ICES - PICES Strategic Initiative on Climate Change effects on Marine Ecosystems (SICCME)

SICCME update for SCICOM, March 2017

SICCME activities are contributing to the overall goals and objectives of both SICCME itself, as well as ICES and PICES Science Plans. This strategic initiative is co-chaired by Drs. Anne Hollowed (USA, PICES), Shin-ichi Ito (Japan, PICES), Myron Peck (GE, ICES) and John Pinnegar (UK, ICES). A detailed, 3-year (Phase 3 – 2018-2020) plan will be submitted to PICES at the end of March and, at that point, made available to SCICOM. The plan will include slight modifications and additions to the SICCME mission and activities in light of the success of Phase 2 (2015-2017) including identifying and aligning (to the fullest extent possible) climate change research activities in regional nodes across the northern hemisphere and elsewhere. A roadmap of future activities highlights comparative / synthetic products for uptake in the next IPCC assessment report.

Activities 2016/17 (since March 2016 SCICOM meeting and looking forward)

1. June 2016: ICES/PICES intersessional workshop on "Economic Modelling of the Effects of Climate Change on Fish and Fisheries" (WKSICCME_Econ), held in Brest, France (See Appendix 1).
2. Aug 2016: CLIVAR/PISCES workshop on ENSO predictability that ICES/SICCME co-sponsored (via travel funds to Mark Payne). Mark reports that "the California Current Community is further ahead than us, in that they have a long history of thinking about physical-biological connections, and already have some operational forecast systems running (e.g. J-SCOPE). On the other hand, our (SICCME) thinking is much further advanced, and our potential prediction horizons are much longer (years in Europe, months in the Pacific). There was also a strong desire expressed to link the ICES and PICES working groups together, and the idea of proposing a joint theme session at the next "Impacts of Climate Change on the Ocean" conference in 2018 was mooted.
3. September 2016: ICES-PICES sponsored Theme Session "I" at ICES ASC in Riga, Latvia. Seasonal to decadal prediction of marine systems: opportunities, approaches and applications. Co-convened by Mark Payne (Denmark), Desiree Tommasi (U.S.A.), Alistair Hobday (Australia).
4. September 2016: ICES/PICES Workshop on Phase 1: Modelling Effects of Climate Change on Fish and Fisheries (WKSICCME1).This was a full-day open workshop to review regional models and preliminary results on the ICES side. This was held in conjunction with the ICES ASC in Riga, Latvia and co-convened by John Pinnegar (UK), Myron Peck (GE), Mark Payne (DK), Anne Hollowed (USA). (See Appendix 2).
5. October 2016: 41st Annual Groundfish Forum plenary presentation of SICCME activities. Myron Peck was invited to discuss potential risks and benefits of climate change to the fisheries sector. At this global event, SICCME activities and regional research nodes were presented.

6. November 2016: PICES Workshop W5, on SICCME modelling updates. This was a full-day open workshop to review regional models and preliminary results on the PICES side. This was held in conjunction with the PICES ASC in La Jolla, California and co-convened by Anne Hollowed (USA), John Pinnegar (UK), Shin-ichi Ito (Japan) (See Appendix 3)
7. November 2016: ICES-PICES sponsored Theme Session S7. "New Stage of Ocean Acidification Studies: Responses of oceanic ecosystems including fisheries resources". Considering over 20 years of progress on ocean acidification studies. Co-Convened by Tsuneo Ono (Japan), Jun Kita (Japan), Debby Ianson (Canada), John Pinnegar (ICES / UK). Invited speakers: John Pinnegar (UK), Georg Waldbusser (USA), Steve Widdicombe (UK).
8. November 2016 – Climate change and fisheries and aquaculture stakeholder engagement workshop. The Hague (Netherlands) hosted by Wageningen Economic Research (LEI). This event was part of the EU H2020 Project CERES (Climate change and European Aquatic Resources), involving many (European) SICCME members (including Myron Peck, John Pinnegar).
9. December 2016: ICES/PICES Workshop on Understanding the Impacts and Consequences of Ocean Acidification for Commercial Species and End-users (WKACIDUSE), at ICES HQ, Copenhagen (ToRs - Appendix 4). Chaired by Silvana Birchenough (UK, ICES), Catriona Clemmesen-Bockelmann (BioAcid, Germany) and Tsuneo Ono (Japan, PICES). SICCME was represented by John Pinnegar (UK).
10. December 2016: Scoping Meeting for the IPCC Special Report on Climate Change, the Oceans, and the Cryosphere, at Monaco. Manuel Barange (FAO), William Cheung (Canada) and Shin-ichi Ito (Japan) attended from SICCME.

Planned Activities (looking forward)

1. March 2017: Victoria, Canada. A SICCME side-event (March 5th) to the ICES/PICES Symposium on Drivers and Dynamics of Small Pelagic Fish Resources, has been organized to allow ICES and PICES participants to review our accomplishments, and to discuss and update our implementation plan. The outcome of this meeting will set the stage for PICES and ICES research on the effects of climate change on marine ecosystems for the period 2018-2021. This will be sent to SCICOM when submitted to PICES.
2. March 2017: In the International Symposium "Drivers of Dynamics of Small Pelagic Fish Resources" SICCME contributes to hold two workshop; Workshop 4 "Modeling migratory fish behavior and distribution" convened by Shin-ichi Ito (Japan) and Enrique Curchitser (USA) and Workshop 5 "Recent advances in the life stage ecophysiology of small pelagic fish: Linking laboratory, field and modeling studies" convened by Myron Peck (Germany), Kirstin Holsman (USA), Shin-ichi Ito (Japan) and Laure Pecquerie (France).
3. March 2017: Galway, Ireland. SICCME members will meet at the CERES Annual Meeting to review progress on future scenarios for EU fisheries as well as vulnerability assessments. CERES is coordinated by Myron Peck (Univ. Hamburg) with many SICCME participants (including John Pinnegar, Cefas; Mark Payne, DTU). Anne Hollowed, (NOAA) and William Chueng (UBC) will attend as members of the Research Advisory Board (RAB).

4. May 2017: Wakefield Symposium. 'Impacts of a Changing Environment on the Dynamics of High-latitude Fish and Fisheries'. This symposium examines the impacts of the environment, especially climate change and variability, on the dynamics of arctic and subarctic species of commercial, subsistence, and ecological importance. It will focus on the effects of warming, loss of sea ice, ocean acidification, and oceanographic variability on the distribution, phenology, life history, population dynamics, and interactions of these species and how a better understanding of these effects can inform the assessment and management of fish and invertebrate. PICES co-sponsors this event. SICCME are represented on the steering committee (Anne Hollowed, NOAA; Mark Payne, DTU Aqua; Franz Mueter, University of Alaska Fairbanks)
5. June 2017: ESSAS Open Science Meeting on Subarctic and Arctic Science. The Ecosystem Studies of Subarctic and Arctic Seas (ESSAS) is a regional program of the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project. Its objectives are to understand how climate variability and climate change affect the marine ecosystems of Subarctic and Arctic seas and their sustainability, and in turn, how changes in these marine ecosystems affect humans. The title of the OSM is *"Moving in, out and across the Subarctic and Arctic marine ecosystems: shifting boundaries of water, ice, flora, fauna, people and institutions".* SICCME are represented on the steering committee (Ken Drinkwater (IMR), Alan Haynie (NOAA), Shin-ichi Ito (University of Tokyo), Franz Mueter (University of Alaska Fairbanks).
6. July 2017- Three-day SICCME workshop on regional climate change vulnerability assessment for the large marine ecosystems of the northern hemisphere (WKSICCME-CVA) at ICES HQ, Copenhagen. Workshop specially requested by ICES secretariat as an activity of SICCME (see Appendix 5). Task teams have been or are in the process of being formed to conduct climate vulnerability assessments in various regions around the world including many Large Marine Ecosystems within the ICES and PICES member nations. This workshop will compare and contrast various vulnerability assessment approaches as well as drafting short statements on climate change impacts and vulnerability for regional ecosystem overviews produced at ICES and potentially other organizations.
7. September 2017: ICES ASC 2017 (Fort Lauderdale). Theme session A "Projected impacts of climate change on marine ecosystems, wild captured and cultured fisheries, and fishery dependent communities" Conveners: Jon Hare (USA); John Pinnegar (UK) and Myron Peck (GE); (See Appendix 6). The format will allow for suites of regionally focused papers that address modeling approaches, environmental change, representative fishing scenarios, implications to fisheries, and implications to human communities. We envision a maximum 2-day session with a keynote speaker starting each day. We will include a 30 minute discussion period after each half-day session and schedule lightning talk sessions for poster-presenters to introduce their work. (See Appendix 4)
8. September 2017: SICCME has requested a brief open session slot (Wednesday pm 15:00–16:30 – 1½ hours) to discuss progress on modelling nodes and to get general updates from both ICES and PICES partners. Another important element will be to discuss ongoing efforts to incorporate and align political, social and economic trajectories of change into future climate change scenarios being tested in various programs around the world. Therefore, this session will have a strong link with the Strategic Initiative on the Human Dimension (SIHD).

9. September 2017: PICES Topic session "Can short-term forecasts inform long-term climate projections and visa-versa?" SICCME co-convene with a PICES new working group WG-CEP and Jackie King (Canada) will be a co-convenor from SICCME.
10. May 2018: The "Fourth International Symposium on the Effects of climate change on the world's oceans" will be held in Washington D.C. (USA) (2013/3/SSGHIE04) with the support of IOC, PICES and ICES. Jason Link, USA (ICES), Shin-Ichi Ito, Japan (PICES - SICCME), and NN (IOC) are lead conveners. SICCME is represented on the scientific steering committee including Anne Hollowed (USA), Myron Peck (GE), John Pinnegar (UK), Angelica Pena (USA), Kirstin Holsman (USA). Plans are well underway including a finalized text for the mission statement/call for papers and announcement to conveners of potential theme sessions.

Funding Updates

A. EU H2020 project "Climate change and European aquatic RESources" (CERES) started work in March 2016 and addresses call H2020-BG-2015-2 on 'Blue Growth'. The 'kick off' meeting was held 6-8th April 2016, Catalonia Majórica Hotel, Palma, Majorca. It is a 4 year project (2016-2019), coordinated by University of Hamburg (Myron Peck) and involving scientists and industry partners from 14 countries. [see http://ceresproject.eu]

CERES will involve and closely cooperate with industry and policy stakeholders to:

1. Provide regionally and industry relevant, short-, medium- and long-term future projections of key environmental variables for European marine and freshwater ecosystems;
2. Integrate the resulting knowledge on changes in productivity, biology and ecology of wild and cultured animals (including key indirect/food web interactions), and'scale up to consequences for shellfish and fish populations and assemblages as well as their ecosystems and economic sectors
3. Anticipate responses and assist in the adaptation of aquatic food production industries to underlying biophysical changes, including the development of early warning methods, new operating procedures, infrastructures, location choice and commercial markets
4. Assess relative exposure, sensitivity, vulnerability and adaptive capacity within the European fisheries and aquaculture sectors;
5. Consider market-level responses to changes (both positive and negative) in commodity availability as a result of climate change;
6. Apply innovative risk-assessment methodologies that encompass drivers of change, threats to fishery and aquaculture resources, barriers to adaptation and likely consequences if mitigation measures are not put in place;
7. Formulate viable autonomous adaptation strategies (solutions) within the industries to circumvent/prevent perceived risks or to access future opportunities;
8. Formulate policy guidelines (solutions) and highlight management challenges where established governance structures may hinder successful adaptation to long-term climate change.
9. Effectively communicate these findings and tools to potential end-users and relevant stakeholders.

The total budget for CERES will be €5.58 million and the project will run over 48 months (2016-2019).

B. EU H2020 project "CLIMEFISH" has been funded under exactly the same call as CERES (see above). In ClimeFish, 21 institutes from 16 countries will work together, and the consortium is led by Michaela Aschan (University of Tromsø, Norway). (see http://climefish.eu/)

ClimeFish has eight specific objectives:

1. To investigate the effects of climate change on fisheries and aquaculture at European and regional scale, and to collect and harmonize relevant data which will be made available in the H2020 Open Research Data Pilot.
2. To develop novel forecasting models to simulate and analyse changes in distribution and production in the fisheries and aquaculture sectors.
3. To identify risks and opportunities based on analysis of market and non-market costs and benefits of affected ecosystem services; propose potential mitigation strategies.
4. To develop early warning methodologies for these risks, including a traffic-light system.
5. In co-creation with stakeholders, develop case-specific Management Plans that mitigate risks and utilize opportunities associated with anticipated effects of climate change on aquatic production, based on ecosystem and results-based management approaches.
6. In co-creation with stakeholders, develop guidelines, good practice recommendations and a voluntary European standard outlining how to develop this type of Management Plans in the future.
7. In co-creation with stakeholders, develop the ClimeFish Decision Support Framework. This contains the ClimeFish Decision Support System and other decision support resources, such as models, datasets, sample runs and guidelines.
8. To provide training and dissemination for industry, policy makers, scientists and other stakeholders; to ensure active utilization of the developed tools and guidelines beyond the project lifetime in close collaboration with the European Climate Adaptation Platform (Climate- ADAPT).

C. NOAA has funded a new comprehensive Bering Sea climate change project: the Alaska CLimate Integrated Modelling, ACLIM, http://www.afsc.noaa.gov/News/BS_climate-change-study.htm). This 3 year project (2015-2017) will utilize a multi-model climate projection framework that will allow scientists to the implications of different sources of uncertainty (e.g., scenario uncertainty, parameter uncertainty, process uncertainty, and structural uncertainty) in projections of climate change impacts on fish and fisheries in the Bering Sea.

Other business

A. PICES formed a new study group on *Climate and Ecosystem Predictability* Co-chaired by Emanuele Di Lorenzo (Chair). Anne Hollowed is a member and will seek to find ways to ensure the products are complimentary to the overarching activity of SICCME

(especially with respect to Terms of Reference 2-4m http://www.pices.int/members/study_groups/SG-CEP.aspx).

B. PICES and ISC approved a Joint Working Group on "Oceanographic Conditions on Distribution and Productivity of Highly Migratory Species". The WG 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 SICCME modelling 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 SICCME efforts and the proposal is supported by S-CCME.

C. PICES updates - Drs. Nancy Shackell and Denis Gilbert, both from the Department of Fisheries and Oceans Canada, were nominated and have agreed to serve on SICCME in her place. Dr. Michael Foreman retired and Angelica Pena has been nominated to serve in his place. Drs. Keith Brander, Jurgen Alheit and Harald Loeng have all retired and it is not clear whether they will continue to participate in SICCME meetings. Three new members were added to SICCME: Dr. Sara Gainluca (UNIP), Valerio Bartolino (Sweden) and Mikael van Deurs (DK). Requests have been made to the US delegation of PICES to add Dr. Kirstin Holsman (USA) to SICCME. It is envisioned that Dr. Alan Haynie will petition the US delegate for membership in SICCME (PICES). SICCME Chairs nominate the following individuals to be added to SICCME: Jose Fernandes (ES, AZTI), Trond Krisitiansen (NO, IMR) and Hamon Katell (NL, DLO-LEI), Mark Payne (DK, DTU-Aqua).

Appendix 1: PICES/ICES SICCME intersessional workshop

ICES/PICES Workshop on Economic Modelling of the Effects of Climate Change on Fish and Fisheries (WKSICCME_Econ).

The ICES/PICES Workshop on Economic Modelling of the Effects of Climate Change on Fish and Fisheries (WKSICCME_Econ), was convened June 3-4, 2016 in Brest, France. The workshop arose out of the August 2015 meeting of the Strategic Initiative on the Effects of Climate Change in the Marine Environment (SICCME) workshop in Seattle, and an awareness of the need to develop economic and social pathways to include in different efforts to model the impacts of climate change on fish and fisheries. The workshop was chaired by Alan Haynie (USA), Sophie Gourguet (France), John Pinnegar (UK), Lisa Pfeiffer (USA), and Jörn Schmidt (Germany) and followed the 'Understanding marine socio-ecological systems' (MSEAS) symposium which was held the previous week in Brest. Associating this workshop with MSEAS significantly reduced its cost, as virtually all participants attended the MSEAS meeting earlier in the week. The workshop was funded by NOAA and hosted by IFREMER.

Approximately 35 people from a broad group of ICES, PICES, and other nations participated in the workshop. The workshop included a balanced group of biologists, economists, and other social scientists with members having a wide variety of experiences in interdisciplinary projects and in contributing to fisheries and marine resource management in North America, Europe, and elsewhere.

As articulated in the terms of reference for the workshop, the meeting was held primarily to address the following three goals: a) identify the socioeconomic data and features of a suite of representative future fishing and ecosystem scenarios that could be employed for use 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 what management tools are most likely to be resilient to climate change effects on fisheries; and c) identify suites of bio-economic 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.

Workshop participants addressed these and a variety of related questions. The workshop was a success and identified the means for ongoing collaboration, common assumptions that can be made across projects, and the need for additional research on the further development of common scenarios. Individual integrated modeling projects have made great progress developing socioeconomic scenarios which will be compared, refined, and further coordinated in 2017. We expect that collaborations from this workshop will result in several peer-reviewed publications and addition international collaboration in coming years.

Appendix 2: ICES WKSICCME1 Workshop

Workshop on Phase 1: Modelling Effects of Climate Change on Fish and Fisheries (WKSICCME1)

The ICES-PICES Strategic Initiative (Section) on Climate Change Impacts on Marine Ecosystems (SICCME) convened a 1-day **Workshop on Phase 1: Modelling Effects of Climate Change on Fish and Fisheries** on 24 September 2016, Riga, Latvia, to discuss progress on projection modelling of climate impacts on fish and fisheries. The workshop was attended by 16 scientists from 6 nations. The workshop was chaired by Anne Hollowed (USA, PICES), Myron Peck (Germany, ICES), John Pinnegar (UK, ICES) and Mark Payne (DK, ICES). The workshop was organized as a PI meeting to discuss ongoing modelling efforts by different regional modelling nodes. The meeting is part of the roadmap of activities defined at a previous workshop in Seattle WA, USA (August 2015). The roadmap includes identifying regional modelling nodes, aligning common future scenarios (i.e., representative fishing pathways, broader "PESTLE" scenarios, etc.), producing and comparing projections within and among regions, and publishing results soon enough (late 2018) for uptake by writing teams of sixth Assessment Report of the IPCC. This WKSICCME1 workshop discussed: i) ongoing regional projects, ii) common future scenarios, iii) the global 'FishMIP' program, and iv) advancements in short-term environmental and biological forecasting.

i) Several, newly funded, regional projects were reviewed. These included the National Oceanic and Atmospheric Administration's Climate Coastal and Ocean Climate Applications (COCA) program (an umbrella of several projects, NW Atlantic from the mid-Atlantic Bight through the Gulf of Maine), the Alaska Climate Integrated Modeling (ACLIM) project (south-eastern Bering Sea) and the Climate change and European aquatic RESources (CERES) project (all European Seas from the Mediterranean through the Barents / Norwegian Seas). Activities associated with the US National Aquatic Climate Change Research Program and the Global Climate Change Effects on Fisheries and Aquaculture team working on NEMURO (NW Pacific, Japan coast) were presented. A list of regional modelling nodes in the ICES area was assembled. A sister workshop at the up-coming PICES ASC will provide updates on regional modelling with emphasis on teams in the NE and NW Pacific.

ii) Future marine resource management scenarios are being developed and an example was provided within the EU CERES project. Workshop discussions underscored that short-, medium- and long-term developments in governance, social, technological and economic drivers may be just as important to fisheries as climate-driven changes in habitats and species. In combination with outputs from physical / biogeochemical model-ling, storylines are being developed and used to generate a set of combinations of environmental and socio-economic projections for the fishery sector. A summary of ongoing efforts to create representative fishing pathways in other projects (e.g. ACLIM – Bering Sea) was also provided.

iii) Efforts to harmonize and compare global and regional model projections of climate impacts on fish and fisheries were discussed. The FishMIP, a network of scientists includes 15 different models (10 global and 5 regional). Some of the specific global (e.g. BOATS) and regional/global (e.g. POEM2) and regional (EwE) modelling tools were presented along with the protocol to harmonize input and output variables (e.g. 39 forcing variables used as input for the various models). This protocol may be useful to some ICES and PICES modellers. Most of the modelling teams in the northern hemisphere planned to use scenarios based on Representative Concentration Pathway (RCP) 8.5 and/or 4.5. Given the outcome of the Conference of the Parties 21, several modelling teams are considering adding RCP 2.6.

vi) Advances in high-resolution Global Climate Models and higher-resolution, dynamically downscaled products available to the community were discussed. The continual increase in the short-term (months to years) predictive skill of ocean habitats (e.g. sea surface temperature) in some ocean regions will help complete the portfolio of projection tools and techniques available to fisheries scientists to address short-, medium- and long-term physical changes in ocean habitats.

Appendix 3: 2016 PICES Workshop, PICES annual meeting in San Diego, California.

Title: Phase 1: Modelling Effects of Climate Change on Fish and Fisheries

The PICES/ICES Section (Strategic Initiative) on Climate Change Impacts on Marine Ecosystems (S-CCME/ SICCME) convened a 1-day FIS-sponsored workshop on November 4 at PICES-2016 in San Diego, USA. The workshop was attended by 46 scientists from eight countries. A similar workshop (WKSICCME Phase 1) was held in conjunction with the ICES Annual Science Conference in Riga, Latvia on September 24, 2016.

W5 was chaired by Drs. Anne Hollowed (USA, PICES), Shin-ichi Ito (Japan, PICES), and John Pinnegar (UK, ICES). It was organized as a Principal Investigators' meeting, providing an opportunity for scientists to discuss the progress of ongoing regional projection modeling nodes. The meeting is part of the roadmap of activities defined at a previous workshop held in Seattle, USA (August 2015, PICES Press Vol. 24 No. 1, pp. 20–23). The roadmap includes identifying regional modeling nodes, aligning common future scenarios, producing and comparing projections within and among regions, and publishing results by late 2018 for uptake by writing teams of the sixth Assessment Report of the Intergovernmental Panel on Climate Change and possibly by the Special Report on climate change and oceans and the cryosphere (SROCC). W5 focused discussions around four topics: i) ongoing regional projects, ii) common future scenarios, iii) advancements in the development of shared socioeconomic scenarios, and iv) issues related to global model selection and bias corrections.

S-CCME relies on ICES and PICES member countries to provide funding to support the projection modeling that forms the foundation of the Section. It was exciting to learn that many new programs have been funded and are actively striving to meet the goal of providing projected impacts of climate change on marine ecosystems in time for upcoming national and international reviews. These existing or emerging research projects hold great promise for the success of S-CCME.

Discussion

The workshop group held an open discussion session on best practices for model selection. The group was divided in its opinions regarding best practices and the debate was lively. The group also identified two inter-sessional activities for 2017. S-CCME's first meeting will occur on March 5, 2017 in Victoria, British Columbia, Canada. The focus of this workshop will be to review and update the S-CCME/SICCME Implementation Plan. This activity will ensure that S-CCME/SICCME remains on the cutting edge of research efforts focused on projecting the impacts of climate change on marine ecosystems and the communities that depend on them. The second meeting will be a 3-day workshop from July 19–21, 2017 at ICES headquarters (Copenhagen, Denmark). This workshop will provide a forum for the discussion of climate vulnerability assessments.

Appendix 4: PICES/ICES SICCME intersessional workshop

Terms of Reference for WKACIDUSE

2015/2/SSGEPI15 The Workshop on Understanding the Impacts and Consequences of Ocean Acidification for Commercial Species and End-users (WKACIDUSE), chaired by Silvana Birchenough (UK, ICES), Catriona Clemmesen-Bockelmann (BioAcid, Germany) and Tsuneo Ono (Japan, PICES) will meet at ICES Headquarters in Copenhagen, Denmark, 5–8 December 2016 to:

A. Provide scientific evidence to support demonstration advice (meaning, who is going to use this information, what is the level of evidence/detail needed) to inform end-users. Overall there is a pressing need to translate existing information to dedicated advice to make long-term investments decisions;
B. Examine existing evidence from a 'objective basis' what is the reality of the OA effects and potential consequences (considering the effects of single or multiple stressors);
C. Provide examples to illustrate what are the current 'prevailing conditions' (spatio-temporal scales to explain the local variability of exposure). This information will help placing into context specie's responses.
D. Deliver an assessment for potential for adaptation from commercial species (considering phenology, physiology, behaviour and genetics);
E. Understand what will be the consequences for end-users and who could be likely to be affected (answering the "so what question?");
F. Suggest practical solutions for end-users to prepare and adapt to potential ocean acidification effects in conjunction with combined multiple stressors ef-fects;
G. Discuss the best way to continue to support ICES/PICES and OSPAR/HELCOM this area (e.g. setting up an OA Working Group to summa-rise the 'state of the art' science to support advisory requests).

WKACIDUSE will report by 10 February 2017 (via SSGEPI) for the attention of SCICOM.

Appendix 5: PICES/ICES SICCME intersessional workshop

Workshop on "Regional climate change vulnerability assessment for the large marine ecosystems of the northern hemisphere (WKSICCME-CVA)

Contacts: Myron Peck (Myron.peck@uni-hamburg.de); Kathy Mills (kmills@gmri.org); Elliott Hazen (elliott.hazen@noaa.gov)

July 19th to 21st , 2017, ICES Headquarters, H. C. Andersens Boulevard 44-46, DK 1553 Copenhagen, Denmark

Background

Climate change and ocean acidification pose significant risks to some marine species and the communities that depend on those species. Rapid assessment methods have been developed to assess these risks to marine life and humans. These assessments use qualitative ranking of risks based on a synthesis of data derived from existing climate change projections and expert knowledge of the sensitivity of species or human communities to projected changes in environmental conditions. These rapid vulnerability assessments typically involve an evaluation of the relative exposure and sensitivity of an organism to climate change and methods utilized vary depending on data availability. These vulnerability assessments can also be used to identify key gaps in on-going research and to identify potential risks to marine life and coastal communities. Task teams have been or are in the process of being formed to conduct vulnerability assessments in various regions around the world including many LMEs within the ICES and PICES member nations. Our main goals for this 3-day workshop are to:

A. Compare and contrast various vulnerability assessment approaches used for fisheries and aq-uaculture including their strengths and weaknesses;
B. Discuss opportunities for comparative studies looking at the relative vulnerability of species in different Large Marine Ecosystems (LMEs);
C. Discuss best practices for extending vulnerability assessments of marine fish and invertebrates to vulnerability of coastal communities and identify a suite of representative concentration pathways for use in vulnerability assessments in the northern hemisphere;
D. Identify opportunities for operationalizing vulnerability assessment methods to enable updates (e.g., release of CMIP6 scenarios) and automating exposure assessments;
E. Draft short statements on climate change impacts and vulnerability for regional ecosystem overviews produced at ICES and potentially other organizations.

Appendix 6: ICES ASC 2017 Theme Session A, ICES ASC 2017 (Fort Lauderdale)

Projected impacts of climate change on marine ecosystems, wild captured and cultured fisheries, and fishery dependent communities

Conveners:
Jon Hare (USA)
John Pinnegar (UK)
Myron Peck (Germany)

Climate change is expected to impact marine ecosystems throughout the world; however, the severity of these impacts will vary regionally. This theme session seeks examples of the types of regional impacts that are expected in the near term (2020-2040) and longer term (2080-2100). We also seek papers that describe the relative exposure of marine organisms to changing environmental conditions and those that address the ecological as well as socioeconomic implications of shifting spatial distributions and changes in population productivity (growth, reproductive success, and mortality).

Also encouraged are projects that compare outcomes from different projection modeling platforms, discuss the range of uncertainties (scenario, parameter, and structural) associated with regional climate projections, and address ecological realism and uncertainty.

There is growing recognition that projections of the implications of climate change on fisheries and fishery-dependent communities require the incorporation of representative fishing pathways (RFPs) to fully depict the range of possible mitigation scenarios that could be considered by managers. Regional examples of the selection process for establishing RFPs and the performance of the RFPs relative to status quo are encouraged.

This theme session will allow researchers to compare results, evaluate harvest control rules, and discuss challenges encountered in developing multi-model ensembles of impacts on fish and fisheries.

We envision a 2 day session with a keynote speaker starting each day. We will include a 30 minute discussion period after each half-day session and schedule lightning sessions for poster-presenters to introduce their work.