S-CCME: PICES/ICES Section on Climate Change Effects on Marine Ecosystems
Business Meeting Agenda – October 4th version
Co-chairs: Jackie King (Canada), Shin-ichi Ito (Japan)
October 20, 2018 9:00-12:30
Shaughnessy Ballroom, Victoria Conference Center Victoria, BC

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1. **Introductions**

2. **Adoption of Agenda**

3. **Election of New PICES Co-Chair and Report on new ICES Co-Chairs**
   Prof. Shin-ichi Ito will step down as Co-Chair.

4. **Reports on 2019 S-CCME Activities and Accomplishments**

a.	Final Report and Executive Summary ICES-PICES Workshop on Political, Economic, Social, Technological, Legal and Environmental scenarios used in climate projection modelling (WKPESTLE) June 8 2018 Final Report – for information only (Appendix 1)	
b.	IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) Fourth Lead Author Meeting (4-9 March: Kazan, Russia)	Hollowed
c.	IPCC AR6 2nd Lead Author Meeting (14-19 July: Kathmandu, Nepal)	Holsman & Ito
d.	Third Meeting of the ICES Working Group on Seasonal-to-Decadal Prediction of Marine Ecosystems (WGS2D) (26-30 August: Copenhagen, Denmark) -- for information only (Appendix 2)	
e.	Scenarios Forum 2019 (11-13 March: Denver, US) Session on "Scenarios for the Future Ocean" (Appendix 3)	Haynie
f.	CERES Annual Meeting (11-15 March: Bordum, Turkey)	King
g.	ICES Annual Science Conference (ASC): PICES Co-Sponsored Theme session D, "*Assessing ecosystem vulnerability to multiple drivers and pressures*" (Appendix 4)	Holsman
h.	PICES 2019 Annual Meeting Sessions – for information only (Appendix 5)	

5. **PICES Updates**

a.	FUTURE Science Program • *Frontiers in Marine Science* Publication—for information only (Appendix 6) • Open Science Meeting (April 2021) • FUTURE Lifespan and Science Integrated Plan	King
b.	NPESR Climate Impacts Section update and opportunities for S-CCME products to be included	Chandler

6. S-CCME Activities and Events of Interest in 2020

a.	IPCC WG II AR6 Lead Authors' Third Meeting (27 January – 1 February: Faro, Portugal)	Holsman & Ito
b.	MSEAS 2020 "Managing for Sustainable Use of the Earth's Marine and Coastal Systems" 25-29 May: Yokohama, Japan (Appendix 6)	Haynie
c.	CERES Meeting	King
d.	2020 ICES Annual Science Conference theme sessions.	All
e.	2020 PICES Annual Meeting and Expert Groups—suggested S-CCME sessions, workshops and requested feedback on proposed Expert Groups i. Joint ICES/PICES Working Group on Small Pelagic Fish (WGSPF) – Terms of Reference in Appendix 7. No S-CCME sponsorship requested. Requesting $7K from PICES for Intersessional Workshop. ii. Joint ICES-PICES Working Group on Impacts of Warming on Growth Rates and Fisheries Yields (Appendix 8). Requests S-CCME sponsorship. iii. Session and workshops proposed for 2020 Annual Meeting – updated at Business Meeting	All

7. S-CCME Phase III (2018-2020) Appendix 9

a.	**Phase IV (2021-2023)** • Within PICES, the lifespan of S-CCME was to correspond to FUTURE end date of 2020, however FUTURE will extend past 2020. • S-CCME will need to develop a Phase IV Implementation Plan. Options include: o Intersessional Meeting in 2020: with Implementation Plan ready to present to ICES SCICOM (Sept 2020) and ICES SB (Oct 2020) o ½ Day Implementation Plan Meeting at PICES 2020 Annual Meeting. Implementation Plan presented to PICES Science Board at PICES Intersessional Meeting (April 2021) and ICES SCICOM (Sept 2021). o Others?	

8. Other Business

12:30 Close of Meeting

Appendix 1: Executive Summary of ICES-PICES Workshop on Political, Economic, Social, Technological, Legal and Environmental scenarios used in climate projection modelling (WKPESTLE) Final Report

ICES/ PICES Workshop on Political, Economic, Social, Technological, Legal and Environmental scenarios used in climate projection modelling (WKPESTLE), held in Washington D.C., USA, 9 June 2018, was attended by 20 participants from 9 countries. The workshop directly followed the 4th International Symposium on the Effects of Climate Change on the World's Oceans (ECCWO) and hence benefitted from enhanced participation.

As ICES strives to provide improved scientific advice within the context of a changing environment, it is essential to consider how different futures of physical climate as well as societal development are together impacting marine ecosystems and maritime activities. Short-, medium- and long-term developments in governance, social, technological and economic drivers may be just as important to the future development of fisheries and aquaculture as climate-driven changes in habitats and species abundances and distributions.

WKPESTLE aimed to investigate how and where scenarios are being developed around the world to explore the impacts of anthropogenic drivers on marine systems?

WKPESTLE brought together a diverse group of researchers from the ICES and PICES communities who are active in the development of social and economic storylines and connecting them to integrated marine climate modelling approaches. One of the workshop cochairs, John Pinnegar, is a co-chair of the ICES/ PICES Strategic Initiative on Climate Change Impacts on Marine Ecosystems (SICCME) and two of the co-chairs, Jörn Schmidt and Alan Haynie, are co-chairs of the ICES Strategic Initiative on the Human Dimension (SIHD). Tyler Eddy, the fourth co-chair, is coordinator for regional models and the co-coordinator of the scenarios working group within the global FishMIP initiative.

The meeting provided an opportunity for the leading researchers to exchange ideas and to update each other on current work. A number of related publications are in preparation by meeting attendees and a global synthesis paper remains in discussion. The meeting was valuable for all participants as a means to understand the different approaches to scenario building employed across different projects. The workshop led directly to a successful proposal for an 'oceans' theme session at the first 'Scenarios Forum' in Denver in March 2019. A range of different projects was presented during the WKPESTLE workshop (and subsequently in Denver) and the geographic and thematic focus of each was compared, contrasted and discussed. Conclusions from the work included:

- Comparison across projects is valuable, although the diversity of purposes makes direct comparisons challenging.
- Projects have adopted a wide variety of approaches, some involving stakeholder engagement and elicitation, others drawing heavily on previous published studies.
- Shared Socioeconomic Pathways (e.g., O'Neill 2015) provide some general direction for how society may address climate adaptation and mitigation challenges. Many projects are working to balance the value of standardization with these frameworks with the specific needs of their project and geographic scope.

Appendix 2: Working Group on Seasonal-to-Decadal Prediction of Marine Ecosystems

The Working Group on Seasonal-to-Decadal Prediction of Marine Ecosystems (WGS2D) studies ocean predictions on timescales from seasons to decades in order to support marine resource management.

Tremendous advances in oceanographic observing and modelling systems over the last decade have led to dramatic improvements in our ability to predict the ocean. However, the logical next step of translating these predictions of the physical environment into predictions about biological outcomes and incorporating them into advice remains just a dream: only 1-2% percent of stocks today have any form of environmental information incorporated into their management procedures. Nevertheless, exploiting this predictive skill to aid in resource management is emerging as one of the new challenges in marine science and can be seen as a key prerequisite for developing ecosystem-based management.

WGS2D aims to take up this challenge. While research has historically focused on recruitment, many other biological responses such as spatial distributions, growth and timing of key events, are also tightly linked to the physical environment and therefore potentially predictable . The group will identify these more achievable and predictable biological variables and use them to produce ecological forecast products for applications in advice-generation within the ICES area.

Terms of Reference and Reports: https://www.ices.dk/community/groups/Pages/WGS2D.aspx

Appendix 3: Scenarios for the Future Ocean, Scenarios Forum, March 12, 2019, Denver, USA. Convenors: Tyler Eddy (University of South Carolina), Jörn Schmidt (University of Kiel), Alan Haynie (NOAA), John Pinnegar (CEFAS)

Formal methods and tools for scenario analysis are used in support of ecosystem-based management of natural resources, including marine fisheries. In addition, there is a growing requirement for these methods and tools to enable the evaluation of alternative decision rules that fully encompass (i) the dynamics of marine social-ecological systems and transition phases associated with management implementation, and (ii) multiple political, economic, social, technological, legal, and environmental objectives of management. To date, most socio-economic scenarios have been developed in the context of the IPCC and are focussed on land-based activities. However, coupling ocean and coastal systems is attracting growing attention and debate, demonstrating that this is an important research area. While many studies focus on the exploration of possible futures, there is also a need to develop normative scenarios, which consider objectives for the management of ocean uses, and possible pathways for these objectives to be met in the future. This session will focus on the presentation and discussion of recent advances and key challenges in scenario development for ocean and coastal systems. We invite papers describing approaches to develop future trajectories of change in some or all of the elements of the "PESTLE" approach (Political, Economic, Social, Technological, Legal, and Environmental) needed to project bioeconomic consequences of climate change on fisheries and aquaculture. Scenario approaches can be at local, regional, and global scales and of varying time horizons. They can include ecosystem-based management and fisheries strategies, integrated ecosystem assessments or biodiversity scenarios, such as those being developed for the Intergovernmental Panel on Biodiversity and Ecosystems Services (IPBES). We also encourage approaches that connect land and sea as well as approaches that would be relevant to model intercomparison projects (MIPs), such as CMIP, ISIMIP, and Fish-MIP.

Appendix 4: ICES Annual Science Conference 2019 Theme Session D - Assessing ecosystem vulnerability to multiple drivers and pressures, September 10, 2019, Gothenburg, Sweden (Co-sponsored by PICES). Convenors: Kirstin Holsman (USA), David Reid (Ireland), Mette Mauritzen (Norway)

While providing critical support for human societies, marine ecosystems face impacts and threats from multiple sources. These include the overexploitation of marine life, pollution, climate change and its associated effects on sea level rise, ocean temperature redistribution and acidification, and other emerging challenges. Assessing the cumulative impacts of drivers and pressures on ecosystem components, as well as the consequences for ecosystem structure, functioning, and services, is recognized as one of the most challenging tasks in marine science. Cumulative impact assessment, and the identification of relevant management objectives and actions, are also one of the primary challenges for advancing ecosystem based management (EBM).

Scientific assessments of species, community, or system vulnerabilities to drivers and pressures lie at the core of assessing cumulative impacts. Approaches to understanding and assessing vulnerabilities provide the means to identify high-risk impacts, and to prioritize management options to reduce those impacts. Recently, diverse approaches have been developed to assess vulnerability to drivers and pressures. These approaches can be qualitative or quantitative, and can range from focusing on species and habitat vulnerabilities to focusing on the vulnerabilities of coupled socio-ecological systems, including both direct and indirect, foodweb mediated effects.

Theme session D welcomes papers on novel qualitative or quantitative approaches to enhance our understanding and assessment of the vulnerability of marine species, habitats, communities, and systems to multiple drivers and pressures. These approaches can be adapted to both situations with high data availability and good knowledge of impacts and responses, and to situations with limited data and knowledge. Finally, we welcome papers relating vulnerability assessments to management objectives and management options for the advancement of EBM.

Appendix 5: PICES 2019 Annual Meeting S-CCME Co-sponsored Sessions.

Session S5: Trends in ocean and coastal ecosystems and their services and its future, co-chaired by Shin-ichi Ito (Japan), Angelica Peña (Canada), Kirstin Holsman (USA), Igor Yashayaev (Canada). October 23.

Oceans and coastal ecosystems provide various ecosystem services to humans. However, ocean and coastal ecosystems are changing and showing trends in regional and synoptic scales responding to global climate change. It is urgent that we elucidate the mechanisms responsible for trends in ocean and coastal ecosystems and enable its future projections. We propose a topic session that involves participation from multiple PICES committees and focuses on trends in ocean and coastal ecosystems responding to global climate change. Specifically, we welcome presentations on topics such as (a) observational approaches to detect trends in ocean and coastal ecosystems, (b) elucidation of mechanisms of the ocean and coastal ecosystem responses, and (c) future projections of ocean and coastal ecosystems.

Session S11 - Incorporating ecosystem variability and climate change into fisheries management: Progress and challenges for EBFM in the 21st century, co-chaired by Kirstin Holsman (USA). October 23-24.

Physical, biological and social components of marine ecosystems interact in complex ways through space and time, resulting in challenges for natural resource managers. Environmental variability and climate change can drive shifts in the spatial distribution and productivity of target and bycatch species. This can impact the effectiveness of stock assessment and management. Ecosystem-Based Fisheries Management (EBFM) aims to address these issues by including environmental effects, species interactions, and other ecosystem-level processes in the management process for exploited species, in addition to fishing pressure. Ecosystem variables can be considered qualitatively in management advice by providing context about the state of the ecosystem or quantitatively in models that derive management-relevant quantities (e.g., allowable catch). However, despite the theoretical benefits of EBFM, most stock assessments and management measures still use single-species models with no ecosystem information incorporated. In this session, we seek examples describing how ecosystem variability and climate change have been considered in management advice qualitatively and/or quantitatively, or proposals on how management advice could consider those variables. Management applications could include the development or modification of stock assessment models, dynamic ocean management rules, bycatch mitigation, multi-species assessments, or other decision processes. This session will also address: how can qualitative information on ecosystem state be integrated with quantitative outputs from stock assessments? How can this information and the underlying uncertainties be effectively communicated to managers? In addition we seek examples of how decisions that consider ecosystem and climate variability and change have been or could be evaluated a priori (e.g., through management strategy evaluation) or retrospectively. Does management advice that accounts for theses variables result in better decisions? The session will begin with scientific presentations, followed by a discussion panel of scientists and natural resource managers, which will explore practical aspects of operationalizing EBFM, and promote exchange of ideas between the scientific and management communities.

Appendix 6: FUTURE Scientific Steering Committee *Frontiers in Marine Science* Publication, Bograd et al., 2019.

frontiers in Marine Science

PERSPECTIVE
published: 18 June 2019
doi: 10.3389/fmars.2019.00333

Developing a Social–Ecological–Environmental System Framework to Address Climate Change Impacts in the North Pacific

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Specialty section:
This article was submitted to Marine Conservation and Sustainability, a section of the journal Frontiers in Marine Science

Received: *07 March 2019*
Accepted: *29 May 2019*
Published: *18 June 2019*

Citation:
Bograd SJ, Kang S, Di Lorenzo E, Horii T, Katugin ON, King JR, Lobanov VB, Makino M, Na G, Perry RI, Qiao F, Rykaczewski RR, Saito H, Therriault TW, Yoo S and Batchelder H (2019) Developing a Social–Ecological–Environmental System Framework to Address Climate Change Impacts in the North Pacific. Front. Mar. Sci. 6:333. doi: 10.3389/fmars.2019.00333

"Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems" (FUTURE) is the flagship integrative Scientific Program undertaken by the member nations and affiliates of the North Pacific Marine Science Organization (PICES). A principal goal of FUTURE is to develop a framework for investigating interactions across disciplinary dimensions in order to most effectively understand large-scale ecosystem changes and resulting impacts on coastal communities. These interactions are complex, often nonlinear, occur across a range of spatial and temporal scales, and can complicate management approaches to shared and *trans*-boundary problems. Here, we present a Social–Ecological–Environmental Systems (SEES) framework to coordinate and integrate marine science within PICES. We demonstrate the application of this framework by applying it to four "crisis" case studies: (a) species alternation in the western North Pacific; (b) ecosystem impacts of an extreme heat wave in the eastern North Pacific; (c) jellyfish blooms in the western North Pacific; and (d) Pacific basin-scale warming and species distributional shifts. Our approach fosters a common transdisciplinary language and knowledge base across diverse expertise, providing the basis for developing better integrated end-to-end models. PICES provides the structure required to address these and other multi-national, inter-disciplinary issues we face in the North Pacific. An effective and comprehensive SEES approach is broadly applicable to understanding and maintaining resilient marine ecosystems within a changing climate.

Keywords: North Pacific, North Pacific Marine Science Organization, social–ecological systems, climate change, ocean sustainability

Appendix 6: 2nd Marine Socio-Ecological Systems (MSEAS - 2020) Symposium "Managing for sustainable use of the Earth's marine and coastal systems" May 25-29, 2020, Yokohama, Japan.

The challenge in supporting enhanced and sustainable uses of the marine domain is to enable current and future growth in the blue economy, and the associated development of coastal livelihoods, while equally supporting sustainable social, economic and environmental outcomes. This challenge explicitly involves managing human impacts on the earth's marine and coastal systems, and managing the feedback of these impacts on coastal communities, industries, stakeholders, society in general. To fully address this topic, an evaluation of marine socio-ecological systems is warranted. Exploration of tools to specifically evaluate these socio-ecological systems is needed, timely, and has not yet systematically been done.

Topic Sessions:

S1: Running the Gamut Gauntlet: Socio-ecological modelling in a complex world

S2: Improving marine governance with interdisciplinary research and cross-sectoral approaches

S3: Sustainable Ocean Development

S4: Risk perception and assessment for marine ecosystem-based management

S5: Mapping human dimensions onto seascapes: Progress and challenges in the integration and utilization of socioeconomic and ecological data in marine spatial planning and spatial considerations of marine ecosystems

S6: Social-Ecological Systems Thinking: From Cultural Services Perspectives

S7: Co-production of knowledge, participatory approaches and engagement with stakeholders

S8: Applying and integrating marine biodiversity indicators and assessments to evaluate progress towards policy goals

S9: Coastal Communities and Change

S10: Vulnerability of marine SES to climatic changes and anthropogenic pressures

Evening Session: We all think we are inter and transdisciplinary: Are we really, what makes it work, and how can we support integration in marine SES?

Appendix 7: Joint ICES/PICES Working Group on Small Pelagic Fish (WGSPF)

Group Type: Working Group

Group Name: Joint ICES/PICES Working Group on Small Pelagic Fish (WGSPF)
Reporting to: Fishery Science Committee (FIS) and FUTURE Scientific Steering Committee (FUTURE-SSC) within PICES
Steering Group on Ecosystem Processes and Dynamics (EPDSG) within ICES

Term: November 2019 – October 2022

Terms of Reference
1. To review recent progress on understanding how various drivers (environmental and/or anthropogenic) impact the population dynamics of SPF in different ecosystems and whether and how potential drivers shift with changes in ecosystem state.

2. To create a networking environment for international and multidisciplinary collaboration to foster the establishment of similar study frameworks and comparative analyses of SPF across different social–ecological systems, based on updated time series data sets of climate indices, environmental factors and fisheries biology as well as ecophysiological information (feeding, growth and survival).

3. To identify, prioritize and conduct research most needed to advance our knowledge and capacity to predict the population dynamics of SPF at both short (seasonal to inter-annual) and long (decadal to centennial) time scales.

4. To provide recommendations for strategies of marine ecosystem monitoring and fisheries management of SPF which will contribute to sustainable ecosystem-based fisheries management, through biophysical, ecosystem and/or socio–economical models.

5. To propose topic sessions at PICES Annual Meetings and ICES Annual Science Conferences focused on advances in SPF science and to organize a joint ICES/PICES symposium on SPF at regular intervals (*e.g.*, once every 4 years) leading to the publication of findings in special issues of primary journals.

Appendix 8: Proposed ICES-PICES Working Group on Impacts of Warming on Growth Rates and Fisheries Yields

Group Type: Working Group

Group Name: ICES-PICES Working Group on Impacts of Warming on Growth Rates and Fisheries Yields (WGGRAFY)

Reporting to: Fishery Science Committee; linkage to Section: Climate Change Effects on Marine Ecosystems (S-CCME) which is a joint expert group with ICES Strategic Initiative on Climate Change Effects on Marine Ecosystems

Term: Start 1/1/2020, End: 31/12/2022

Linkages to previous PICES Expert Groups or activities, if any: Unknown

Linkages to other organisations and programs: joint ICES-PICES WG; administered in ICES by the Ecosystem Processes and Dynamics Steering Group chaired by Dr. Silvana Birchenough (http://ices.dk/community/groups/Pages/EPDSG.aspx)

Background:
The Temperature Size Rule (TSR) proposes that fish at warmer temperatures have rapid early growth and lower adult size (Forster et al. 2012). Several North Sea fish stocks have exhibited a synchronous, common trend towards smaller maximum body sizes that was correlated with increasing temperature. This "shrinking" decreased per-capita yields of those stocks by ca. 23% (Baudron et al. 2014). Similarly, it has been projected that by 2050 global fish yields will decrease by 14-24% due to shifting biogeography and the TSR (Cheung et al 2012). Forecasting climate impacts on food security require establishing how past warming has impacted growth rates and fisheries yields.
The aim of WGGRAFY is to determine whether temporal trends in individual growth rates of marine fish are consistent with the TSR and, if so, evaluate the impacts for fish yields. Length and age have been routinely measured for many commercial fish stocks on time scales that are associated with warming. These substantial data have never been compiled as a single, analytical resource for climate change research on global scales.

The WG will compile decadal-scale length at age datasets for large marine ecosystems experiencing differential rates of warming or cooling or no overall trend (e.g., upwelling regions). A standardised statistical approach for modelling growth will be developed to specifically test whether there is a component of the total variation in growth rates that can be attributed to temperature. This knowledge could provide an empirical foundation for forecasting the impacts of future climate warming on yields. The unique spatial and temporal scale of length-at-age data are valuable resource for ecological research. The WG will also develop a strategic plan for archiving length-at-age data similar to how ICES archives data for European waters (Datras) or how global data on recruitment and catch are reported and maintained (e.g., RAM Legacy). This will require engaging with various agencies (ICES, EMODnet,

FAO, universities, tech specialists) and national fisheries laboratories as well as potential funding sources.

References

Baudron, A.R., Needle, C.L., Rijnsdorp, A., Marshall, C.T. 2014. Warming temperatures and smaller body sizes: synchronous changes in growth of North Sea fishes. Global Change Biology 20: 1023-1031.

Cheung, W. W. L., et al. 2012. Shrinking of fishes exacerbates impacts of global ocean changes on marine ecosystems. Nature Climate Change, 3:254–258.

Forster, J., Hirst, A.G., Atkinson, D. 2012. Warming-induced reductions in body size are greater in aquatic than terrestrial species. PNAS 109:19310 LP-19314.

Terms of Reference

ToR	Description
a	Assess the capacity of statistical models to incorporate temperature-dependency of growth, and then compare their predictions of growth variation across specific warming scenarios and locations
b	Analyse long-term growth patterns across multiple large marine ecosystems that are experiencing different trends in temperature, using a common modelling approach
c	Assess the impacts of warming on past yield per recruit of commercial fisheries, and forecast trends in future yield given plausible warming scenarios
d	Identify options for expanding scientific community access to global length-at-age data that are routinely collected by fisheries agencies worldwide.

Proposed membership:

NAME	INSTITUTE	AFFILIATION	*THIS WILL BE DELETED BUT HELPFUL FOR US TO DETERMINE MEMBERSHIP*
Tara Marshall	University of Aberdeen	ICES - UK	
Paul Spencer	NOAA Fisheries, Alaska Fisheries Science Center	PICES - US	
Alan Baudron	Marine Scotland - Science	ICES - UK	
Melissa Haltuch	NOAA Fisheries, Northwest Fisheries Science Center	PICES - US	
Christine Stawitz	NOAA, Office of Science and Technology,	PICES - US	
Bjarte Bogstad	Institute of Marine Research	ICES - Norway	
Einar Hjörleifsson	Marine Research Institute, Iceland	ICES - Iceland	
Alan Haynie	NOAA Fisheries, Alaska Fisheries Science Center	PICES - US	

Robert Allman	NOAA, Southeast Fisheries Science Center	PICES - US	
John Pinnegar	Centre for Environment, Fisheries and Aquaculture Science	ICES - UK	
Pieter Daniël van Denderen	National Institute of Aquatic Resources, Technical University of Denmark	ICES - Denmark	
Bryony Townhill	Centre for Environment, Fisheries and Aquaculture Science	ICES - UK	
Joanna Bernhardt	University of British Columbia	PICES - Canada	Unknown
Myron Peck	University of Hamburg	ICES - Germany	
Malin Pinsky	Rutgers University	ICES - US	
James Thorson	NOAA Fisheries, Alaska Fisheries Science Center	PICES - US	
William Cheung	University of British Columbia	PICES - Canada	Unknown
Asta Audzijonyte	University of Tasmania, Australia	Guest	
John Morrongiello	University of Melbourne, Australia	Guest	
Gretta Pecl	University of Tasmania???, Australia	Guest	Wishes to be kept informed
Curtis Champion	University of Tasmania???, Australia	Guest	New position with Australian fisheries lab
Tim Essington	University of Washington	PICES - US	
Tim Miller	NOAA, Northeast Fisheries Science Center	PICES - US	

Proposed leadership: C. Tara Marshall, UK (University of Aberdeen, UK, ICES), Paul Spencer, USA (NOAA – Alaskan Fisheries Science Center, PICES), Alan Baudron (Marine Scotland-Science, UK, ICES), ***co-chair from Asia as yet to be identified (PICES)*** and John Morrongiello (University of Melbourne, Australia, Guest).

Appendix 9: S-CCME Activities identified in the Implementation Plan for Phase 3, 2018-2020.

In Phase 3 S-CCME will conduct activities similar to those described in Phase 1 and 2, namely:

a) Recognizing that S-CCME has progressed to the point where active climate research nodes exist in most member countries, S-CCME will take a more active role in providing forums for communication and coordination between national modeling teams.

b) S-CCME will continue to complete ecosystem projections and evaluate outcomes based on IPCC AR5 results and explore the new CMIP6 projections when they are released in 2019.

c) S-CCME will continue to expand core research activities needed to advance the global synthesis of climate change impacts on marine ecosystems. This will be used to assess research gaps.

d) S-CCME will continue to recommend topic sessions and workshops that provide a forum for the synthesis of existing projections of climate change impacts on marine ecosystems (e.g., contributions to the 4th Symposium on Effects of Climate Change on the World's Oceans).

e) S-CCME will recommend topic sessions and workshops that provide a forum for the synthesis of climate change vulnerability assessments.

f) S-CCME will encourage further integration between the Section on Human Dimensions [now Human Dimensions Committee] through joint theme or topic sessions and workshops (e.g., contributions to the 4th Symposium on Effects of Climate Change on the World's Oceans and MSEAS-2 Symposium)

g) Publication of climate change impacts and their effects on human societies and marine ecosystems should be timed to allow their consideration by the IPCC in the formation of the AR6 report (for 2021). This effort will facilitate international collaboration and provide a mechanism for communicating our current knowledge to stakeholders and the broader scientific community.

New research and activity efforts for Phase 3 include

1. **Advanced science and methodology**
    a. Help develop and align future scenarios to be used to explore the future cultural and social impacts of climate change on fisheries and fishery dependent communities.
    b. Work with national funding organizations to advance the mission of S-CCME
    c. Encourage and integrate S-CCME science with and between external climate assessment organizations.

d. Promote the development of platforms that are flexible and can be used to streamline implementation of the projection modelling enterprise to facilitate the delivery of policy-relevant management advice.
e. Promote innovation in coupled biophysical–social modelling through workshops and topic sessions. This activity would address things like the exploration of methodologies to explore the role of watersheds to ocean coupling and land-sea margins, uptake of nutrients and chemistry and other advancements in regional ocean modelling, and include bias corrections, ensemble modelling, scenarios, uncertainty, and post-normal science.
f. Develop social science metrics jointly with PICES and ICES human dimension Committee/working groups.
g. Explore issues of spatial resolution including two-way feedbacks between anthropogenic activities and global carbon budgets and innovations in the treatment of vertical fluxes on estimates of regional production.
h. Improve our ability to project the synergistic impacts of climate-driven multiple stressors on marine ecosystems (linking with PICES WG36 on Common Ecosystem Reference Points). Distill the most important drivers (e.g., wind effects on nutrient delivery) impacting ocean systems.
i. Continue to advance new methods to assess and attribute climate variability (modes) from global climate change.

2. Communication and integration of science through international symposiums

a. Identify and recommend to ICES and PICES opportunities for joint (co-sponsored) activities with other organizations to advance the mission of S-CCME.
b. Training options – coursework
    i. Call for proposals for applied work – geospatial modeling, size spectral models, EwE, Atlantis,
    ii. Call for proposals for communicating research,
    iii. Communicating climate impacts to the general public, NGOs and decision makers. Perhaps staged coincidentally with the release of AR6. Differences in impacts from terresterial ecosystems and description of uncertainty,
    iv. Training in communication of uncertainty. Distinguishing quantitative (likelihood) vs qualitative (evidence and agreement in the scientific communication) uncertainty.
c. Develop an external communication outreach strategy, including tools to identify products of greatest value to the public and decision makers. Expand the use of mass communication tools (e.g., pod-casts or documentaries) for education of the difficulties associated with conducting and modeling ocean systems. Perhaps engaging with the press as part of the 4th Effects of Climate Change on the World's Oceans symposium, e.g. COMPASS.
d. Outreach - web-presence, Effects of Climate Change on the World's Oceans symposia; COP side meetings; workshops, etc.
e. Develop and maintain an internal and external communication strategy

i. Maintain website: metadata, archiving outputs, links to data delivery sites, perhaps through ClimeFish.
ii. S-CCME Co-Chairs will work with members to maintain relevant information (publications, logo, presentations etc.)
iii. Encourage S-CCME members to contribute research products to a distributed database. S-CCME could establish protocols and data management policy for contributions to a shared database (explore FishMIP protocols, and Sea Around Us database).

3. Dedicated S-CCME Sessions for ICES and PICES annual meetings. In addition, S-CCME will strive to **introduce training programs** to support the scientists involved in providing strategic advice on climate change effects on marine ecosystems.