harmful algal blooms

Gwenn M.M. Hennon, Sonya T. Dyhrman

11. Modelling HABs in a changing climate

David K Ralston and Stephanie K. Moore.

12. The Future of HAB Science: Directions and challenges in a changing climate, Mark Wells, Bengt Karlson, Angela Wulff, Raphe Kudela, Charles Trick, Valentina Asnaghi, Elisa Berdalet, William Cochlan, Keith Davidson, Maarten De Rijcke, Stephanie Dutkiewicz, Gustaaf Hallegraeff, Kevin J. Flynn, Catherine Legrand, Hans Paerl, Joe Silke, Sanna Suikkanen, Peter Thompson, Vera L. Trainer

OCEAN CARBON ACTIVITIES SUPPORTED BY SCOR

Communication/coordination

- PICES, through its Working Groups on *CO₂ in the North Pacific* (WG 13; 1998–2001) and *Biogeochemical Data Integration and Synthesis* (WG 17; 2002–2005), and now through the Section on Carbon and Climate (S-CC), has provided coordination for synthesis of ocean carbon research and the development of a network of ocean carbon observations in the North Pacific. The importance of ensuring effective two-way communication with other international scientific groups that have a responsibility for the coordination of ocean carbon research, such as the SCOR/IOC International Ocean Carbon Coordinated Project (IOCCP) and to the SOLAS/IMBeR Carbon (SIC) Research Working Group, has been explicitly included in the terms of reference for S-CC.

Scientific Activities

- Ocean acidification has been proceeding for a century, at an accelerating rate, and its impacts are beginning to be felt in many corners of the North Pacific. A workshop on “*Acidification of the North Pacific Ocean: a basin-wide assessment*” was held on November 3, 2016 at the PICES Annual Meeting in San Diego, CA. It was well attended, and brought together scientists from all of the PICES countries to synthesize observations and projections of acidification processes and impacts in our respective countries’ waters and adjacent international waters. The workshop is the culmination of a two-year long process of collation of relevant information, and synthesis of data collected in each of the countries of the North Pacific basin. The workshop proceedings will form the basis for subsequent assessments, with improved understanding of which ocean regions are most vulnerable to acidification impacts, and how additional resources might best be deployed to predict or detect changes likely to produce significant impacts. There were several topical presentations, as well as individual national updates and extensive discussion of the contents of the proposed assessment and strategies for completing it.
- During the past two years a group led by the co-chairs (James Christian (CAN) & Tsuneo Ono (Japan)) of the PICES Section on Carbon and Climate (S-CC), worked with other contributing authors to complete the document. **It was published as PICES Special Publication No. 5, and titled “*Ocean Acidification and Deoxygenation in the North Pacific Ocean*”.**

SCOR WORKING GROUPS

PICES regularly provides comments on SCOR Working Group proposals and often recommends and funds an Associate Member for PICES-relevant groups. The support from PICES extends the expertise available within the group, increases the geographic coverage of the groups, and helps individual scientists from the North Pacific become more involved in SCOR activities, which benefits both organizations.

- PICES currently supports Associated Members for three SCOR Working Group:
 - WG 149 on *Changing Ocean Biological Systems: how will biota respond to a changing ocean? (COBS)* (Dr. Uta Passow, USA, Assoc. Member) – This WG was approved in late 2015, so should be completing its tasks in 2019.
 - WG 154 on *Integration of Plankton-Observing Sensor Systems to Existing Global Sampling Programs (P-OBS)* (Dr. Sonia Batten, Canada, Assoc. Member)—This WG was approved in late 2017, and is holding their third meeting in September 2019.
 - WG 155 on *Eastern Boundary Upwelling Systems: Diversity, Coupled Dynamics and Sensitivity to Climate Change (EBUS)* (Dr. Ryan Rykaczewski (USA); Note also that Dr. Enrique Curchitser (USA) is a full member of EBUS and the Vice Chair of PICES.—This WG was also approved in late 2017, and met for the first time in Washington DC immediately prior to the ECCWO-4 Symposium. I am unsure if there has been a second meeting, as there is not information about other meetings on the website.
- PICES provided partial support to Sonia Batten to participate in the first P-OBS meeting immediately prior to the AGU Ocean Sciences meeting in Portland, OR in February 2018, and partial support to Ryan Rykaczewski to participate in a 2-day meeting of EBUS immediately prior to the 4th Symposium on the Effects of Climate Change on the World’s Oceans, held in Washington, DC in early June 2018.

CAPACITY BUILDING

SCOR and PICES have a history of cooperating in capacity building.

- SCOR provides travel support for scientists from countries with “economies in transition” to participate in SCOR-relevant sessions/workshops at PICES Annual Meetings, international symposia and capacity building events led/co-organized by PICES. For this reporting period, funding from the SCOR/NSF fund was provided/committed for the following event, and there is one other request pending with SCOR (see below):

- \$5,000 USD (~6,650 CAD) for the PICES-2019 Annual Meeting “*Connecting Science and Communities in a Changing North Pacific*”, which occurred from 16-27 October 2019 in Victoria, BC, Canada. The scientists to be offered partial travel support from SCOR are Samuel Akande (Nigeria; 1200 CAD), Basheer Ahamedd KK (India; 1000 CAD), Pengbin Wang (China; 1000 CAD), Maria Shulgina (Russia; 1000 CAD), Jianchao Li (China; 1000 CAD), Gloria S. Duran (Peru; 1000 CAD), and Baolan Wu (China; 450 CAD).
- SCOR and PICES share ideas on capacity building, and a PICES representative has traditionally participated on the SCOR Committee on Capacity Building. Dr. Harold Batchelder has served in this capacity since September 2012; beginning in 2017 he is one of named external liaisons to the SCOR Committee on Capacity Building.

Past PENDING REQUEST for Consideration by SCOR

(IGNORE THIS: NO DECISION BY SCOR): Travel support in the amount of \$5000 USD has been requested from SCOR for scientists from countries with “economies in transition” to attend sessions and workshops at the MSEAS-2020 Symposium that will be held 24-28 May 2020 in Yokohama, Japan. **NOTE: THIS REQUEST WAS NOT ACTED UPON AS IT BECAME CLEAR THAT THE MAY 2020 MSEAS WOULD BE POSTPONED TO MAY 2021 DUE TO THE COVID-19 ACTIVITY.**

CURRENT REQUEST for Consideration by SCOR

(PENDING WITH SCOR): Travel support in the amount of \$5000 USD has been requested from SCOR for scientists from countries with “economies in transition” to attend sessions and workshops at the MSEAS-2021 Symposium that will be held ca. 24-28 May 2021 in Yokohama, Japan.