Report of the Section on *Climate Change Effects on Marine Ecosystems*

The meeting of the Section on *Climate Change Effects on Marine Ecosystems* (S-CCME) was held from 08:55 to 18:00 h on October 17, 2015 in Qingdao, China. S-CCME Co-Chairs, Drs. Anne B. Hollowed and Shin-ichi Ito, welcomed all participants. Dr. Hollowed chaired the meeting. Each of the workshop attendees (*S-CCME Endnote 1*) introduced themselves and Dr. Hollowed reviewed the agenda (*S-CCME Endnote 2*). Dr. Jacquelynne King proposed an item regarding the new FUTURE program implementation. No additional changes/additions were offered and the agenda was adopted. Dr. King agreed to act as a rapporteur.

AGENDA ITEM 3
Review of 2015 activities

a) Dr. Hollowed reviewed the 3rd PICES/ICES/IOC Symposium on "*Climate change effects on the world's oceans*" (Santos Brazil, March 21–27, 2015). S-CCME members, Drs. King and Manuel Barange, were Symposium Co-Convenors and several S-CCME members attended with workshop or session presentations or as session Chairs. Several sessions and workshops had S-CCME involvement, including:

- S1, *Role of advection and mixing in ocean biogeochemistry and marine ecosystems*,
- S2, *Ocean acidification*,
- S4, *Regional models for predictions of climate change impacts*,
- S6, *Climate change in the seasonal domain: Impacts on the phenology of marine ecosystems and their consequences*,
- S9, *Impact of climate change on ecosystem carrying capacity via food-web spatial relocations*,
- S10, *Forecasting climate change impacts on fish populations and fisheries*,
- S11, *Impacts on coastal communities*,
- W1, *Addressing uncertainty in projecting climate change impacts in marine ecosystems*,
- W5, *Moving towards climate-ready fishery systems*.

Major outcomes relevant to S-CCME are:

- Environmental modeling capabilities are emerging quickly; biological models lag behind;
- Baseline research on adaptive response in the Central Arctic is critical;
- The tropics remain vulnerable due to species redistribution, and the coastal communities are dependent on these species;
- Seasonal monitoring is needed to capture phenology changes;
- Adaptive capacity studies are needed on species vulnerable to ocean acidification.

b) Dr. Ito provided a review of the International Scientific Conference "*Our common future under climate change*" (July 7–10, 2015, Paris). The conference explored current understanding of all dimensions of the climate change challenge plus the full range of mitigation and adaptation options that can lead to sustainable, equitable solutions across all nations and regions. Dr. Barange convened a session on "*Transformative pathways to sustain marine ecosystems and their services under climate change*" and Dr. Barange and Dr. Ito made presentations in this session. Dr. Ito's presentation (see PICES Press, Vol. 24, No. 1, pp. 18–19) was a joint work between S-CCME and Working Group on *Regional Climate Modeling* (WG 29).

c) Dr. Hollowed reviewed the results of ICES Theme Session G on "*Managing marine ecosystem services in a changing climate*" (September 21–25, 2015, Copenhagen) which was convened by Drs. Sebastian Villasante (Spain), Manuel Barange (ICES/S-CCME), and Keith Criddle (PICES/S-HD).

d) Dr. Ito reviewed the 2nd International Ocean Research Conference on "*One planet one ocean*" (November17–21, 2014, Barcelona, Spain). A session on "*New frontiers in modelling for oceanography*,

fisheries and marine ecosystem management" was convened by Drs. Pierre Petitgas (IFREMER) and Shin-ichi Ito. Three recommendations for future work emerged from discussions at the session:

- To develop biological observation systems and skill assessment of complex models,
- To address biological adaptation in models, and
- To design model complexity to answer a given objective.

e) Dr. Suam Kim reported that the S-CCME Co-Chairs published a synthesis paper on S-CCME in *Oceanography* (Kim *et al*. (2014) Strategies for coordinating research on the impacts of climate change on marine ecosystems. *Oceanography* 27(4): 160–167). S-CCME will request the Secretariat to post the PDF version of this paper on S-CCME website.

AGENDA ITEM 4
Outcome of WKSICCME

Dr. Hollowed provided a review of the August 2015 PICES/ICES Workshop on "*Modelling effects of climate change on fish and fisheries*" (WKSICCME; see also PICES Press, Vol. 24, No. 1, pp. 20–23).

- Workshop goals:
  - Identify a suite of representative future fishing and ecosystem scenarios;
  - Identify a suite of climate models and representative concentration pathways that would be used to project climate change;
  - Identify suites of single species, multi-species and ecosystem climate enhanced projection models;
  - Assess trade-offs (spatial and temporal) of alternative management decisions in the context of ecosystem based fisheries management
- A website for this workshop and on-going work will be developed;
- The FISH-MIP activity, which was represented at the workshop by Dr. Tyler Eddy, is conducting work complementary to S-CCME, with deliverables expected by December 2015:
  - FISH-MIP has a focus on global impact assessments; S-CCME has a more regional focus with specific fisheries responses;
  - Both are seeking to improve knowledge for the next IPCC reports;
- 4 peer reviewed papers in preparation – two in draft form;
- Socio-economic workshop is proposed for 2016 to address the range of possible management responses in conjunction with a symposium in Brest, France, May 2016 (see Agenda Item 6a);
- Important timelines:
  - Fall 2015 reports to – PICES and ICES;
  - 2016 – publish papers on protocol; hold socio-economic scenario workshop; scenario development and testing;
  - 2017 – stakeholder feedback;
  - 2018 – Session/Workshop at 4th Symposium on "*Climate change effects on the world's oceans*" to discuss results/paper writing;
  - 2019 – special issue publication in order to have published results in time for IPCC AR6;
- This effort is a large international undertaking and requires much support from PICES and ICES, and would benefit from the identification of an international umbrella to work with.

AGENDA ITEM 5
FUTURE SSC

Dr. King explained the new implementation of the FUTURE program: FUTURE Scientific Steering Committee.

AGENDA ITEM 6
Proposals for workshops and topic sessions for 2016

a) ICES/PICES inter-sessional workshop on "*Economic modelling of the effects of climate change on fish and fisheries*" (WKSICCME_Econ), Brest, France, May 30–June 3, 2016 (see *S-CCME Endnote 3*).
   - This is a recommendation from the August 2015 WKSICCME to address the need for developing an agreed-upon range of fisheries management scenarios, which is required to have socio-economic experts discuss options.
   - Approved by ICES and a proposal will be considered by PICES at this Annual Meeting [recommended by PICES Science Board and approved by Governing Council].

b) ICES workshop on S-CCME modeling update (WKSICCME_Phase1; *S-CCME Endnote 4*)
   - A full-day open workshop to review regional models and preliminary results on the ICES side.

c) PICES workshop on S-CCME modeling updates (Phase 1; *S-CCME Endnote 5*)
   - A 1-day open workshop to review regional models and preliminary results on the PICES side.
   - Next year the designated S-CCME business meeting will be split into a ½-day discussion on new proposals and a 1-day open workshop to review regional models and preliminary results; if the workshop proposal is not accepted S-CCME would extend its meeting to be 1½ days to allow for member reporting on preliminary results.

AGENDA ITEM 7
Collaborations with other groups

The following collaborations with other groups are planned.

a) ICES – Decadal forecasting (*S-CCME Endnote 6*)
   - ICES to contribute to the proposed Topic session at PICES-2016.

b) International Conference on "*Species on the Move*", February 9–12, 2016, Hobart, Tasmania. Conference sponsors: University of Tasmania and Institute for Marine and Antarctic Studies. (*S-CCME Endnote 7*)
   - S-CCME to contribute to the conference.

Publications

Review of S-CCME activities:

- Kim *et al*. 2014. ICES and PICES strategies for coordinating research on the impacts of climate change on marine ecosystems, *Oceanography* 27(4): 160–167.

Papers from the PICES/ICES Workshop on "*Global assessment of the implications of climate change on the spatial distribution of fish and fisheries*", May 22–24, 2013, St. Petersburg, Russia:

- Bell *et al*. 2015. Disentangling the effects of climate, abundance and size on the distribution of marine fish: an example based on four stocks from the Northeast U.S. Shelf. *ICES J. Mar. Sci.* 72(5): 1311–1322.
- Jones *et al*. 2015. Multi-model ensemble projections of climate change effects on global marine biodiversity. *ICES J. Mar. Sci.* 72(3): 741–752.
- Lynch *et a*l. 2015. Projected ocean warming creates a conservation challenge for river herring populations. *ICES J. Mar. Sci.* 72(2): 374–387.
- Gislason *et al*. 2014. Long-term changes in abundance of *Calanus finmarchicus* south and north of Iceland in relation to environmental conditions and regional diversity in spring 1990–2013. *ICES J. Mar. Sci.* 71(9): 2539–2549.

Other expected publications

- Special issue on 3rd International Symposium on "*Climate change effects on the world's oceans*" (2015, Santos, Brazil) to be published in 2016.
- At least 4 papers from the PICES/ICES Workshop on "*Modelling effects of climate change on fish and fisheries*" (WKSICCME; 2015, Seattle, USA) will be submitted to the peer reviewed literature.

AGENDA ITEM 8
Other business

A. Scientific collaboration between PICES and ISC

Dr. King provided an overview of the proposed Joint ISC/PICES Working Group on *Oceanographic Conditions on Distribution and Productivity of Highly Migratory Species*. The Working Group will produce a habitat model for North Pacific albacore, which will have a finer-scale resolution than the ecosystem models that currently exist for the central North Pacific region of S-CCME modeling efforts. The Working Group would also identify the underlying mechanisms for this, and other commercially important species. The habitat model developed could be coupled to climate change model outputs for forecasting. As such, the proposed Joint Working Group products would be beneficial for S-CCME efforts and the proposal is supported by S-CCME.

B. Laboratory experiments

There are many field studies and computer modeling studies on climate change impacts, but it is not clear how many and what kind of lab studies are being conducted. S-CCME will relay to the FUTURE SSC the need for coordinating existing laboratory studies on climate change impacts on species and, for example, producing an inventory of laboratories conducting relevant research.

AGENDA ITEM 9
Requests for FIS, BIO, POC, FUTURE SSC and Science Board

a) Support for two or more invited speakers to attend the ICES/PICES inter-sessional workshop on "*Economic modelling of the effects of climate change on fish and fisheries*" (WKSICCME_Econ), Brest, France, May 2016;
b) Support for one invited speaker to attend the ICES workshop on S-CCME modeling update.
c) Support for one invited speaker to attend the PICES workshop on S-CCME modeling updates.
d) PICES co-sponsorship of "*Species on the Move*" International Conference.
e) Coordination of existing laboratory studies on climate change impacts on species and, for example, producing an inventory of laboratories conducting relevant research

S-CCME Endnote 1

S-CCME participation list

Members

Anne B. Hollowed (USA, Co-Chair/PICES)
Shin-ichi Ito (Japan, Co-Chair/PICES)
Hirosih Kuroda (Japan)
Sukgeun Jung (Korea)
Sukyung Kang (Korea)
Suam Kim (Korea)
Jacquelynne King (Canada)
Guimei Liu (China)
Franz Mueter (USA)
Chuanxin Qin (China)
Cisco Werner (USA)
Xuelei Zhang (China)
Yury Zuenko (Russia)

Observers

Steven Bograd (USA)
Alexander Bychkov (PICES)
Qinzeng Xu (China)
Yi Xu (USA)

PICES

Harold (Hal) Batchelder

S-CCME Endnote 2

S-CCME meeting agenda

Saturday, October 17, 2015

1. Welcome of new members, introductions, and nomination of a rapporteur
2. Adoption of agenda
3. Review of 2015 activities
   a) 3rd Climate Change Effects on the World's Oceans symposium, Santos, Brazil
   b) Our common future under climate change symposium, Paris, France
   c) Theme session G, ICES Annual Science Conference, Copenhagen, Denmark
   d) 2nd International Ocean Research Conference "One Planet One Ocean", Barcelona, Spain
4. Outcome of WKSICCME
   a) IPCC scenarios
   b) Model selection
   c) Candidate regions
   d) Core contacts for regional modeling teams
   e) Core species
   f) Core modeling approaches
5. FUTURE SSC
6. Proposals for workshops and topic sessions for 2016
   a) ICES/PICES inter-sessional workshop on socio-economic pathways, Brest, France May 2016
   b) ICES workshop on SICCME modeling update
   c) PICES workshop on SICCME modeling updates
7. Collaboration with other groups
   a) Decadal forecasting
   b) Scientific collaboration between PICES and ISC
8. Other business
9. Requests for FIS, BIO, POC, FUTURE-SSC and SB
10. Adjourn

S-CCME Endnote 3

Proposal for a PICES/ICES S-CCME inter-sessional workshop on "*Economic modelling of the effects of climate change on fish and fisheries*"

The ICES/PICES Workshop on *Economic Modelling of the Effects of Climate Change on Fish and Fisheries* (WKSICCME_Econ), chaired by Alan Haynie (USA), John Pinnegar (UK), Lisa Pfeiffer (USA), Mitsutaku Makino (JPN), Jörn Schmidt (DE), and Sophie Gourget (France) will be established and will meet for 2 days in Brest, France, in association with the existing '*Understanding marine socio-ecological systems*' symposium, in June, 2016 to:

a) Identify the socioeconomic data and features of the suite of representative future fishing and ecosystem scenarios identified during the August 2015 inter-sessional workshop that could be used in evaluating climate change effects on fish and fisheries.
b) Identify how fisheries management policies will interact with climate change and identify how researchers can best evaluate which management tools are most likely to be resilient to climate change effects on fisheries.
c) Identify suites of bioeconomic and spatially explicit models of fishery behaviour that can be used to project the implications of different climate models on commercially important marine fish stocks in the northern hemisphere.

WKSICCME_Project will report by September 4, 2016 for the attention of the Strategic Initiative on Climate Change Effects on Marine Ecosystems (SICMME).

Priority	The group will identify socio-economic scenarios for future use of marine ecosystems, especially commercial fishing, and therefore the projections will contribute the most to the the ICES second thematic area Understanding Interactions of Human Activities. This activity will also contribute towards the first ICES thematic area: Understanding Ecosystem Functioning under climate change processes and projections of associated. with Ecosystems. Consequently, the activities of WKSICCME_Econ are considered to have a very high priority.
Scientific justification	Climate change is a global issue affecting marine ecosystems and species that span international boundaries, and is one of the most universal challenges facing fisheries scientists, economists, and managers around the world. The projected changes in climate are expected to alter marine ecosystems through shifts in trophic demand, predator and prey distributions, overall system productivity, and human access to resources. It is unclear how these changes will impact the future of commercial fisheries in the northern hemisphere. To address this challenge scientists have developed models to project future impacts. These models are being tested regionally and discussed globally in an effort to initiate an international collaboration to provide quantitative estimates of the status and trends of commercial fish and fisheries worldwide by 2019 (for consideration by IPCC AR6 working groups). Understanding the vulnerability of commercially important species, and their predators and prey to changing climate conditions is critical if ICES and PICES plans to provide climate-literate options for mitigation of, and management under a changing climate. The spatial distribution of global climate models and earth system models varies and institutions are rapidly improving the performance of the models. While regional ocean modellers and fisheries scientists are working to balance the trade-offs of models of different scale and complexity, greater effort is required to tie ocean and fisheires models of different complexity to the most realistic economic models of fisheries and communities. Integration of different types of bio-physical models with economic model will not occur overnight, but necessitates further efforts to match the appropropriate economic models, given the data available in different countries. In some cases, the complexity of social and bioeconomic models may be similar to that of the most complex ocean models, while in other cases, qualitative inferences will be made from available information. This process will be directed at both informing other modeling efforts and providing insights to policy makers on additional research that will help develop more climate resilienct management institutions. WKSICCME-Econ will provide a forum for economists, other social scientists, and natural scientists to meet and discuss options for selecting reasonable economic and fishing scenarios that could be generated for several large marine ecosystems in the northern hemisphere and can be integrated with other aspects of WKSICCME. Combining the output from this process with population dynamics models of different complexity will allow analysts to provide more realistic understanding of the social and economic impacts of climate change on the marine environment.

Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resources required to undertake additional activities in the framework of this group is negligible. By holding this workshop in conjunction with the existing ICES/PICES 'Understanding marine socio ecological systems' symposium in Brest (30th May – 3rd June), it is hoped that many marine economists and social scientists will be attending anyway, thus saving on travel expenses and expanding participation. The workshop requests ICES endorsement, participation by ICES scientists, some secretarial assistance (e. g., email communication, workshop publicity on website, etc.).
Participants	The workshop will be attended by some 30-40 members and guests from both ICES and PICES.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	There are no obvious direct linkages with the advisory committee.
Linkages to other committee or groups	The workshop contributes directly to SICCME objectives and activities, and to the activities of SSG UEF and SSG UIHA.
Linkages to other organizations	The workshop is a joint activity with PICES.

S-CCME Endnote 4

ICES S-CCME Workshop proposal

Expert Group Meeting Resolution (Category 2) WKSICCME

The ICES/PICES Workshop on Phase 1: Modelling Effects of Climate Change on Fish and Fisheries (WKSICCME_Phase1), chaired by Anne Hollowed(USA), John Pinnegar (UK), Myron Peck (DE), and Mark Payne (DK) in September, 2016 to:

a) Meet with other SICCME investigators in ICES member countries to review progress on projected impacts of climate change on fish and fisheries.
b) Identify new analytical approaches that could be used in other regional nodes.
c) Review challenges in comparing suites of single species climate enhanced projection models, multispecies climate enhanced projection models, full food web (e.g., EcoSIM), and dynamic spatially explicit ecosystem models that would be used to project the implications of (a) and (b) on commercially important marine fish stocks in the northern hemisphere.

WKSICCME_Phase1 will report by November 2016 for the attention of the Strategic Initiative on Climate Change Effects on Marine Ecosystems (SICCME).

Priority	This activity will contribute towards the first ICES thematic area: Understanding Ecosystem Processes and Dynamics (SSGEPD) and their response to change. Our focus will be on responses of fish and fisheries to climate change. To assess this, the group will identify scenarios for future use of marine ecosystems, especially commercial fishing, and therefore the projections will contribute also to the the second ICES thematic area onUnderstanding Interactions of Human Activities with Ecosystems (SSGHIE). Consequently, the activities of WKSICCME_Projection are considered to have a very high priority to ICES.

Scientific justification	In August 2015 SICCME convened a workshop to discuss the details needed to establish an international effort to project the implications of climate change on fish and fisheries. The group identified 15 regions that could be part of the SICCME research effort. The group also agreed to work closely with the FISH-MIP research group to ensure that the efforts are complimentary. The central focus of the SICCME effort is to understand the vulnerability of commercially important species and their predators and prey to changing climate conditions. This is critical to ICES and PICES plans to provide climate-informed options for mitigation of, and management of harvested resources under a changing climate. This proposal calls for a one day workshop to be held prior to or immediately after the ICES annual meeting in Riga, Latvia in 2016 (WKSICCME-I). This ICES regional workshop will allow researchers a chance to compare results, evaluate harvest control rules and discuss challenges encountered in developing multi-model ensembles of impacts on fish and fisheries for the SICCME project. The format will allow for breakout groups for intradisciplinary discussions and plenary interdisciplinary research. Projected outcomes of these scenarios using population dynamics models of different approaches and complexity will allow analysts to compared and report on the relationship between model complexity, efficiency, and the computational costs of increased ecological realism in models[1].
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resource required to undertake additional activities in the framework of this group is negligible. The workshop requests ICES endorsement, participation by ICES scientists, and some secretarial assistance (e. g., email communication, workshop publicity on website, etc.).
Participants	The workshop will be attended by ca. 20–25 members and guests from both ICES and PICES.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	There are no obvious direct linkages with the advisory committees.
Linkages to other committees or groups	The workshop contributes directly to SICCME objectives and activities, and to the activities of SSGEPD and SSGHIE.
Linkages to other organizations	The workshop is a joint activity with PICES.

S-CCME Endnote 5

Proposal for a 1-day Workshop on
"*Phase 1: Modeling effects of climate change on fish and fisheries*" at PICES-2016

Co-Convenors: Anne B. Hollowed (USA), Shin-ichi Ito (Japan)

Invited Speaker: John Pinnegar (UK)

Description

In August 2015 S-CCME convened a workshop to discuss the details needed to establish an international effort to project the response of fish and fisheries to different climate change scenarios and fisheries management strategies. Several regional modeling teams were identified that would form the core of the S-CCME projection modeling research effort. S-CCME members were tasked with working with modelers within each of the modeling nodes to initiate projections in 2016.

The proposed workshop will provide an opportunity for S-CCME investigators and collaborating modelers in each of the regional nodes to meet to discuss the current status of their regional integrated modeling teams. Specific goals of this workshop are to:

a) Identify analytical approaches that are being used in each of the regional nodes;
b) Review methods for comparing projections derived from different suites of single species climate enhanced projection models, multispecies climate enhanced projection models, full food web (e.g., EcoSIM), and dynamic spatially explicit ecosystem models;
c) Preliminary inspection of the implications of future climate change on commercially important marine fish stocks in the northern hemisphere. Results will provide a critical opportunity for S-CCME scientists to coordinate their regional modeling efforts.

S-CCME members plan to use the scenarios derived from the regional modeling teams to provide climate-informed options for mitigation of, and management of harvested resources under a changing climate. This proposal calls for a one day workshop to be held prior to or immediately after the PICES annual meeting in La Jolla, California in 2016. The format will allow for breakout groups for intradisciplinary discussions and plenary interdisciplinary research. Projected outcomes of these scenarios using population dynamics models of different approaches and complexity will allow analysts to compare and report on the relationship between model complexity, efficiency, and the computational costs of increased ecological realism in models.

Expected products include a meeting report.

S-CCME Endnote 6

Proposal for an ICES Theme Session on
"*Seasonal to decadal prediction of marine systems: Opportunities, approaches and applications*"
at 2016 ICES ASC

(seeking PICES co-sponsorship)

Proposer: Mark R. Payne (National Institute of Aquatic Resources, Denmark)

Conveners:
Mark R Payne (Proposed ICES co-convenor; Technical University of Denmark)
Desiree Tommasi (Proposed PICES co-convenor; Princeton University and NOAA GFDL, USA)
Alistair Hobday (CSIRO, Australia)

Description

Tremendous advances in oceanographic observing and modelling systems over the last decade have led to unprecedented developments in the nature of information available to marine science. While improvements in observational technologies and networks have garnered much attention, remarkable developments in forecasting the ocean have received much less focus. Exploiting this new predictive skill to improve scientific understanding, generate advice and aid in the management of marine resources, is emerging as one of the new challenges of marine science.

The potential for predicting the ocean far exceeds that of the atmosphere. The slow-dynamics (and therefore "long-memory") of the ocean mean that anomalies can persist for months or longer, and can thus be used as the basis for simple persistence forecasts. State of the art global climate prediction systems can increase forecast skill above persistence, adding further value and allowing for higher forecast skill at longer lead times. Moreover, in some areas, most notably in the NE Atlantic (but also potentially in the North Pacific and Southern Ocean), statistically meaningful predictive skill of variables such as sea-surface temperature has been demonstrated out to five years or more. Conversely, the spatial scale of dynamical features in the ocean is significantly smaller than dynamical features in the atmosphere, and this poses computational challenges in ocean forecasting that must be examined.

Translating these predictions of the physical environment into biological outcomes, on the other hand, is not straightforward. Fisheries scientists, for example, have been trying to understand the links between physics and biology, and generate predictions of variables such as recruitment, for close to a century, with limited success. Nevertheless, spatial distributions and the timing of key events, which have received less focus, are often tightly linked to the physical environment and may have management-relevant applications.

This session aims to provide an overview of marine forecasting at seasonal-to-decadal scales, a scientific field that is still in its infancy, and allow researchers to share their experiences of developing prediction systems for marine resource management. It is also an opportunity for those involved in advice and management of these systems to get an overview of a rapidly emerging field, and to consider how this new knowledge can be used to benefit human societies. We welcome contributions that address all aspects of prediction in marine ecosystems, including, but not limited to:

- What aspects of the marine physical (and chemical) environment can be predicted? For what variables and over what time and space scales does predictability exist? How does the predictability arise?
- What aspects of the marine biological environment can be predicted? What biological responses are the most predictable and why?
- Do we need to have mechanistic understanding or can useful predictions be predicated on the basis of correlative relationships?
- How do we assess the quality (skill) of a prediction?
- What can be learned from biological predictions already being made on the climatic (centennial) time-scales? Where are there similarities and where are there differences?
- How do we use predictions of biological outcomes in pre-existing advice and management structures? What structures are required to take advantage of this new knowledge? How can these estimates be incorporated into management strategy evaluations?
- How do we make predictions with a frequency and timeliness that is appropriate for end-users?
- Does predictive knowledge have a value in the management of marine systems? How can we quantify the value of such knowledge?
- Case studies of existing and proposed predictive systems
- Needs for future research, advisory and management structures

Suggested theme session format

We propose a workshop format, based primarily on invited speakers and submitted presentations to set the scene and provoke discussion. A discussion session (1-2 hrs) will follow centered on small groups facilitated by the conveners that address specific questions: the outcomes of these discussions will be collated into a

synthesis paper. Furthermore, if accepted, we will propose the contents of this theme session to "Frontiers in Marine Science" as a Research Topic. Papers presented during the ICES theme session will be encouraged to submit to this issue, with a deadline for submission three months after the conference. Upon completion of the review process, the accepted papers will be published by Frontiers as an "e-book" that surveys the current state-of-the-art of this emerging field.

Expected participation

Given the wide scope of this theme session, the scientific challenges involved and the direct relevance to advice generation, we expect it to be of interest to members of both the scientific and advisory communities within ICES. Furthermore, the international spread of the conveners and the proposed linkages to PICES are intended to attract participants from both within and outside the ICES community. The conveners also intend to promote the session within existing networks focusing on seasonal-to-decadal prediction and within their own scientific communities, to ensure the broadest international participation possible.

Linkages to ICES Strategic Plan

The theme session address the following goals of the strategic plan:
Goal 1: (Science Plan), by integrating existing knowledge and providing an interdisciplinary forum for researchers to share their seasonal-to-decadal prediction experiences.
Goal 3: (Advisory Plan), by developing seasonal-to-decadal scale forecasts of marine-ecosystems and showing how they can be incorporated into evaluating and advising on the use and protection of marine ecosystems.
Goals 4 and 5: (Data and Information Plan), by demonstrating how forecast products can be operationalized for use by the ICES community.

Linkages to ICES Steering Groups and/or Advisory Committee (if relevant)

The theme session has clear linkages to the broad goals of both ACOM and SCICOM. Furthermore, the SCICOM Steering Group on Ecosystem Processes and Dynamics (SSGEPD), and the SCICOM/ACOM Steering Group on Integrated Ecosystem Assessments (SSGIEA) both have forecasting and prediction as a key aspect of their work and therefore closely link to the content of the theme session.

Linkages to ICES Strategic Initiatives and/or ICES action areas on Aquaculture and the Arctic

Given the similarities in the approaches employed and the questions asked, linkages to the climate-change community via SICCME (The ICES-PICES Strategic Initiative on Climate Change Impacts on Marine Ecosystems) are natural. The proposal has been discussed with the current chairs of this initiative, who have expressed interest in such a theme session.

S-CCME Endnote 7

Species on the Move Conference

Drs. Stewart Frusher, Gretta Pecl and Alistair Hobday, on behalf of the Species on the Move Organizing Committee (http://www.speciesonthemove.com/), asked S-CCME and FIS to think about support of the conference.
The request includes:

- Keynote or invited speakers on "Implications of species range change for health, food security and ecosystem services'' and "Cultural, social and economic dimensions of range shifts and changing ecosystems".
- Support of the next generation of scientists to be working in this space and have a range of opportunities available including a Mentor Matching program, an Early Career Networking Function where ECRs will have the opportunity to meet and discuss their research with the plenary and invited speakers.